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MediaLab: video as a multi-valent tool for science teaching and learning

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ABSTRACT

In this article we examine the utility of video storytelling in the discipline of food chemistry in the development of media literacy for science graduates and as a radical approach to science teaching and learning where the production of a video is both a process and a product. The pedagogical programme aimed to integrate food chemistry and digital video technology using an iPhone. Students, in groups of four, prepared a four-minute video that demonstrated their knowledge of food chemistry either by preparation of a food item, or by visiting a local industry body and were charged with describing and videoing the food chemistry process they observed. As part of this programme students were taught videography skills by filmmakers and mentored by chemistry educators to ensure that the food chemistry described was comprehensive and accurate. This programme facilitated a learning environment in which students could construct, develop, learn, and consider their understanding through multiple sensory inputs. The programme fostered connections between research and education, allowed more personalised learning to develop, and permitted alternate assessment strategies.

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The use of the video essay in the pedagogies of the humanities and arts is an emergent and increasingly well theorised area (Redmond and Tai 2019; Fowler 2019). The use of video as a form of non-traditional research output is more common in film and media studies than it is in other disciplines and fields (Monaghan 2017; Keathley 2017). Increased academic legitimisation of video essays in the arts and humanities as a research output can also be seen through the emergence of peer reviewed video-based academic journals such as *[in]Transition*, a film studies journal, or *Audiovisual Thinking*, which features academic videos exploring communication, media and design. However, even within the humanities and arts disciplines the idea of a 'video essay' remains difficult to define and continues to evolve from a longstanding cinematic history (Alter 2007; Faden 2008; McWhirter 2015). Lavik (2012) observes that the video essay is a burgeoning genre that has not converged into established forms. Visosevic and Myers (2017)

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formulate a definition of the video essay from two standpoints: from a screen studies perspective and from an educational perspective. It is from the educational standpoint that we approach the case study underpinning this article. From the 'educational standpoint,' Visosevic and Myers (2017) draw on a range of literature to define the video essay in multifarious ways including as digital video, video documentary and video assignments. They describe the role of video as a pedagogical tool, providing a multimodal experience to students, many of whom already use video-based technologies outside the classroom, noting

> Students can form new understandings of a subject by intentionally using their video skills in a creative and expressive way. As an alternative to text based assessments, the Video Essay presents opportunities for students to experience the transmediation process that occurs when composing between written-text to digital forms. (Visosevic and Myers 2017, 167)

As discipline areas beyond arts and humanities seek to engage with mediums beyond text to articulate research and knowledge, there is an opportunity to engage with this 'burgeoning genre' of the video essay and to explore new forms and new definitions of video essays that can fit discipline specific expectations. This article explores multivalent pedagogical outcomes made possible through video assessments in scientific disciplines. We examine the utility of the video essay in the development of media literacy for science undergraduates and as a radical approach to science teaching and learning where the production of a video essay is both a process and a product.

With the increasing ubiquity of smart phones, both researchers and educators of different academic disciplines are engaging with the creative potential of video essays (Hoban and Neilsen 2010). Pedagogical approaches such as the emerging 'student as producers' paradigm coupled with increased ease of producing and distributing video on mobile devices has led to a corresponding growth in the use of video as a medium, and a subsequent requirement for universities to consider the digital literacy capabilities of their graduates (Gallardo-Williams et al. 2020). By acknowledging that digital technologies now allow us to 'capture' our everyday and more profound experiences, we as educators wanted to explore the use of smartphones to enable the accessible production of video essays, and in the interests of furthering new pedagogical practices in an undergraduate chemistry unit. Our pedagogical approach was influenced by established motivational theories that focus on learning as an activity from which students must derive a sense of competence (Deci et al. 1991), as well as self-regulatory skills and self-reflection (Zimmerman 2002). Thus, the pedagogical programme aimed to integrate food chemistry and accessible digital video technology made possible by the use of the iPhone, with a focus on students producing a video essay within the second year food chemistry subject for one assessment.

