A Seed for Future Adoption: Mobile-Filmmaking in The Secondary Science Classroom

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ABSTRACT

Mobile learning activities in the classroom offer affordances and strategies to address challenges in science education related to STEM engagement and digital technologies' pedagogy. In this study, we draw on findings from the Science Video Project – where four middle-years'-classes in New Zealand researched, filmed, and edited short informational science videos on mobile devices. Previous research found this project to be a successful method to enhance students' science engagement in the classroom and prepare them with future-ready skills. Utilising established mobile-adoption frameworks, we analysed participants' experiences and how they affected teachers' likelihood of adopting this mobile learning activity regularly. Findings indicate that students across all cases expressed high levels of digital literacy and low levels of *ICT Anxiety* about utilising mobile devices for film production. Teachers exhibited mixed initial concerns with the project regarding their own *Digital Literacy, ICT Anxiety,* and *ICT Teaching Self-efficacy*, which progressed to positive views by the end of the project. This indicates that teachers are likely to adopt such activities in the future, and suggests that this was in part due to students' confidence with the task, as well as the ease and usefulness of implementation. We argue science mobile filmmaking utilises students' existing digital literacy skills, and can act as an easy-to-implement seed project to overcome teachers' concerns about learning with mobile devices.

Author Keywords

Mobile Filmmaking, Science Education, Mobile Adoption, Middle-years' Education, Mobile Learning Activities

INTRODUCTION

Currently, there are international calls for both increased engagement with science, technology, engineering and mathematics (STEM) and integrated digital technologies pedagogy to prepare students for the future in Aotearoa New Zealand (Ministry of Education, 2017; Potvin & Hasni, 2014). The ubiquity of mobile devices, and the myriad affordances that they offer, underpin the importance of incorporating them into education (Crompton, Burke, Gregory, & Gräbe, 2016; Park, 2011). In New Zealand, mobile learning activities also support the new Digital Technologies Hangarau Matihiko Curriculum which is expected to be implemented as a linking strand across all content learning areas by 2020 (Ministry of Education, 2017).

Learner generated digital media has to ability to utilise these cross-curricular skills and foster student learning and engagement (Kearney & Schuck, 2005). Student-made 'slow-mation' videos utilising cameras and desktop software have previously been found to engage students with science and aid learning (Mills, Tomas, Whiteford, & Lewthwaite, 2018). With the rise of smartphone and tablet technology, this has paved the way for mobile filmmaking where students can plan, edit, and record short science films on a single device (Martin, Davis, & Sandretto, in press). While positive experiences have been reported for students' engagement with science mobile filmmaking, sustainability and regular adoption by teachers ultimately determines the value of such activities.

The Science Video Project (SVP) was designed as a mobile learning activity for middle-years classrooms (ages 11-15) to address the dual challenges of science engagement and incorporating digital technologies into the secondary classroom. Here we investigate the classroom experience and likelihood of teacher adoption of mobile filmmaking in the secondary science classroom. Our research aimed to answer the following questions:

1. What experiences did students and teachers have in the classroom utilising mobile devices during the Science Video Project?
2. How does the experience of conducting a mobile filmmaking project in the science classroom affect teachers' likelihood of adopting mobile learning activities in the future?

ADOPTION OF MOBILE LEARNING ACTIVITIES

When estimating the likelihood of incorporating a new information and communications technology (ICT) into their teaching, Davis, Bagozzi, and Warshaw (1989) suggested two original factors within their Technology Adoption Model. *Perceived Ease of Use* related to the educator's feelings on how simple it was for teachers to use the new technology. Similarly, P*erceived Usefulness* corresponded to the degree of worth of a particular activity for the teacher and their students. This original model has since been extended to better reflect the factors effecting the adoption of mobile technology specifically, including *Digital Literacy*, *ICT anxiety*, and *ICT teaching self-efficacy* (Mac Callum & Jeffrey, 2014). *ICT anxiety* describes the level of worry or discomfort that teachers have about using mobile technology for learning (Bitner & Bitner, 2002; Mac Callum & Jeffrey, 2014). *Digital Literacy* corresponds to the level of an educator's skills in using technologies, and in this case, mobile technologies specifically (Hasan & Ahmed, 2010; Markauskaite, 2007). Finally, *ICT teaching self-efficacy* describes the ability of an educator to effectively implement the use of a particular digital resource in their classroom (Celik & Yesilyurt, 2013; Teo, 2009). In this study we focus on teachers' development of all five of these factors to investigate any changes in their likelihood to adopt mobile technology in to their classroom.

