Implementing Digital Media Presentations as Assessment Tools for Pharmacology Students

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Abstract At the Faculty of Science we introduced the use of digital presentations as assessment tools for third-year pharmacology students. A cohort of 167 students self-allocated into groups of four and were assigned a topic related to the pharmacology lecture material. A one-hour lecture was delivered to discuss digital media principles (visual design, video composition, multimedia learning principles, etc.) and how to apply these to create digital media projects. During practical classes, students developed a storyboard and received feedback and technical advice from tutors. Towards the end of the semester, students uploaded their preliminary presentations to a YouTube channel and received feedback from lecturers, tutors, and peers before submitting the final version. A marking rubric was developed and shared with students at the beginning of the semester. The study used a mixed-methods approach to evaluating the intervention. A comprehensive 35-step questionnaire was used, covering demographics, students' attitudes towards technology, digital media support, understanding of the assignment, and knowledge construction and skills gained. It also contained five open-ended questions. A high response rate was achieved for the voluntary survey (97/167). Additionally, students reviewed contributions of group members using SPARKPlus, and the marks attained were used to triangulate the questionnaire responses. In summary, the data shows that students found the assignment was engaging, fostered learning and creativity, and that they gained additional skills relevant to their future careers.

Keywords: digital presentations, learner-generated digital media, digital video in science education, digital storytelling

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1. Introduction

The affordability of technology, in conjunction with a broad range of free or inexpensive software and applications, makesfeasible the production and hosting of digital video on the web via sharing services such as YouTube [1] and Vimeo [2]. Video production know-how is becoming a 'desirable' skill in the 21st century. Social software platforms such as Facebook [3], Instagram, and Vine [4] are examples of how people document their everyday activities using digital video. In the area of science, digital video is being used as a way to report scientific findings in journals such as JoVE (*Journal of Visual Experiments*). In other words, the videohas become an important part of both our personal and professional lives.

Learning Management Systems (LMS) are designed to facilitate teaching activities and the delivery of content, but do not foster students engagement and active learning [5]. Authentic assessments using digital media can create an opportunity to upskill students in the use of technology and to help them 'learn by doing' and further engage with their subjects.

It has been reported that Learner-Generated Digital Media (LGDM) in curricula can be used to provide opportunities to improve students' skills like problem-solving, cooperative learning, critical thinking, and motivation [6].

The outcome of this research is a simplified methodology to implement LGDM assessments for science students. The workflow proposed considers pedagogyas a starting point and includes training in digital media principles, hosting and sharing of content, marking schemes, group work, feedback, and evaluation.This research also uses multiple data-points and methodological triangulation to increase the credibility of the results.

The aims of this studyare: (1) to propose a workflow to implement LGDM as an assessment tool, and; (2) to investigate students' attitudes towards digital presentations as assessment tools in a pharmacology subject.

2. Literature Review

Digital presentations in higher education have been reported as a way to deploy content for blended learning ([7,8]) and, most recently, to 'flip' classrooms [9]. Learner-generated digital presentations emerged more than a decade ago in the field of education (pre-service teachers) ([10,11,12,13]) and have been incorporated recently into other disciplines. It has been documented

that digital presentations provide opportunities for the improvement of students' skills like problem-solving, cooperative learning, critical thinking, and self-motivation ([6,14]). Other skills developed by participating in the process of designing, creating, and presenting digital presentations include different types of literacy like digital, technological, visual, and globalliteracy ([6,14,15,16]). Teachers are using these technologies as a valuable tool for motivation, collaboration, expression, and authentic assessment [17]. Learner-generated content has been shown to have the potential to add value not only in hands-on experience but also in peer-driven learning [18].

Subject areas where learner-generated digital presentations have been used as assessment tools include: computer science ([19,20]), accounting [21], language studies [22], mathematics [23,24], middle school science [25], and pre-service teaching studies ([26,27,28]). In the subject area of education, where most of the research has been conducted, the use of digital presentations has been focused on reflective teaching experiences [29], rather than on active learning, creativity, inquiry, and research approaches. Nevertheless, research on digital presentations in higher education is considered under-the orised and barely adequate ([30,31]), and there is a need for rigorous studies to evaluate their effectiveness in different disciplines ([32,33]).