Video is becoming an important, multi-valent tool for scientists, as a visual tool for learning by watching in lectures, independently and for laboratory work (Gallardo-Williams et al. 2020). Science-focused journal articles increasingly include a video abstract (Berkowitz 2013) and a study of the *New Journal of Physics* found that proportionally more of the 100 most-read papers used a video abstract than papers in the journal as a whole (Spicer 2014). The *Journal of Visualised Experiments* (*JoVE*, www.jove.com) is both producer and publisher of video-based scientific experiments and publishes the peer-reviewed, PubMed indexed video methods journal. Zhang (2010, 31) quotes

from a 2010 section of the JoVE Video Journal website which notes the use of video addresses:

> two of the biggest challenges faced by today's life science research community: (i) low transparency and poor reproducibility of biological experiments and (ii) time and labor-intensive nature of learning new experimental techniques. (Zhang 2010, 31)

In the right hands, video is a highly effective communication tool with which to engage audiences in a journey of discovery, as well as to share the results of research. As demand for accessible and engaging science increases and as competition for jobs, funding and publications in journals becomes more intense – the ability to produce engaging stories that communicate across a variety of media offers a distinct advantage to scientists with video production capacity (Milojević, Radicchi, and Walsh 2018). However, scientists typically do not receive training on what makes an effective, impactful video that communicates with a broad audience. On the 'Scientist Videographer' website Karen McKee (2013) observes:

> Videography skills will become increasingly important for the scientist of the future to keep pace with the rapid changes in communications technology and electronic publishing. As demand for more accessible and engaging science information increases and as competition for science jobs, research funding, and space in journals becomes more intense, those scientists with multimedia skills such as videography will be at a distinct advantage. Twenty-first century consumers of scientific information, both technical and non-technical, will expect media-rich content, and science educators and researchers must be prepared to provide it.

Traditionally, articulating research and writing academic essays demands high-level writing skills. For example, the setting of written essays for Monash University science undergraduates aims to teach students how to obtain information from scientific literature, to synthesise information from diverse sources, to critically evaluate arguments, data or ideas and to clearly communicate this to a reader (Weir 2013). When using video there are similar demands of skill, awareness and rigour. A foundational task for educators using video must be to direct creative and critical attention to the emergent forms and possibilities of the medium in terms of developing visual language and literacy in a way that also upholds the demands of academic rigour and integrity that are found in the written essay.

For the remainder of this article, we focus on a specific case study of integrating the video essay with chemistry education. We explore the development of this case study programme, the goals underpinning programme development, the process by which the video component of the chemistry programme was delivered and assessed and how students engaged with the video essay. Our objective is to illustrate how video essays in an undergraduate science context offer new pedagogical opportunities, allow critical thinking and provide the opportunity for group work (Gallardo-Williams et al. 2020)

Teaching of undergraduate chemistry commonly occurs in the lecture theatre and the laboratory. However, it is recognised that the laboratory setting can have a number of challenges. Chemistry, as a discipline, is regarded as a difficult subject, with an inflexible practical curriculum (Royal Australian Chemical Institute 2005, 40). Students can be intimidated by laboratory settings and technical procedures (Burrows, Nowak, and Mooring 2017; Agustian and Seery 2017), and are often highly self-critical of failed chemical reactions, although less fazed by a poor 'cooking' outcome when making dinner. In other

words, they often believe that the product of the chemistry experiment is more important than the process of undertaking the experiment. The authors recognised that the introduction of the video essay as an assessment task would allow an alternate laboratory environment. Additionally, it would offer videography training, giving transferable skills for students' future employment as well as contributing to the learning outcomes for the subject which were based on written and visual presentations of findings from a multi-stage laboratory programme. Furthermore, introduction of the creation of the videos and their subsequent student and educator critique, addressed a number of pedagogical principles elaborated below.

The programme was initially a six-month pedagogical initiative that received financial support through a 'Better Learning, Better Teaching' grant from Monash University to explore the use of video essays in science teaching and learning, with an on-campus 2nd year undergraduate food chemistry cohort of 160 students. Our aim was to integrate food chemistry and video as a learning and communication tool. Students, in groups of four, needed to prepare a four-minute video that demonstrated their knowledge of food chemistry either by preparation of a food item, or by visiting a local industry body that used food chemistry processes. The case study is further illustrated with a video essay produced to accompany this article (See: vimeo.com/397872939).