METHODS

Background to the Science Video Project

The activities within the SVP are underpinned by multiple learning theories, like many mobile learning activities (MacCallum & Parsons, 2016). Primarily the project is built on constructivist and situated cognition theories that have students learning through the creation of their own digital artefacts with their peers (Parsons & MacCallum, 2017; Wang & Shen, 2012). The goal of the SVP was to have students utilising their existing mobile technology skills to produce a short (<4 min.) science video on a mobile device. The project was carried out during normal class times, over a series of four filmmaking sessions (Table 1) guided by the regular classroom teacher. This type of activity has been shown to be effective with tertiary students, but little evidence exists for its use in school science classrooms (Clarkson, Houghton, Chen, & Rohde, 2018; Speed, Lucarelli, & Macaulay, 2018).

Session	Activities
1 – Preparation	Students have a 'Film Screening' of exemplars of the four main types of informational science videos.
2 – Building a Story	Small groups choose a topic, research, and storyboard their movie.
3 – Filmmaking	Students film and edit together their short movie.
4 - Filmmaking	Students film and edit together their short movie.

Table 1. The Science Video Project. Teachers implemented these lessons over four approximately 1-hour class periods. Teachers were allowed to adapt the project to their curriculum/content area.

A set of 16 iPads with iMovie and Camera apps were provided for the duration of the SVP from the researchers. While ultimately the goal of this kind of project would be to use students' own device in the production of short film, standardisation of the devices in these exploratory case studies allowed for comparison between students, classes, and schools. Most classrooms had access to other devices such as students' own mobile devices, laptops, or Chromebooks whether these were devices brought to school because of the school's Bring Your Own Device (BYOD) policy or school devices. Because students would typically have access to these devices for a class project, we allowed students to utilise them for research purposes only if they wished to. All filming and editing was conducted edited using iMovie for iPad.

Participants

The participants in this study were the teachers and students in four middle-years classes in an urban centre in New Zealand. Two classes were chosen at Year 8 (ages 11-13) and two at Year 10 (ages 14-15). Year 8 is the last year of primary school, and represents the transition into high school. Year 10 students represent those who are in the process of making their course decisions for senior studies where they have the opportunity to opt out of courses such as Science or Digital Technologies. Classes were selected purposively to capture student and school diversity in New Zealand (Table 2).

School [Year]	Age	Distinctive Factor(s)	'Science' Taught By
Moana College [10]	14-15	Single-sex (female)	Science Teacher - A
St. Duke's Academy [10]	14-15	Religious special character	Science Teacher - B
St. Duke's Academy [8]	12-13	Combined intermediate and high school	
Dragon Valley Middle School [7+8]	11-13	Highest % of non-European students in study area	Primary Teacher - C

Table 2. Participating schools (names anonymised for privacy).

