Peer tutoring using student-made screencasts

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While the flipped classroom has found much discussion recently, peer tutoring using screencast resources produced by students has not yet. In this paper, we describe student responses to the approach taken at a secondary Catholic school in Melbourne, Australia, where the mathematics teachers used the roll out of tablet PCs to all teachers and students as an opportunity to shift from teacher produced resources towards student produced resources to enhance student learning. Students were engaged in the production of short screencast videos explaining mathematical concepts. We analyse student feedback from a survey issued to all students, and focus our analysis in particular on: identifying where students go for assistance in mathematics; what benefits they see from creating these screencasts and also from watching screencasts produced by their peers; and who should create screencasts—students or teachers or both. While many students do recognise there are benefits for them, responses seem to indicate that they may not be ready to embrace student-centred education without significant guidance from their teachers and with a shift away from current perception that the teacher should do all teaching as this is what they are paid for.

Introduction

The study of mathematics often polarises secondary school students. Whilst some students thrive on the mathematical challenges presented, others struggle with the subject. Research has shown that this may be due to negative experiences (Frenzel, Pekrun & Goetz, 2007), lack of confidence in their ability (Kesici & Erdogan, 2010) or simply their lack of understanding (Jennison & Beswick, 2010). These issues arise from the outset of early years of education but become more problematic when the students are in secondary school. Students who struggle with mathematics may be able to receive limited individualised attention from a teacher during class time, however beyond this, anecdotal evidence indicates that they often seek further assistance from parents, family friends, private tutors, or by searching for online material.

In one secondary school in Melbourne, Australia, the introduction of technology enabling mathematical handwriting on the computer screen provided incentive to trial an innovative approach. This project was made possible as the school was moving from a laptop program to a pen-enabled tablet PC program, where all teachers and students were equipped with the technology. Students were engaged in the production of resources for their peers. As part of this project the students were to be self-directed, and to take ownership of their learning in the production process. These resources would also improve the availability of mathematical assistance outside of school hours as they were made available online to students, and they would be available to be viewed before classes, that is, to support a flipped classroom approach. This project resulted in 100 Year 10 Advanced Mathematics students creating screencasts on ‘expanding and factoring’.

Our research study was designed to investigate student and teacher views of the value of such an approach. Whilst the mathematics teachers were interviewed, the students were surveyed. In this paper, we focus on the student views. In particular, we investigate what benefits students see from producing screencasts, what benefits they perceive from watching screencasts created by other students, and who they think should be producing screencasts to assist with the learning of mathematical concepts. We were also interested in learning what resources students would usually access for support outside school hours to identify how student created screencasts may complement existing resources that students access.

Literature review

Mathematics is a subject that elicits various opinions from students. To some, mathematics is positive and enabling and to others the subject conjures dislike and hostility (Grootenboer & Marshman, 2016b; McLeod, 1992). This negativity could be contributed to the perception that mathematics is seen as “hard or difficult” by students (Larkin & Jorgensen, 2015, p. 942). For other students, mathematics is generally a positive experience with some topics identified as challenging (Grootenboer & Marshman, 2016a). When students find mathematics challenging or require further enrichment, they often seek further assistance, however the choice of support is dependent on the type of help that is available at any given time.

With technology use on the rise, and “anytime, everywhere learning” (Martin & Ertzberger, 2013), students are seeking alternative ways in receiving mathematics learning assistance outside of the classroom. Both the Kahn Academy (http://khanacademy.org) and YouTube (http://youtube.com) are examples of popular online repositories for no-cost hosting of screencasts[1] or live videos, with a plethora of resources addressing mathematical concepts at all levels (Cargile & Harkness, 2015). Technology has "enabled the amplification and duplication of information" and has assisted in the removal of "physical barriers" to enable the free flow of information via the Internet (Bishop & Verleger, 2013, p. 1).