Goals

The goal was to transform learning experiences of undergraduate science students by engaging them in a fundamentally different programme of enquiry and presentation as embodied in the process of producing a video essay. There were two key overlapping themes underpinning this programme. The first concerned the development of media literacy for science graduates. The second was a radical approach to science teaching and learning using the video essay. The intention of this approach was to facilitate an environment in which students would construct, develop, learn and consider their own understanding through multiple inputs (e.g. group discussion, instruction, lecture, observation, questioning, practice and research). It was intended that students would:

- Learn in an environment outside of the university (often in an industry setting), in small groups (4 people maximum), allowing for active and collaborative learning. The alternate learning environment allows students to develop a clear sense of identity with the task.
- Be asked to reflect on the underlying chemistry behind the experiment and their learnings as a team, thus establishing a connection between research and education, and obtaining a robust understanding of food chemistry processes.
- Have the opportunity for critical thinking and inquiry through an open-ended task designed to encourage them to ask questions and value subsequent feedback.
- Be exposed to different assessment strategies, giving them greater autonomy and scope for self-learning, and encouraging them to be active learners.
- Obtain transferable, elementary videography skills.

The video approach addressed two issues that had been previously identified: (1) an under-developed ability to deliver and receive critique, and (2) a heightened focus on

performance over mastery of concepts and content. These issues stem from several challenges facing undergraduate students in chemistry. Graduates of chemistry face a changing employment market with shifting work opportunities for Chemists in Australia (Royal Australian Chemical Institute 2005), although they find employment in non-chemical fields where they are highly valued for their problem solving and critical thinking skills. The previous Chief Scientist of Australia, Professor Ian Chubb, highlighted the urgent need to enhance national scientific literacy and to attend to the STEM pipeline (Office of the Chief Scientist 2014). Science and innovation are recognised internationally as key to boosting productivity, creating jobs, enhancing competitiveness and growing an economy – an economy where new technologies and 'smart' companies lead. There is an urgent need to reinvigorate the teaching of scientific disciplines to enhance retention and provide graduates with the new skills required for a changing job market.

Method

The method of delivery included an introductory lecture on video essays, a blog-based website, practical sessions on video production and editing, screening of films, assessment, a student questionnaire, and compilation of the film by the authors. As noted in the introduction, a video essay has been produced capturing this process and showcasing some of the films produced by students.

The lecture and blog

The lecture, written by co-author Martin Potter, delivered by filmmaker Anna Grieve and published as an unlisted video on the Monash Physics and Astronomy YouTube channel, introduced students to the task of producing short video essays on an aspect of food chemistry. The lecture highlighted new modalities of science communication, quick tips and explored examples from *YouTube* based creators such as Sally Le Page (aka Shed Science), Physics Girl, Veritasium and Periodic Videos (Monash Physics and Astronomy 2015). These examples showed engaging, short video-based approaches to science communication that had reasonable production values, underpinned by well-evidenced science. The videos have high engagement, with one of the videos 'Cheeseburger in Hydrochloric Acid' (Periodic Videos 2010) having over 19 million views on YouTube as of August 2020.

The lecture reinforced a number of key messages for the video essay: this was an experiment in teaching and learning and the process of creating the video essay was as important as the final product. Other key messages were that although the creative process was important, the videos did need reasonable production values (as detailed in Figure 1. Rubric) and thoughtful storytelling underpinned by good science. Ethics were also foregrounded and based on the 2007 UK Government universal ethical code to support scientists in doing ethical research (King 2007). The three key points of this code are rigour, respect and responsibility. (See: monashchemistry.wordpress.com/2015/07/24/universal-ethical-code/).

The importance of presenting science 'honestly and accurately' was highlighted. Meaningful public engagement based in trust was positioned as a basic contractual relationship. The things that students would be doing and showing within their videos would

Criteria	Superior	Well-developed	Successful	Under-developed	Poor	No evidence
Clear identification of topic						
Clarity of explanation of key ideas						
Clarity of explanation of specialist food chemistry knowledge						
Accuracy of food chemistry knowledge						
Comprehensiveness of food chemistry knowledge						
Synthesis of knowledge with field observations						
Awareness of level of audience comprehensibility						
Video Presentation						
Quality of camera use and visual images						
Design and coherence of visual images						
Compatibility of visual images and audio						
Narrative flow						
Communication with audience (Target Second Year Food Chemistry)						
Voice clarity, volume and articulation						
Quality of the editing						
Correct running time (= XX mins per group)						