Data Collection and Analysis

Student focus groups and teacher interviews were conducted within one week before and after the project during daily free periods such as lunch time or homeroom. Discussion questions on mobile technology adoption centred on five main factors previously shown to affect the adoption of mobile technology (MacCallum, Jeffrey, & Kinshuk, 2014). Excerpts from interviews with teachers and group interviews with students were first identified based on whether the speaker was commenting on the mobile learning experience. These comments were then coded using the Mobile Learning Adoption Framework categories of *Digital Literacy, ICT Anxiety, ICT Teaching Self Efficacy, Perceived Ease of Use*, and *Perceived Usefulness*. Each comment was assigned to one of these categories in addition to a valence of positive or negative in order to indicate the nature of the comment. Coding by these categories then allowed for description of the three case teachers' and their four classes' experiences using mobile devices for filmmaking during the SVP. We classified students and teachers by the proportions of positive and negative comments that were made to give them a Low, Moderate, or High score on the five adoption factors. *Low* represented mostly negative comments, *Moderate* represented a roughly equal amount positive and negative comments, and *High* represented mostly positive comments. The factor *ICT Anxiety* was reverse coded as having high anxiety corresponded to an overall negative adoption outcome, whereas high values for the other factors corresponded to a positive adoption outcome. Researcher field notes while observing the mobile filmmaking project were utilised as secondary sources to provide context while describing case themes and implication.

Code	Meaning When Assigned to Quotes
Digital Literacy +	Confident or experienced using mobile technology for filmmaking.
Digital Literacy -	Not sure how to use technology or very little experience.
ICT Anxiety +	Strong comments showing a heightened concern for using devices and naming problems that were expected to arise.
ICT Anxiety -	Openness to trying to use devices and an overall feeling of the project running smoothly.
ICT Teaching Self Efficacy +	Expressed confidence that they could successfully implement the Science Video Project or other mobile learning activities. (Teacher's Only)
ICT Teaching Self Efficacy -	Concern that they could not effectively implement the Science Video Project or other mobile learning activities.
Perceived Ease of Use +	The devices and software were simple to use for filmmaking.
Perceived Ease of Use -	The devices and software were difficult to use for filmmaking.
Perceived Usefulness +	Mobile devices generally, or the Science Video Project in particular, were described as being beneficial in some way.
Perceived Usefulness -	Mobile devices generally, or the Science Video Project in particular, were described as ineffective or not beneficial.

Table 3. Code meanings used for describing student and teacher interviews.

Consent and Ethics

Before beginning school recruitment, the following ethical considerations and plans were approved by the University of Otago Human Ethics Committee. Classes were initially contacted about participating in the Science Video Project through school administration with approval from the school principal. Teachers interested in participating gave their consent for the project to occur in their classroom, and to have their interviews audio recorded. As all participating students were minors, consent was obtained by their parent or guardian to participate in the project. An information sheet was provided detailing the extent of data collection (video, audio, and researcher field notes). A selection of students were also involved in group interviews, which required additional consent to be obtained so that they could participate in this process with the researchers and have their responses audio recorded and transcribed. To protect the identity of all participating schools, teachers, and students this research account utilises pseudonyms or code names.

FINDINGS

Below we describe teacher and student experiences of using mobile devices for a science mobile filmmaking project in relation to five factors known to affect the adoption of mobile technology. Student responses were consistent across classrooms and ages, so are presented together. A summary of the key themes and developments during the project are summarized in Table 4.

Adoption Factor	Students	Teacher A	Teacher B	Teacher C
Digital Literacy	High	Moderate	Moderate	High
ICT Anxiety	Low	Moderate	High > Moderate	Moderate
ICT Teaching Self Efficacy	N/A	Moderate > High	Moderate > High	High
Perceived Ease of Use	High	Moderate > High	Low > High	High
Perceived Usefulness	High	High	Moderate> High	High

Table 4. Summary of Findings. Low, Moderate, and High correspond to the level of a particular adoption factor. Where there was a change in level between the beginning and end of the project, the two levels are listed separated by a ">".