The implementation of digital presentations can be challenging in several ways, for example: (1) they are less familiar than written tasks; (2) they require careful alignment with learning outcomes and graduate attributes; (3) they can create inequity issues when students work in groups; (4) they may disadvantage students who do not own any technology; (5) they require integration of skills from different disciplines such as visual design and aesthetics, creativity, etc; and (6) they present intellectual property and copyright issues regarding images, background music, and text used ([26,34]). But the biggest problem with implementing digital presentations as assessment tools is the lack of a practical model to ensure a consistent approach when implementing them in curricula.

3. Methodology

This research used a mixed-methods approach [35], a procedure for collecting, analyzing, and mixing both quantitative and qualitative data from each stage of the research process within a single study, to gain anin-depth understanding of the problem [36]. The data gathered came from three sources: (1) a student attitude 35-step questionnaire; (2) group contributions (SPARKPlus); and (3) the grades attained. Methodological triangulation was applied to analyze the data sets, as the integration of multiple techniques increases the amount of data available and gives more credibility to student responses [37].

The study was conducted in Spring Semester 2015, in the science subject Pharmacology 2 (n=167). Students worked in groups of four(41 groups), were assigned a topic by the subject coordinator relating to the lecture material covered in the subject, and were asked to produce a five minute Digital Media Presentation (DMP)to develop the topic further.

The following elements informed the design of the assessment task: (1) pedagogy and rationale; (2) giving students support regarding digital media; (3) hosting and dissemination; (4) marking schemes; (5) contribution to group work; (6) feedback on drafts, and; (7) evaluation via Survey.

3.1 Pedagogy and Rationale

Active learning approaches drove pedagogy and rationale, with students working in small groups and 'learning by doing'. Problem-Based Learning [38], Collaborative Learning [39] and Cooperative Learning [40] were identified as suitable pedagogies. These teaching strategies promote student engagement with technology, development of research skills, collaborative working, problem solving, and organizational skills [14]. The DMP assessment task was aligned with subject learning objectives (pharmacology content) using a constructive alignment approach [41]. Additionally, the following UTS Science graduate attributes were mapped against the assessment: (1) disciplinary knowledge and its appropriate application; (2) professional skills and their appropriate application; (3) communication skills, and; (4) inquiry and innovation.

3.2. Student Support with Digital Media

Reports on digital presentations as assessments have not yet considered the need to train students in digital media fundamentals. This research delivered training, on how to create effective digital presentations, to students by an instructor with ten years' industry experience. A lecture on digital media fundamentals for presentations was delivered during the first week of the semester. Topics covered were: (1) digital presentation types; (2) video quality and resolution; (3) audio recording; (4) video framing; (5) use of images to convey messages; (6) effective use of colour; (7) typography; (8) content creation for digital media projects;(9) copyright issues; (10) tools available to produce digital presentations, and; (11) development of a storyboard. A week after the lecture, students engaged in a hands-on workshop to receive feedback from the unit coordinator on the content, and from the instructor on the digital media approach to be used.

3.3. Hosting and Distribution of Presentations

Our institution uses Google Applications, including YouTube. The subject coordinator created an account and shared it with all students. The idea was for the groups to upload a draft of the presentation and be inspired by the different approaches developed by the other groups. This method has been found to motivate students to make an impact on the audience with their digital presentations[42]. Using YouTube was also chosen as the most efficient way for the instructor to give feedback online in a timely fashion, as all the presentations could be loaded onto one channel.

3.4. Marking Scheme

The DMP constituted30% of the final subject mark. Amarking rubric was designed before the semester started, and was provided and explained to the students during the workshop. The marking criteria included accuracy and completeness of information, use of digital media to enhance communication of the topic, creativity (how the

presentation enhances the topic), understanding of the underlying scientific principles, and the quality of the research using available resources (textbooks, published papers, etc.).