Figure 1. Rubric for assessment of video essays within the food chemistry unit.

be framed as 'true' and not a misrepresentation. Trust was part of a respectful engagement with the student's primary audience of peers and assessors, a responsibility to both the field of chemistry and to the audience. Therefore, films needed to be underpinned by a body of evidence and rigour as in any other science process that students were learning, researching and publishing. The lecture then detailed stages of production (research, pre-production, production and post-production), visual thinking (how and when to show, not say it), shot basics (shot sizes, angles, mobility) and storyboarding as a tool for pre-visualising their videos.

The use of mobile phones to produce the videos was introduced not only to exploit the 'everydayness' of the technology but to also create a level playing field for students. It was

recognised that not every student would have a smartphone available and hence a pool of 20 iPhones were made available ensuring that every student was using similar technology. The technological limits of the phones were also addressed. The generation of iPhones used by students had limited capacity for changing exposure, focus and for recording audio. Again, process was foregrounded so that students would film and review each shot to ensure that what they saw and heard was what was captured by the phones.

Key advice included filming the demonstration or process and then asking questions about the process afterwards. A brief introduction to post-production software was covered. However the main focus was the process orientation of preparing for the edit by reviewing and logging footage and creating paper-based edits. At the end of the lecture the 'Monash Food Chemistry Mobile Digital Storytelling Lab' blog was introduced (See: https://monashchemistry.wordpress.com/). This blog had been pre-populated with a range of material, including 'how-to' videos, ten articles on video production, extensive links and a forum for student participation through comments and questions.

Workshops 1 and 2: video production and editing

Students were split into four tutorial groups, comprising forty or more students in each group. Two hands-on workshops (4-hours) were held, focused on videography using the phones and an editing workshop using Adobe Premiere. The first workshop involved a series of rapid filming and editing exercises with the first exercise a very basic introduction known as 'The Name Game' (Lunch and Lunch 2006). In this exercise, students were separated into groups of approximately eight. One person films another person who introduces themselves and maybe gives an interesting factoid (or half-factoid) about their life or what they want to do. (e.g. 'My name is Jim and I like eating anchovies while they are still alive … '). It is important that this introduction is under 15 seconds in order that the process of filming and review is timely.

The person who filmed this introduction watches the video back with the person being filmed. If both are happy with the video introduction, the person filming hands the camera on to the subject who then films another student and so on until everyone has completed an introduction on video and watched the video back. The videos were then edited in Adobe Premiere software by the lead facilitator and shown back to students in this session. This group feedback allowed for comment on shots (steadiness, framing, mise-en-scène) and other elements including audio quality. This simple exercise is a way of modelling the process of production (shoot, review, re-do if required), of troubleshooting basic limitations of the phone (e.g. auto exposure or audio recording limits), rapidly illustrating how editing works and modelling a process of peer review and commentary.

The second exercise was themed around a process ('Paper Planes') and a format known as '5 × 5,' comprised of 5 shots of 5 seconds each (Potter 2019, 201). This compressed video-based storytelling exercise is a microcosm of the entire production process – planning, thinking visually, scripting and storyboarding, filming, digitising, organising material in the editing software, editing and output. Students were able to edit either using software in the phone or onsite laptops, which all had Premiere pre-loaded. The tutorial then shifted to basic interviewing techniques building on two of the blog articles (See: https://

monashchemistry.wordpress.com/2015/07/24/interview-techniques/ and https://monashchemistry.wordpress.com/2015/07/31/you-had-me-at-h-e-l-l-o/).

During this first workshop the goals of the programme were further explained, and students were able to discuss the food chemistry related video essay that they wanted to research. Two pathways into the research story were mapped – one was for students to prepare a food item that required some technical ability and where their knowledge of food chemistry needed to be demonstrated. The other was for students to visit an industry body that used food chemistry processes, such as a brewery or a food manufacturing company. To establish a connection between research and education, knowledge and skill was needed to refine the process of both food preparation and video production to produce a quality product for evaluation (i.e. the final video essay). Students were required to reflect on the underlying chemistry behind the processes found either in the recipe or with the company and their learnings as a team. This encouraged active and collaborative learning, established a connection between research and education, and enabled them to develop personalised learning.