Students

For all students across the four case classrooms, *Digital Literacy* in respect to the skills required for making a film on a mobile device was very high. They also found devices generally useful as they offered more portability and functionality than a laptop or netbook. While using devices for research was the most common classroom activity, most described previous experiences in and outside of school where they had made their own videos before. These videos were often described as being part of a classroom activity, for fun in their free time, or via social media. Their technological skills were also revealed when they were asked how they would attempt to overcome a filming or editing challenge on the iPads:

> *Student 3A: Ask someone who knows. I'm sure someone would know.*
>
> *Student 2A: Search it up?*
>
> *Student 4A: I would Google it, yeah.*
>
> *Student 1A: There's probably like, a YouTube tutorial on how to do it.*
>
> *Student 2A: I would probably Google it first though.*
>
> Moana College Students (Female, ages 14-15)

> *Student 2C: We have three people from our class that always edit our stuff before Assembly so we could just ask them and get them to teach us, or go to YouTube or something.*
>
> *Student 3C: Also, there are icons you can see, that show a little drawing of it [help menus].*
>
> Dragon Valley Students (Mixed, ages 11-13)

Here students from different schools and different age groups offer numerous strategies for finding a solution to a technology problem such as searching the internet, looking for tutorial videos, consulting help menus, or asking their peers; none of which relied on their teacher. Students from other classes echoed these strategies, and in one case (St. Duke's [10]) even found it mildly humorous when asked if they would consult their teacher for help. Overall, students predicted that making a video on the iPads would be quite easy for them to accomplish, and found this to be the case.

While not worried about the technological skills required to produce their films, students did express a few comments reflecting a low-level *ICT anxiety*. These comments mainly centred on their peers not being able to successfully focus and do their work because of undesirable behaviours when using devices. Based on their previous experiences, they felt that some students misbehaved when using mobile devices but identified this as a personal choice of each student to act appropriately or not. As different students described when asked what challenges the class might face:

Student 4A: If they actually want to learn, they're going to use them the right way

Student 1A: It's their fault if they're on their phone the whole time.

Student 3A: When you're doing it properly, its actually really good. It works really well. But when you're abusing it, it doesn't work.

Moana College Students (Female, ages 14-15)

Student 2B: People won't end up doing it I reckon.

Researcher: You don't think people will finish?

Student 5B: Yeah, cause like some people in our class will just muck around.

St. Duke's [10] (Mixed, ages 14-15)

While the student's participating in the group interviews did not express anxiety that that they *personally* would have these challenges, they did predict that some in their class would struggle. This indicates that while they do not personally experience *ICT Anxiety*, they are accustomed to witnessing negative outcomes in some cases when using devices.

Teacher A: Open to Trying

The teacher at Moana College regularly taught general science for senior high school classes (ages 14-18). She described herself as having average technology skills generally but little experience with mobile filmmaking. She occasionally allowed students to use mobile devices for research, but with recent school restrictions on websites and devices put in place, she tended to rely on their set of school netbooks. While she recognised that portability and a camera were benefits of using devices, concerns over inappropriate device usage had kept her from using them more often in class. Before the project, she felt that she could trust the particular class conducting the project, but when asked about her other classes she commented:

> *Teacher A: ...In another class I could imagine a few girls getting a bit distracted with the technology, because maybe they're not as mature. That would be the main thing with other classes. Or take videos of each other when it wasn't actually appropriate to do so. And then they might share it on their 'stories' or whatever they do with that Snapchat stuff.*

These comments are indicative of a higher level of concern over whether any class would have negative outcomes when using mobile devices for learning. Related to this was some concern that she was not personally confident in movie making on the iPads. However, she felt confident that the students would know what they were doing. When asked whether this was the case during the project, she described:

> *Teacher A: Yes. Oh, yeah. No one asked me anything about iMovie. No one. They just did it, they just knew. Yep, so that was cool.*

By the end of the project, she felt confident to conduct a similar type of activity again in the future. Seeing students' own skills with filmmaking would allow here to focus on developing the project as a form of assessment, as she described:

> *Teacher A: I would really like to use it as a tool, as a form of assessment... Imagine if we had class set of iPads, and we could learn a topic, and at the end you and your group come up with a plan of sharing all this information that you just learnt, in an interesting and exciting way. Obviously have a written part, like a script or a plan, and then make a video. How cool would that be? Getting assessed like that... Instead of sitting and doing a test for an hour and freaking out about it. That's how I'd like to carry on with it.*

Teacher B: A Mobile Critic

The teacher at St. Duke's conducted the project with two of her classes, one at Year 8 (12-13 years old) and one at Year 10 (14-15 years old). She did not find technology challenging in itself, but did not have extensive experience with mobile filmmaking. She showed enthusiasm for the project, but had previously attempted to implement a mobile learning activity where students made videos on their mobile devices. This previous attempt had been more trouble than it was worth, so she was wary of the SVP's benefits.