One of the main difficulties both teachers and students often find in the online space is the ability to navigate through the resources and select one that matches their search criteria both in the terms of content and similar terminology as used in their classroom (Handal, Campbell, Cavanagh, Petocz & Kelly, 2013). If a student is struggling with a concept, it may be very difficult for them to find additional help online unless the creator of the content has used the exact terminology that the teacher has used at school. For example, how will a struggling student judge that a particular topic is the same as the one found on the Internet? Unlike other on-demand resources such as textbooks, screencasts are "dynamic and are perfectly tailored" to the subject that is being taught (Ford, Burns, Mitch & Gomez, 2012, p. 192). We may also ask how well-equipped students are to detect the level of difficulty of a problem that is solved in a video compared to what they are trying to solve as homework?

One solution to assisting students to have access to mathematical assistance outside of school hours and also having resources catered to their individual needs is to have screencasts created. When students access instructional videos, they can watch the development of the solution of a problem over and over again. Studies have found that one of the main advantages of screencasts is the ability to repeatedly view the content when it is needed (Mullamphy, Higgins, Belward & Ward, 2010; Sugar, Brown & Luterbach, 2010). Moreover, positive student outcomes have been identified when using screencasts such as enhanced learning, increased satisfaction, motivation, and engagement (Morris & Chikwa, 2014). It has also been shown that student performance in solving mathematical problems may improve after watching mathematical screencasts (Loch, Lowe & Mestel, 2014). In particular, short screencasts, that is ones that are kept below 10 minutes are preferable as they keep students interested and focused and promote deep learning (Loch et al., 2014; Morris & Chikwa, 2014).

The development of screencasts in a classroom is often associated with the 'flipped classroom' (Bergmann & Sams, 2012). Using the concept of preparatory videos as inspiration, schools and universities have been experimenting with flipping the classroom, where teachers create their own video tutorials (or screencasts) to demonstrate concepts and work through examples – in a similar way to what the Kahn Academy offers. Then, a "flipped" model of learning refers to moving classroom teaching outside of normal class time and using this time to engage with students. Students are expected

1 A screencast consists of screen capture and audio narration.

to view videos that are created by teachers before class and be prepared for a discussion resulting from the work done outside of the class (Bergmann & Sams, 2012; Bishop & Verleger, 2013). One of the primary advantages of screencasts produced by the students' teacher is that students know these resources are "correct" and the teacher uses the same terminology in the screencast as what is used in the classroom, so there is no confusion from the students. Additionally, students prefer materials made by their teacher rather than seeking random online resources (Muir & Geiger, 2016). In a traditional flipped classroom, the teacher is the creator and producer of these multimedia resources (Ford, 2015; McBride, 2015; Yong, Levy & Lape, 2015).

Given there are many studies about the flipped classroom (Clark, 2015; Lai & Hwang, 2016; Muir & Geiger, 2016), where the teacher is responsible for the screencast creation, the researchers wanted to explore how screencasts would be accepted by the students when the resources were peer developed. Peer learning has long been widely used in schools (Topping, 2005) due to the benefits presented such as allowing students to be active participants in the learning process. According to Topping (2005), the students learn the topic more deeply and also develop their communication and listening skills which encourages personal and social development. Student created screencasts allow students to develop technical, personal, organisation and communication skills and encourage deeper understanding of mathematical topics (Croft, Duah & Loch, 2013).

Evidence from studies indicate that students can benefit from using screencasts (Rocha & Coutinho, 2011; Triantafyllou & Timcenko, 2015). These benefits include promoting deeper learning of concepts and procedures and promoting active forms of learning (Green, Pinder-Grover & Millunchick, 2012). Student perceptions about watching screencasts tended to be positive (Bishop & Verleger, 2013; Muir, 2014) however there was limited literature to determine the perceptions of secondary school student's creation of screencasts (Rocha & Coutinho, 2011).

Piaget's theory of cognitive development is recognised for its constructivist theoretical framework, which fosters learners actively constructing their own knowledge through a dynamic classroom rather than one-way transmission of information. According to Piaget (1973) as cited by Green and Gredler (2002), schools "should include spontaneous student experimentation, both independent and collaborative" (p. 56). The creation of screencasts provides students learning opportunities in a constructivist environment, simultaneously using technology and furthering their understanding of mathematical concepts.