3.5. Group Work Contribution

Due to the time-consuming nature of the task, a mechanism to ensure that group work was effective was implemented. Students were able to assess individual contributions to their groups using SPARKPlus. This program allows students to self- and peer-assess group member contributions, which helps to overcome potential inequities in marking [43]. Team members were responsible for negotiating and managing the balance of contributions and then assessing whether the balance was achieved. The task used the following criteria: (1)the student turned up to group meetings prepared and on time; (2)the student completed assigned tasks efficiently and contributed significantly to the overall assignment, and; (3)the student interacted well with other group members and contributed original ideas and suggestions. Inside SPARKPlus students needed to use a slider to grade themselves, and then their peers, using the following scale:

NC = No Contribution
WB = Well Below Average
BA = Below Average
AV = Average
AA = Above Average.

Students also had the opportunity to write feedback for their peers. The system automatically calculates a rating that identifies unbalanced groups, and reviews and corrects individual marks accordingly.

3.6. Feedback

Students received timely feedback from the subject coordinator and instructor on two occasions: during the workshop (storyboarding process), and on the DMP draft uploaded to YouTube. The aim of the feedback was to address three major questions: where am I going? (What are the goals?); how am I going? (What progress is being made toward the goal?), and; where to next? (What activities need to be undertaken to make better progress?) [44]. Students were able to modify their digital media presentations and submit a final file incorporating subject coordinator and instructor feedback, as well as peer feedback.

3.7. Evaluation

To evaluate student attitudes towards DMP as an assessment tool, a 35-step online questionnaire (Likert scale) and five open-ended questions were developed, and students were asked to participate on a voluntary basis. The survey included sections on; (1) demographics; (2) attitudes towards technology; (3) digital presentation support (lecture and workshop); (4) the assignment; (5) the contribution of DMP to skill development, and; (6) the five open-ended questions.

Group contribution (SPARKPlus) data was gathered from the application, as CSV files, for further analysis. Based on the ratings of each team member against the criteria, SPARKPlus automatically produced the Self- and Peer-Assessment factor (SPA). This factor is an individual performance factor that measures how the group overall viewed the individual contribution of each team member. The SPA factor is proportional to the average of total ratings of all group members divided into the total ratings of team members. This SPA factor was used to convert group project marks into an individual mark. For example, Individual mark = Group mark x Individual's SPA. If a group receives 80/100 for their project and a student in that group receives a SPA factor of 0.9 for their contribution (reflecting a lower than average team contribution), the student will receive an individual mark of 72. Individual mark = 80 x 0.9 = 72.

An SPA>1, means that that student's contribution was greater than the average. In contrast, an SPA<1 means that that student's contribution was less than average.

The maximum grade the students could get for the DMP assignment was set at 30%, following the subject outline. At the end of the marking period, the grades attained were gathered from the Grade Centre (LMS).

4. Results

4.1. Demographics

Of the respondents to the survey (97/167), 61.9% were female and 38.1% male. Their ages were distributed from 18-29 (96.9%) and 30-49 (3.1%). This shows a cohort of relatively young students. Regarding education completed, 67% were high school graduates, 25% had a university degree already, and 7% had a trade or technical/vocational training. Twenty-two percent of students had English as an Additional Language (EAL) and 78% were native English speakers.

4.2. Attitude towards Technology

Ninety-two percent of students stated that they use technology for personal/recreational use, and 86% reported being confident in using it for this purpose. Ninety-six percent had a positive attitude towards technology for recreational purposes. Regarding the use of technology for learning, 96% reported enjoying it, while 92% were confident using it for learning. Ninety-four percent of students reported a positive attitude towards technology for learning (Table 1).

Table 1. Student's attitude towards technology (%)

	SA	A	D	SD
I enjoy using technology for personal/recreational matters	34	58	7	1
I am confident using technology for personal/recreational matters	38	48	13	1
I have a positive attitude towards technology for recreational matters	40	56	4	0
I enjoy using technology for learning	41	55	3	1
I am confident using technology for learning	37	55	8	0
I have a positive attitude towards technology for learning	36	58	6	0

SA = Strongly Agree, **A** = Agree, **D** = Disagree, **SD** = Strongly Disagree.