Following the first workshops students as a group had two weeks to complete the Proforma#1. This formative assessment either outlined (i) their choice of company, either from a list of companies who agreed to participate in this exercise or a company that the students organised or, (ii) their food chemistry process. Students had to write a brief justification for their choice and their approach (150 words or less). Educators then provided feedback to the students around the food chemistry research question they were asking, what resources and locations were required to answer this question and what occupational health and safety issues needed to be considered during filming.

The second workshop focused on video editing. Filmmakers Potter and Ben Pederick had filmed interviews on an iPhone in Nora Restaurant with owners Sarin Rojanametin and Jean Thamthanakorn, about the process of creating and plating a relatively complex dish by Rojanametin that incorporated a range of food chemistry processes. This footage was transcribed and organised in Premiere and the project shared across all tutorial computers. Students were then introduced in detail to the Premiere editing software and guided through the process of assembling, rough cutting and fine cutting the material to create a video of under 3 minutes. This highlighted the benefit of having a clear research question and the process for investigating it prior to filming. If excessive footage was shot, then the editing time could be considerable. Following this final practical workshop students were tasked with finding, defining and researching their 'story' – be that through their own food chemistry related process or through an industry led focus.

Proforma#2 was a group task worth 25% of the assessment task. It covered the role of each team member throughout the production process, a detailed recounting of the food chemistry story, interview questions or voiceover script for telling this story, the food chemistry knowledge embodied in the story and how this knowledge related to the overall subject curriculum. This Proforma also established if a storyboard and shot list had been developed, how the students understood technical considerations of filming including light, framing and sound, possible challenges they might face during filming and how they might address this. Most importantly, it ensured that their videos had a Food Chemistry story and if they were visiting Industry that the appropriate chemistry questions would be asked. Following signoff from the subject co-ordinator, the students

were able to film in either their own time or in the time set aside for this task in their laboratory timetable. On completion of filming a Proforma#3 (worth 15%), due a week before the screening of the video, was submitted to indicate that students had completed filming, highlighting any issues prior to editing.

Workshop 3: screening and critique

Screening of the student videos occurred in the last week of the semester, 6 weeks after the editing workshop. Four sessions were held, each containing 40 students and 10+ videos. The setup was in a 'film festival' style setting, a darkened room with popcorn supplied. It was attended by students within that session, academics and filmmakers who had hosted the video production and editing workshops. The video-based screenings offered an opportunity for students to show their final videos to their tutorial group and for peer review by their cohort. The opportunity to present videos to their peers and to compare, question and discuss the videos and the food chemistry described within these videos was an important opportunity to reflect not only on the science but also on the developmental and research process. It is also recognised that peer- and self- feedback is viewed more favourably than academic feedback and as a consequence can offer more educational benefit (Bedford and Legg 2007). It was noted that this environment encouraged an element of competition (who could make the best film) as well as creating an environment where feedback and review was necessary and was valued.

A number of reflective peer discussions were constituted on the reproducibility of techniques used in the experiments featured in a video. Students' videos were critiqued and assessed by three academic staff members and three film makers, totalling 50% of their mark for this task. A rubric marking guide was included in the Videography booklet given at the start of the semester (Figure 1). A final Proforma (worth 10%), was an individual task and was submitted following the final video-based screenings. In this Proforma, students evaluated each of their group members indicating whether each was an excellent contributor, a satisfactory contributor, poor contributor or did they not participate at all in the exercise.

Rubric and assessment

The video essay component of the subject was assigned 10% of the total grade for the Food Chemistry subject. This was equivalent to three standard laboratory based practicals. This percentage allocation was not commensurate with the time students devoted to the video production, with students doing many more hours then they might have for in-house practical sessions and written reports. This was reflected in student feedback. The initial choice of the low percentage grade allocation for this assignment was, in part, to mitigate risk for students who did not consider themselves creatively or technically minded. 'Punishing' students for a lack of video production skill does not necessarily have any correlation to their skill in chemistry. Another reason for the low percentage allocation, with respect to the time required, was to mitigate risk for the subject, as this was an experimental component outside the domain of standard chemistry teaching and learning frameworks. The video essay project was a compulsory assessment task, and the percentage weighting of this task did allow students to choose to not engage, if

they found the task too difficult or they were not inclined to learn in this way then they were still able to pass the subject. We anticipated that students would embrace the opportunity to engage in a learning experience that involved new technologies, rather than a task that focused solely on grades. This thinking was informed by previous work by students on research projects in individual, student-led labs, as opposed to set laboratory practicals (Weaver, Russell, and Wink 2008).