According to Savery and Duffy (2001, pp. 1–2), constructivism is categorised by three propositions:

1. Understanding is in our interactions with the environment. What is learned is inseparable from how it is learned.

2. Cognitive conflict or puzzlement is the stimulus for learning and determines the organisation and nature of what is learned. It is the goal of the learner that is central in considering what is learned.
3. Knowledge evolves through social negotiation and through the evaluation of the viability of individual understanding. Individuals are a primary mechanism for testing our understanding.

These three propositions lay the foundation and provide the rationale for implementing screencasts in mathematics classes. They encapsulate the essence of constructivism that learning is constructed by having the learner actively engaged in learning rather than passively receiving information. From this starting point, Papert (1990) developed his own constructionist theory of learning, in which he argued that people build knowledge most effectively when they are consciously building something – whether practical or theoretical. The creation of screencasts, using technology provides students with the medium to develop "deep learning and encourages students to be flexible in their critical thinking and problem solving methodology, be effective communicators, work collaboratively in teams and develop their creativity" (Keane, Keane & Blicblau, 2016, p. 11). These are precisely the ways students are learning as they are creating the screencasts (Croft et al., 2013). In this study, it was determined that students would create mathematical screencasts to demonstrate their understanding of the mathematical topic. The students demonstrate the solving of mathematical equations, step-by-step, and record their explanations using screen capture software on a tablet PC. This approach is supported by the literature around how we learn, as it shows that students learn best when doing and teaching others (Lee, Chan & McLoughlin, 2006).

The student screencast project and school context

Rosco College (name modified) is a male single sex secondary school in the Catholic Education system located in Melbourne, Australia. It has an extensive and well-established one-to-one notebook program. In 2012, the College issued all students in Year 10 with a pen-enabled tablet PC. As the school has always been looking for innovative and productive ways to use the computers and integrate them into the curriculum, the student screencast project was perceived as a welcome initiative by school leaders, teachers and parents. The flipped classroom, or production of video resources by teachers, was not a common approach before the start of our project.

Project initiation

All 100 students in the four classes of Year 10 Advanced Mathematics were involved in the project. Prior to the students' creating a screencast, the Advanced Mathematics teachers created screencasts themselves to understand the interface of the software and lead by example. This allowed the teachers to determine the extent of the complexity of creating the screencast and the issues that students might encounter when developing them. It also allowed them to trial *Microsoft Community Clips*, the screencasting software selected for students to use as it was available for free. The teachers demonstrated their screencasts to the students, providing guidelines and parameters such as the suggested length of time of a screencast (2–3 minutes).

Topic selection and approach

The topic to be recorded by students was chosen by the Year 10 mathematics teachers to coincide with the topic being taught at a specific point in the school year: expanding and factorising. The teachers introduced and worked through the topic and then split the class into pairs and allocated a subtopic to each pair in the class. The range of subtopics included: expanding three factors, expanding the difference between two squares, and factorising quadratic trinomials. The students were given two weeks to clarify the task, and learn and understand the topic with assistance by the teacher. If they had questions, they could seek assistance from the teacher. It was during this two-week period that students had to create the screencast of working through their mathematical problem with voice narration to discuss their approach, and then upload it to the central repository on the school's intranet.

Student-produced screencasts

The teacher then had a 'presentation' week, where each student pair introduced their screencast, and talked very briefly about what they did and any issues they had with the development of the screencast. The students then played their screencast to the class. During the screening of each screencast, the teacher would pause the screencast at various points for a number of reasons. These included highlighting critical points, for example to identify errors, taking questions from the students in the class, clarification, or even extending on the student's commentary so that the teacher could enhance and complement a particular area. Students who were viewing the screencasts would take notes in their workbooks, which enabled them to ask questions as required. The top three screencasts from each class were selected and then acknowledged.