4.3. Digital Presentations Support

Regarding the support offered to students via the digital media lecture, 86% of students found the lecture engaging,

while 76% thought the lecture gave them practical skills for their assignments. Eighty-eight percent applied the DMP concepts to their assignment, 93% understood the importance of communicating ideas in the digital world, and 84% would recommend the lecture to their peers. Sixty-five percent of students agreed that they need a better understanding of digital media principles. Regarding tutorial support, 83% of students reported that the support was valuable for their assignment, 74% used the storyboard as recommended, and 85% thought the overall technical support for the DMP was good (Table 2).

Table 2. Digital Media Presentations (DMP) support (%)

	SA	A	D	SD
I found the DMP lecture engaging	59	27	13	1
The lecture on DMP gave me practical skills I needed to develop my assignment	50	26	12	2
I applied DMP concepts from the lecture to my assignment	53	35	12	0
I understand the importance of communicating concepts/ideas in the digital world	32	61	5	2
I need a better understanding of DMP principles	51	32	15	2
I will recommend that my peers attend this lecture	54	30	15	1
The support at tutorials was valuable for my assignment	51	32	15	2
I used a storyboard to structure my project	47	27	22	4
Overall the technical support to complete my project was good	57	28	11	4

SA = Strongly Agree, **A** = Agree, **D** = Disagree, **SD** = Strongly Disagree.

4.4. About the Assignment

This section had two sets of questions. The objective of the first part was to gauge students' understanding of the DMP task. Eighty-eight percent of students thought the instructions were clearly provided, and 99% thought that the timeframe to complete the project was adequate. The second part of this section aimed to evaluate students' attitudes towards the DMP as an assignment. Eighty-nine percent of students were happy with the DMP assignment, while 74% considered the DMP to be a good way to assess students' understanding of a topic. Seventy-seven percent of students advocated encouraging academics to use similar assignments in other subjects (Table 3).

Table 3. About the DMP assignment (%)

	SA	A	D	SD
I believe instructions on the assignment were clearly provided	41	47	11	1
The timeframe to complete the project was good	42	57	1	0
Overall I was happy about the DMP assignment	42	47	9	2
I believe DMP is a good way to assess students understanding of a topic	39	35	21	5
I will encourage academics to use similar assignments in other subjects	40	37	18	5

SA = Strongly Agree, **A** = Agree, **D** = Disagree, **SD** = Strongly Disagree.

4.5 Digital Media Project Contribution to Skill Development

This set of questions was designed to gauge students' perceptions of skill development through the DMP assignment. Eighty percent of students believed the DMP helped them to understand the topic, while 78% and 88% thought it helped them to develop critical thinking and communication skills, respectively. Ninety-one percent of students thought that the DMP helped them to exercise their creative side, and 74% thought that they learned additional skills (Table 4).

Table 4. Digital Media Project (DMP) contribution to skill development (%)

	SA	A	D	SD
I believe the DMP helped me to understand the topic	41	39	18	2
The DMP helped me to develop critical thinking skills	46	32	19	3
The DMP helped me to develop communication skills	41	47	9	3
The DMP helped me to work as a part of a team	37	54	8	1
The DMP helped me to exercise my creativity	37	54	7	2
I believe I learned additional skills by doing this assignment	39	35	21	5

SA = Strongly Agree, **A** = Agree, **D** = Disagree, **SD** = Strongly Disagree.

4.6. Open-ended Questions

The following open-ended questions were asked of the students: (1) Did you experience any problems with the assignment?; (2) What did you like most about the assignment? (3) What did you like least about the assignment?; (4) Do you have any feedback on how to improve this task? and; (5) Is there anything that you would like to say that has not been covered in the previous questions?

On question 1, about issues with the assignment, (n=54), 43% of responses said no issues were encountered, while 15% said some issueswere encountered with group work, naming technical issues such as audio, editing the video, uploading the video, etc. Twenty-seven percent made positive comments on group work, learning new skills, etc.A couple of quotes showcase how students felt about the assignment:

"It is not easy to pull together a professional looking video in that timeframe if you have never done it before, and I wasn't as happy with the video in the end. I understand that it's necessary to be able to do this in the science profession because we are incredibly bad at communicating to the general public so being able to create an engaging and informative presentation is actually really fundamental I just wish this was something we had to do more often because it would have forced a lot of us to learn how to do it better".