A specific rubric for the video essay was created. Within science curricula there is little research describing robust assessment strategies to support this style of integrated, interdisciplinary learning where outcomes are assessed. The development of a rubric for the video was constructed by Monash academics in consultation with the filmmakers. There were 15 criteria in total, with seven criteria relating specifically to food chemistry knowledge and explanation. Eight criteria related directly to the video presentation. The rubric range was inspired by Vandervelde (2010) with measures of criteria ranging from 'superior' to 'no evidence.' Criteria included seven information and expression elements that could be applicable to written or other modes of communication such as clarity of exploration, accuracy of knowledge, synthesis of knowledge with observation etc. Eight criteria were focussed on creative and technical elements of the video presentation. These criteria addressed the storytelling using video (e.g. narrative flow, coherence of images, editing) and technical skill (e.g. camera use, sound, running time).

Student feedback on the subject

Following the screening, nine rapid short interviews were filmed with the student cohort (three females and six males). The questions asked were, (1) What did you like about the video essay project? (2) What was the hardest part of the project? And (3) Any other comments?. These interviews are included in the video essay accompanying this article. There was also a University administered online anonymous survey where students were asked to answer a number of questions (giving scores of 0 (low) to 5 (high)). Students also had the opportunity to write detailed open-ended responses for the questions, 'Which aspect (s) of this unit did you find most effective?' and, 'Would you suggest any changes to enhance this unit in the future?'. The response rate for students that answered the survey was 62 (32.12%) with 40 choosing to respond to the open-ended questions. Within this survey, the subject received a 4.17/ 5 median grade for 'Overall I was satisfied with the quality of this unit', which is framed as a green outcome and 'meeting aspirations.' The video component of assessment appeared in both 'effective' and 'enhance' feedback. There were 18 responses that commented that the video essay component of the subject could be changed, with a recurring theme of comments in relation to the fact that the video should have been worth more than 10% of the final mark for this subject (15 of the 18 suggest changes comments highlighted this). The Food Chemistry subject also featured a poster element and two comments highlighted that two communication-oriented assessments were unnecessary. Both commenters noted that they felt that video was the more important skill to learn, albeit more time consuming. Two comments addressed lack of focus on discipline specific knowledge,

> The videography project was too focused on learning how to make a video - this is not what the unit is about.

And

> All that I learned during the videography assignment was how to make a video, and although this is interesting, it is not what I came to Food Chemistry to learn about.

While the majority of feedback on the video essay component, both positive and negative, acknowledged the importance of learning video, it is important to reflect that a shortcoming of the assignment was in communicating the broader pedagogical approach underpinning the use of video to students. In future iterations, it might be that clearly articulating the learning goals – encourage active and collaborative learning, establish connection between research and education, personalised learning and alternate assessment strategies – would ameliorate such concerns. More likely, giving students an option to do either a poster or a video, or weighting the video essay component more appropriately given the amount of work required would address these concerns.

There was substantial positive feedback on the video component. These included, a novel approach to learning chemistry; a great opportunity to engage with industry or be 'in the field;' learning new skills; a chance to communicate research in a new media; building team skills; peer review and feedback; and a chance to explore student-led topics. Direct quotes from the positive feedback sections of the student survey on the video process included:

> A great opportunity to see some science being done out in the real world, which is drastically different from how it appears at uni. Also creating videos was a fun and interesting new skill to try and develop. I can see how it will be useful going forward. Videos were a good addition and were both realistic (as science needs to be communicated) and enjoyable.