Teacher B: I find for the amount of effort, you don't seem to get anything better that what you would in a poster...the quality isn't that much better, but maybe that's experience and knowing how to get it to run properly.

Researcher: Them [the students] knowing how to get it to run, or you?

Teacher B: Probably both. It's a wee bit outside your comfort zone...if you do sort of a more standard activity that doesn't use a device to record stuff, then they're in front of you and there's a wee bit more of a control thing.

In addition to expressions over how useful the project would be, her comments also seemed to express a concern with handing over control to the students. These comments also highlight how a lack of trust in students using devices was inhibiting her from employing them more often for learning. Of all the teachers, she expressed the greatest anxiety about using devices in the classroom, as she felt that students would not be able to focus or would misbehave.

Unlike the other two participating educators, she had the opportunity to conduct the entire project with two different classes and so could work out some of the challenges she predicted with the project's implementation. When asked how this repetition helped, she indicated that:

Teacher B: It went well, it was good doing it twice, because the second time I was a bit more confident and you knew the pitfalls of the first time whereas if you just did it the first time...It went okay the first time but, it was easier the second time. And I don't think it was the students necessarily probably was just experience with the project... I think it was a really good starting point, and it allows that confidence [to do more].

Overall, she found the project easier to implement than she expected, and enjoyed have the chance to try something new that she had been wanting to attempt for some time, but hadn't had the encouragement to do so:

Teacher B: I guess I was surprised at how easy it was. Like I was expecting it to be really tricky to produce the videos. So, it was good. Cause often you don't get the chance in teaching to have a play with something, cause you're so busy doing reports or marking...it's sometimes hard to find time to do those things. So, it was a good opportunity to have some forced time. And it's something I've been trying to do for a wee while.

With the confidence to try the project again after conducting it twice, and it being easier to implement than she expected, she also expressed a desire to use mobile filmmaking as an alternative form of assessment, similar to Teacher A.

Teacher B: Cause potentially I think it's got really good flow owns particularly for low writing ability kids. So, the kids that are quite strong orally, I think a video provides a really good opportunity for them to explain in a medium they are reasonably comfortable with.

Teacher C: Digitally Experienced

The intermediate teacher from Dragon Valley Middle School was by far the most technologically experienced of the three participating educators. He frequently used different types of devices and software for different learning activities, had previously taught units on movie making at the school, and had used iMovie with his students before to produce short videos. While he was aware of negative outcomes when using mobile devices, he did not present as anxious about these concerns and instead rationally discussed the pros and cons of their use. After describing some behavioural issues that can arise, he stated his position quite clearly by adding:

Teacher C: On the other hand, I'd also add I feel like every kid should have one [a device], have something, access to a device at any time at school. Because that is where the world is at your fingertips there...[devices] are right up to date, so long as they're becoming critical users of that device.

Instead, he saw issues that arise when using devices as deeper behavioural issues for developing adolescents that need to be worked on that we can help them learn to manage. Overall, he felt that devices had the potential to be powerful learning tools, and that it was a great opportunity for students to enjoy building their core abilities that did not rely on writing.

Teacher C: It's a medium they're obsessed with. Y'know...a picture tells a thousand words and a moving picture tells a million... I think because they're motivation tends to be higher

> *through that, and the students who need the most support are often students who find writing a struggle.*

Not only was this teacher confident in his own skills, but he also recognized that his students could do most of the device work independently and even surpassed his own knowledge, and often gave them the opportunity to learn from each other.