"One of the major problems we faced with this assessment was the difficulty in actually understanding who our target audience was. We wanted to present the topic (oxy) as a pressing social issue but at the same time, we were constrained by the fact we also had to discuss its pharmacology. It was difficult to balance the science with the problem presented to society. The task would have been much more enjoyable and engaging if the underlying pharmacology (that is the pharmacokinetics and pharmacodynamics) was not needed to be part of the presentation. The lectures cover this enough, and it seemed redundant at times talking about which receptor the drug binds to, etc.".

On question 2 (What did you like about the DMP?, n=60), the main themes were being able to exercise creativity while learning (33%), group work (27%), freedom to use different tools for the assignment (13%),

and the experience being fun, engaging, and different as well as educational (27%). Some of the relevant comments from the studentsare presented below:

"In the whole three years of my medical science degree, I had never had the chance to use any creativity in any assessments. As a creative person, Ireally enjoyed the chance to apply some of my other less "sciency" skills into an assignment".

"I enjoyed working as a team with my group and understanding the concept of our topic very well, this assignment stimulated our creative side which most assignments I've experienced so far have not. It was enjoyable as my group, and I got to explore animating and programs to help us achieve our video".

"It allowed for creativity that allowed for something different from most other written assessments and gave us a break from report writing. It was an interesting format to work with while still covering all aspects of the pharmacology and health issue. It was much easier to learn via this visual method of presentation and a good way to collaborate with other students".

On question 3 (What did you like least about the assignment?, n=51), students mentioned the time-consuming nature of the task (12%) and the poor availability of equipment to produce the DMP (6%). Eighteen percent mentioned technical problems, and 46% complained about other issues, including not being able to choose the topic, the length of the presentation, issues with specific tools, etc. Eighteen percent of respondents answered'nothing, NIL or N/A.' Relevant comments are below:

"The time is consumed we worked on the assignment for weeks and had to put a lot of hours into making and editing the video. When the group has a mixture of people in it all studying different subjects it was hard to all meet up at the one time as well".

"Making a video without any prior experience or direction. This lead to many of us being worried about the marking scheme when the video is assessed. Not sure on what the ideal outcome would be, not sure on how to convey the idea, with seriousness, satire, or a mix".

On question 4 (Do you have any feedback on how to improve this assignment?, n=45), students highlighted the need for more feedback (16%) and additional training on video editing (22%). Answers also highlighted thedifficulty of borrowingequipment from the university (9%) andthe need for a longer time limit for the video (11%). Forty-two percent of the answers were'no', 'not really' or 'nothing'. Relevant comments:

"The DMP it seemed extremely fluid and was easy to understand what was needed to be done, the assignment allowed students to take control of their learning which I believed got us to be more engaged and keen to produce a good piece of work. It helped in my case in particular that I was quite interested in the topic chosen".

"I personally think that allowing the students to focus on the social issues associated with drug use and prescription results in a much greater level of critical thinking on the issues. It is too easy to ask a student to present how a drug functions. Asking ethical questions, the answers to which aren't clear cut or can be found with a simple google search ensures a greater level of engagement".

On question 5, we received 12 responses, and all were positive. Some examples:

"Really great assessment, again speaking personally, not having any group troubles meant that this assignment was a breeze and a pleasure to complete (something that I would not have seen myself saying about a pharmacology assignment!)".

"Loved this as part of a final assessment for my degree at UTS, it put the cherry on top of a generally enjoyable degree."