And,

> Learning how to make communicate science is important! Having the opportunity to go out into industry was a particularly good experience as I didn't know that the flavour industry was such a secretive industry. Also, because I have seen a little bit of the industry, the lectures made more sense. Yes, it took so much effort to edit the video but showing the finished product in front of the class was a good feeling. I also enjoyed that I got to work like a YouTuber for a few days …

It was clear from the survey results as well as verbally interacting with the students, that the video essay experience gave opportunities for students to be creative and improve their media literacy. Critical analysis and feedback was provided to and by all of the participants. Students were guided through the process so as to hone their ability to deliver, receive and value feedback. The alternate strategies for assessment allowed documentation of their food chemistry outcomes using videography, resulting in a digital portfolio of their learning journey. This results in greater autonomy and scope for self-directed learning and encouraged students to be active learners. During the process they were able to critically self-assess and reflect on their learning and to recognise how, due to repetition and the acquisition of new skills, they mastered the food chemistry challenge. Through the process of planning, producing and editing the video essay the students also had an immersive experience of the subject matter and obtained collaborative skills by working in teams.

In the future, articulating, and repeating these positive learning outcomes to students producing science-based video essays would support greater engagement

with the process. The broader pedagogical aspiration to shift student focus from product to process simply through the inclusion of video essays within one subject is a significant ask. Scaffolding non-traditional assessments throughout an under-graduate science course within both elective and core units could assist in realising this aspiration.

Conclusion

This initiative conducted and documented student chemical enquiry, practice and evaluation in an out of laboratory format. Students self-regulated group activity and documentation of the activity. This initiative emphasised the social nature of the learning experience and encouraged help-seeking behaviour *via* the sharing of advice. The use of smartphones to create films on food chemistry and the documentation of the process of filming, editing, screening and feedback highlighted alternative approaches to learning and teaching as students captured, edited and shared their own experiences for both assessment and peer reflection.

A key question that underpinned the development of this subject was how video essays could be used in science teaching and learning. The case study explored here, along with the accompanying video essay, presents an insight into the multi-valent opportunities offered through the process of creating the video essay, and the resulting artefact of the videos themselves. The videos are a way to capture the experimental process, to connect with industry and other experts, as well as an educational resource and an embodiment of the process of learning. They offer an excellent opportunity to foster teamwork, collaboration and unique opportunities for peer review and reflection through screening work. The process of video making and the shared experience of review and feedback on this work created lateral, conceptual connections between process, artefact and the field of research. The video production process also supports students in building skills to communicate, not just with their peers, but with a wider audience.

The use of the video essay as a mode or tool of teaching to improve students' educational experience and learning outcomes is not, however, without risk. The amount of work required by students must be acknowledged in assessment weighting and, as always, under-graduate collaborative activities are often fraught with inter-personal dynamics. The pedagogical aspiration of this case study to foreground explorations of process, encourage experimentation and failure, and highlight the process of creativity over the final video product was ambitious. While students had a sense of these aspirations, feedback indicates opportunity for further development. The authors anticipated that the use of student-created video essays as a highly effective communication tool as well as a tool for new and engaging pedagogical practices will increase in the coming years. The process allows students to reflect on the task and not focus solely on the product but also the process. The multifaceted programme, engaging filmmakers and chemical educators, allows students to receive guidance from experts in both the field of chemistry and film studies. The case study outlined can be realised in any discipline area with only changes to the research question necessary. The authors advise educators to not underestimate the time it can take students to become an 'expert' with the technology and for

them to decide what shots will allow them to answer their research question. Future iterations of this programme will allow students to be able to opt-in, there will be a larger weighting of the assessment task, and there will be high-quality videos that will assist with their planning.

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Anna Grieve has over 30 years experience as an independent producer/director/scriptwriter and from 2001–09 was Executive Producer at Film Australia. Her extensive production credits includes four large scale dramatised documentaries films with Writer/Director Peter Butt - *I,Spry*, *The Prime Minister is Missing*, *Silent Storm* and the Logie award winning *Who Killed Dr Bogle & Mrs Chandler?* It remains the highest rating documentary on ABC TV. She has also produced the feature documentaries *Croker Island Exodus*, *Death or Liberty*, *The Family*, *Looky Looky Here Comes Cooky*. Anna has extensive interactive and web documentariy experiences and since 2008 she has been co-producing the multi-platform Big Stories Small Towns, a participatory media project gathering local stories for a global audience and winner of the best community interactive SXSW 2012.

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