> *Teacher C: Using children's expertise, they're better at using those machines than I am these days. They seem to do it on their weekends and that… But watching the kids at work on them is just a whole other thing. They don't have any problems, they're really fast.*

Challenges to Adoption

In addition to the adoption factors presented above, teachers mentioned that device access could affect their likelihood to conduct the project again. iPads were provided by the research team to standardise the experience across the four classes, but may have made the project appear easier to conduct than if educators had to coordinate device procurement and usage themselves. We note that this challenge has two parts; (1) having access to devices and (2) usability of school or student owned devices.

In relation to the challenge of device access, students working in groups of 3-4 only regularly used one iPad. The researchers noted that under half of the iPads available were ever being used at one time, indicating that to be successful the project does not require 1:1 device usage. Teacher C offered the idea that:

> *Teacher C: I think everybody needs a device…you wouldn't need 1:1 but a reasonable amount that you could use for visual text creation that you're doing, cause they're really powerful.*

Here the idea has been suggested that access to a small set of mobile devices would suffice for film production. All three teachers also mentioned that their school had BYOD policies, and could utilise the mix of tablets, laptops, phones, and netbooks that are available. Investigating the impact of utilising available BYOD resources in a similar mobile filmmaking project would be an interesting area of further research.

IMPLICATIONS

In this multiple case study, we have explored the experience of three teachers and four classes of their students using iPads for science mobile filmmaking. While this small sample size does not allow generalisation to all classrooms, the results do offer implications for future research and teaching practice regarding mobile filmmaking and the adoption of mobile devices with middle-years' students and teachers.

Overall, we found that making movies on mobile devices was an easy, enjoyable, and useful activity for students. While they exhibited a few concerns about their peers' behaviour using devices, they were overwhelmingly confident and adaptable with their mobile device skills. The varied prior experiences that the three participating teachers brought to the project reflect how a similar activity can affect technology adoption beliefs differently. Teacher A had mild concerns initially related to student behaviour and her limited technology skills. She was open to trying the project and was excited to find how beneficial it was as a new way of assessing her students. Teacher B held strong opinions against device usage and questioned its benefit to students, but found the project easier than she expected and experienced a new confidence after trying it. Teacher C was already likely to be an adopter of mobile devices in the classroom, and had his views solidified by getting to see his students put their technology skills to use and give them a way to communicate in a manner they enjoyed. Teachers' initial concerns related to *Digital Literacy, ICT Anxiety, ICT Teaching Self Efficacy, and Perceived Usefulness* progressed toward positive views for all factors by the end of the project. This progression indicates a likelihood of adopting this kind of mobile learning activity in the future.

It is our assertion that mobile filmmaking offered three opportunities that collectively allow teachers to experience a successful mobile learning activity which increases their likelihood of adoption. First, we found all students to have high existing levels of *Digital Literacy* and low levels of *ICT Anxiety* with mobile filmmaking, which may not be true for other technologies or programmes. This allowed teachers to bypass concerns about their own *Digital Literacy* and the *Perceived Ease of Use* of the project. Second, giving students an authentic and creative activity on the mobile devices with a timeline kept them from engaging in the kinds of negative behaviours that had been causing *ICT Anxiety* for teachers. Third, a positive experience with trying the project gave (or reaffirmed) teachers' confidence in conducting a mobile learning activity. It is our assertion that starting small with an activity like mobile filmmaking, which grows on students' existing digital literacy skills, may offer teachers the opportunity to simultaneously engage their students with classroom content and develop positive views toward adopting this kind of mobile learning activity.

Future research on students' learning outcomes and video type would further illuminate likelihood of adoption of such a project. This study was limited by relying on teachers' *indication* of continued adoption, so it would be of interest to conduct a longitudinal study into the long-term effects the project, and whether experiences with mobile filmmaking carry over to the adoption of other mobile learning activities in the classroom. While teachers suggested future iterations of the project would be possible with the devices typically available, it would be interesting to investigate the implications of utilising devices owned by the school or students opposed to those by researchers. We also note that while our small sample of teachers represented a variety of standpoints on mobile adoption, there may exist groups of educators with other perspectives which would be interesting to classify in further study.

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