"Thanks for the great assignment!! I really enjoyed learning about it and completed it - which is quite rare".
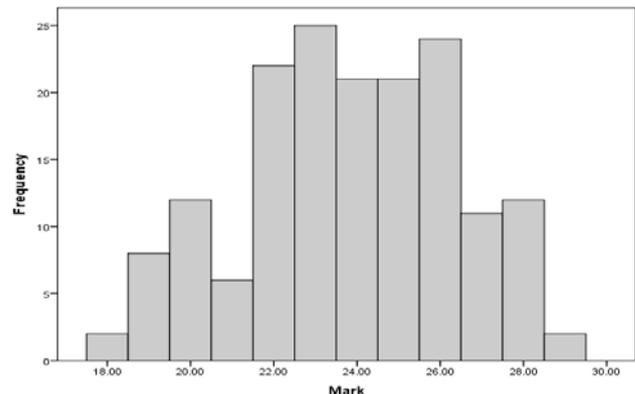
4.7. Group Contribution

We used the SPARKPlus SPA factor to moderate group contributions and identify possible issues. We divided the SPA factor into three categories, Optimum (>1.0), Acceptable (0.9 - 1.0), and Poor (<0.9), to assess team work success. Only nine students (6%) did not participate effectively in their groups (Table 5). The SPA factors were used to produce individual marks.

Table 5. Group contribution in SPARKPlus (SPA Factor)

Contribution	% (n)	Min	Max	Mean	S.D.
Optimum (SPA>1.0)	37 (62)	1.01	1.15	1.04	0.039
Acceptable (SPA=0.9-1.0)	57 (96)	0.91	1.0	0.99	0.017
Poor (SPA<0.90)	6 (9)	0.29	0.86	0.72	0.18

4.8. Grades Attained

Descriptive statistics were used to analyze students' marks [45]. Graph 1 presents the distribution of students' marks for the Digital Media Project. These scores were corrected using the SPA factor and are represented in Graph 1.

Graph 1. Students' marks for the DMP (N=167, Mean=23.75, Std. Dev = 2.77)

5. Discussion

Triangulating the data from the 35-step questionnaire, the group contribution assessment using SPARKPlus (SPA factor), and the grades attained, showed that using DMP as an assessment tool for pharmacology students was a positive experience. These findings are in accordance with previous studies in pharmacology (video)

[46], computer science (screencast) ([19,20]), mathematics (screencast) [23], marketing and accounting (video) [47], accounting (screencast) [21], language studies (screencast) [22], K-12 (video) [32], teacher education (video), ([13,31,42]), and teacher education (storytelling) ([27,28]). Our study is one of the first which uses a mixed-methods approach to evaluating the use of digital media in the classroom. Most of the studies already conducted are restricted to qualitative methodology (surveys). While students' perspectives provide an important data set in educational research, they cannot be relied on solely to evaluate an intervention [48]. For example, research done in the area of online lectures was based on students' perceptions, but a recent study showed that what students report in surveys was not necessarily what they did, so results may not be accurate [37].

The positive results of this study could be explained in several ways. From the demographic perspective, the fact that 96.7% of the students who responded to the questionnaire were aged 18-29 could explain students' engagement with the task. A study conducted on fourth-year pharmacy students in South Australia who were creating digital media reported that 86% of the students were under 25 and had a positive experience with the assignment[46].The age bracket in this study and the South Australian study is of students who can beconsidered 'digital natives' (students born after 1980), and it has been postulated that those students are dependent on digital technologies to find and access information and thus are 'technology savvy' [48]. An extensive study in the USA of 18,000 college students found that high levels of technological hardware ownership do not necessarily predict competent use of technology [49]. The 'digital natives' concept is currently under debate and is not backed by empirical evidence [50].Coincidentally, both the current study and the South Australian study had a large population of females (62% and 78%, respectively).As for self-efficacy in ICT, a study in Finland revealed gender-specific advantages for males for higher ICT tasks and females for internet tasks [51]. Digital Media Production is considered a higher ICT task, so it will be necessary to investigate group dynamics and contributions from males and females to elucidate this difference. If the dynamics are as described in the Finnish study, we would expect women to do more research for the information, and men to get more involved in putting together the digital media presentation. It will be necessary to further investigate gender roles in the dynamics of groups producing DMP, as it could help group formation and lead to better outcomes.

Regarding the 'attitude towards technology' questions, it was evident the participants enjoyed the use of technology for recreational and learning purposes (92% and 86%, respectively). They were also confident using technology for recreational and learning purposes (86% and 92%, respectively), and had a positive general view of technology for recreational and learning purposes (96% and 94%, respectively).Other studies asked students about their frequency of use of specific technologies [46], but this data does not give a clear idea of their attitude towards technology for learning.

Regarding the digital media support (lecture and tutorial), students thought that the DMP lecture was engaging (86%), that it gave them practical skills for the assignment (76%) and that they had applied the concepts learned from the lecture to the assignment (88%). Ninety-three percent of students agreed that communicating thoughts and ideas in the digital world was important. They also agreed that they would recommend the lecture to their peers (84%). Additionally, students thought they needed a better understanding of digital media principles (83%), which could indicate their willingness to receive further training on the topic. Regarding the support in tutorials, students reported that it was valuable for their assignments (83%)and that they used the storyboard to structure their projects (74%). They considered the overall support to complete the DMP to beadequate (85%) (Table 2). Responses to the open-ended questions supported the value of the digital media training given to the students. Twenty-two percent of student responses to open-ended question 4 showed further interest in video editing tutorials. In contrast, the study from South Australia reported drawbacksusing DMP: lack of technical skills (54%), lack of time (67%), issues accessing software (86%), anxiety (39%), apprehensiveness (27%), etc. [46].That study did not train the students in digital media principles. In the present study, 18% of our students reported technical problems completing the DMP, but no other of the drawbacks encountered by the South Australian study. Our better results couldbe explainedby the training which students received, and/orby the support and feedback on their storyboards from the content and digital media perspective.

In the literature on LGDM as an assessment tool, it is very rare that educators train the students in digital media principles. There are assumptions that students are ahead of educators in the use of technology ([31,47]), and even claims that students have already mastered the technology in their daily lives [48]. Evidence indicated that many students might be 'tech savvy', but 50% of them have never edited a video or created a website [52]. Students who were not comfortable with video equipment and editing software reported frustration and were less likely to enjoy the task [47]. Our view, constructed from a combination of digital media background and pedagogy, is that owning technology and being able to use the applications does not necessarily foster an understanding of digital media principles. To create engaging online content, these principles (section 3.2) need to be understood and applied effectively, and this takes time and practice [53]. Asking students to produce digital media and not training them in these principles is like asking them to write an essay and telling them that grammar does not count. The fact that the instructor supports the students in digital media principles could further engage them with the task. Thishypothesis can not be confirmed with the data sets gathered from the current study. Focus groups may be required to ask students what they thought about this support, without restricting their answers to a Likert scale. On the other hand, the rubric to mark the assignment included the digital media principles, and it was clear that students followed these when watching their digital presentations uploaded onto the UTS Pharmacology YouTube channel.

Obviously it is challenging for educators to train students in digital media principles, a specialized area that people with industry experience will understand the best. This challenge is probably the main reason why training

students in digital media principles is not happening in disciplines outside media and design courses. We identified the need to produce a conceptual paper on digital media fundamentals for educators and students to help further engage and develop their digital media skills. These skills are highly valuable for the modern scientist as journals, such as JoVE (*Journal of Visual Experiments*), are adopting the video format to explain findings.

In the survey section about the assignment, students believed the instructions were clear (88%), the timeframe to complete the task was adequate (99%), and that they were overall happy with the DMP assignment (89%). Clear instructions probablyhave a positive effect on the overall experience. It has been reported that students can develop a negative attitude towards technology in blended learning environments when the tasks are not communicated properly, and confusion is created[7]. Students need to buy-in to the task to ensure success, as is reported in other technology-enhanced learning interventions such as the 'flipped' classroom [9].

Students' perception of DMP contribution to skill development was also positive. Eighty percent of them thought the DMP helped them to understand the topic, while 78% and 88% thought it helped them to develop critical thinking and communication skills. These results couldbe explainedby the fact that, while designing and producing digital media, students are meaningfully engaged on many levels as the authoring tools enable interaction with content knowledge in multiple ways [31]. Students needed to conduct background research before storyboarding the content and producing their DMP. Thesemultiple levels of engagement have been shown to be useful for students' learning and provide what is called in cognitive science a 'self-explanation effect' [13]. The qualitative comments in the open-ended questions support these results. The question about issues with assignments showed that students engaged with the task and understood the need to do this more often to improve digital media skills. Only 15% of students reported problems (audio, editing, and uploading). In contrast, a study that used LGDM in teacher education reported that most of the students found the task technically challenging [42]. Our research did not identify problems of this nature, perhaps because we trained the students in digital media principles. The second comment presented above for open-ended question 1 showed a confused student questioning the need to include the pharmacological concepts in the DMP, and we realized we did not brief the students on their audience. We are targeting the next iteration to two types of audience, health professionals and consumers. In both contexts, it will be required that the DMP explain how the drug/medicine works in language suitable for the audience. For the second open-ended question, about what students liked about the assignment, it was clear that students liked being creative while learning (33%).This result is in agreement with the results of the South Australian study on the pharmacology DMP, where 65% of students stated that creativity was one of the things they enjoyed about the digital media assignment [46]. Our findings are also in agreement with a study conducted on marketing and accounting students, where they created videos as an assignment and reported appreciation that they had an opportunity to exercise personal creativity [47]. Being creative allows students to consider different ways of representing content, which promotes higher order thinking [31]. Social interaction and creativity in explaining science have been reported to be beneficial in learning science [13].

Analyzing the SPARKPlus data (SPA Factor), on individual contributions to groups undertaking the DMP, also shows a positive outcome. Only 6% of the cohort had some issues with group work. Analyzingqualitative data, the issues seemed to be reported by students who were hard to contact, did not come to meetings, and who waited until the last minute to contribute. Fifty-seven percent of students had only an acceptable SPA factor, which means there is still room for improvement. Thirty-seven percent had an excellentteamworkSPA. SPARKPlus proved to be an excellent tool to supervise group work and assign marks. It certainly can be used tobetter understand group dynamics in digital media assignments. Responses to open-ended question 2 also highlighted the opportunity to work in a group as a positive aspect of the DMP (27%). Peer assessment of group contribution can also be performed using Google Forms, but some manual work needs to be undertaken, and this may not work with large cohorts of students. An alternative is the use of survey tools such as Qualtrics [54].

On open-ended question 3, about what students liked least about the DMP, students expressed their concern about the time-consuming nature of the task (12%), the availability of equipment (6%), the additional feedback (16%), and technical issues related to video editing (18%). These resultswere confirmed in question 4, which requested feedback on how to improve the assignment. Twenty-two percent of students suggested getting hands-on training in video editing. We are planning to implement a tutorial early in the semester on video editing, where students will have a mini exercise in class. The final question requesting additional comments elicited 12 responses, all of which were highly positive.

Grades attained (Graph 1) showed a normal distribution, which reflected the findings of the survey. Studies in the field of LGDM are usually solely based on student attitude surveys and qualitative research. This study is one of the first whichuses methodological triangulation of students' perspectives, group work, and marks attained. It is also one of the first studiesto deliver comprehensive training, by an industry expert, in digital media fundamentals.

6. Conclusions

We believe that the workflow proposed in this research, on how to implement LGDM as an assessment tool (3.1 to 3.7) and communication with students, helped to achieve these positive results. It will be necessary to further investigate students' meaning-making when creating digital media projects in science education. This knowledge could inform the development of a practical framework to implement LGDM as an assessment task which could be used across disciplines. A conceptual paper will be written, targeting academics and students, on digital media fundamentals for LGDM assignments.

Preliminary data showed that the student cohort researched had a positive attitude towards LGDM as an assessment tool. It seems that training in digital media principles could have a positive impact on student

engagement with the assignment. Further research needs to be conductedusing student interviews, and that will be the next step of our investigation.

Learner-Generated Digital Media as an assessment tool is a powerful way to shift students from being consumers of content to being co-creators of knowledge. Producing digital media presentations can be used to promote student curiosity, speculation, creativity, and intellectual engagement ([17,55]). By placing the responsibility for asuccessful learning experience onto students [56], it also fosters graduate attributes beyond disciplinary knowledge, in areas such as lifelong learning, communication skills in the digital world, authentic teamwork, and promoting creativity and innovation.

The current research may be limited by the lack of student interviews in the study. We are planning to use the same approach next semester and to organize focus groups to gain an in-depth understanding of how students learn while creating digital media presentations.

Acknowledgements

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