The screencast project was created to allow students to take ownership of their learning and to be self-directed. The project was student driven, as the students taught themselves sub-topics of expanding and factorising and then produced a screencast to demonstrate their understanding. Out of the 100 students who created a screencast, 64 completed the questionnaire on their perceptions. The data collected in this questionnaire is analysed in this paper. The four teachers who taught this subject were interviewed, however we will report on the teacher perspective in a different paper.

Method

The analysis of student perception on their production of screencasts was guided by the following overarching research questions that emerged out of the issues presented in the introduction:

1. Where do students report they go for assistance in mathematics?
2. What benefits do students see from creating the screencasts?
3. What benefits do students see from watching screencasts produced by students?
4. Who should create the screencasts?

The first question was of interest to us to identify how student created screencasts may complement existing resources that students access outside school hours. The researchers were observers and were not directly involved in the project. The researchers' roles in this study were to evaluate the project after screencasts had been created.

Participants

Ethics approval for the study was granted and all appropriate human ethics protocols were followed. Although all students participated in the creation of the screencasts as part of their classroom activity, only those students whose parental permission was obtained were given access to the online survey. This resulted in the collection of 64 completed questionnaires from students.

Research instrument: the questionnaire

A data collection instrument was employed comprising a questionnaire soliciting quantitative and qualitative responses. The questionnaire consisted of 26 questions and was delivered electronically to students once the school notified the researchers that the screencasts were created and that the topic was completed. Students completing the questionnaire remained anonymous and could not be identified. The questionnaire was mainly qualitative in nature and involved a series of open-ended response questions directly relating to the research questions listed earlier. Some of the questions asked included:

- Where do you go for help with maths outside of class?
- How does the creation of screencasts help or not help you in understanding maths topics?
- Do you think students should create screencasts about maths topics covered in class?
- Why should students create/or not create screencasts about topics covered in class?
- Do you think teachers should create screencasts about maths topics covered in class?
- Why should teachers create/or not create screencasts about topics covered in class?
- What are three key benefits to you when you create screencasts?

Free text entries from the student questionnaires were coded and categorised to identify common themes. This qualitative data analysis method was informed by the work of Boyatzis (1998) and Bogdan and Biklen (2003).

Results and discussion

Even though this study focused on Year 10 students creating screencasts in mathematics, the findings are applicable to senior mathematics classes in secondary schools or even tertiary settings. The student screencasting project supports the proficiency strands understanding, fluency, problem solving, and reasoning, relevant to the Australian senior secondary curriculum (Australian Curriculum, Assessment and Reporting Authority, n.d.). The screencast project provided students with the opportunity to work in a constructionist environment and take ownership of their learning by creating their own screencast on a mathematical topic covered in class. Through a questionnaire, students were asked to comment on how they perceived the role reversal of creating the screencast themselves. They were also asked where they normally turn to for further mathematical assistance.

Where do students report they go for assistance in mathematics?

To have a better understanding of where students turned to for mathematics assistance beyond the teacher, students were asked to indicate their sources from a selection and were asked to provide comments as well. This selection did not include the teacher. Students were allowed to select multiple options in this question, and they were encouraged to provide comments. Figure 1 shows that outside of classes, the most popular method of seeking additional assistance was through human to human interaction rather than human to machine interaction, as 65% ($n = 64$, $m = 42$) of students relied on assistance from parents, family or friends. One student wrote that his "mum is a maths teacher, so she teaches me most things again" or others referred to older siblings who had studied senior maths "my older brothers both did maths in year 11 and 12 so they are able to help me when necessary." A small minority of students (5%, $n = 64$, $m = 3$) sought help from a paid tutor because they provide individualised help "they help me to understand more in-depth than when a teacher teaches from the board." Some students preferred the web for answers (14%, $n = 64$, $m = 9$), or watched YouTube videos (22%, $n = 64$, $m = 14$) to assist with their particular needs "I look up exactly what I want to know and the internet provides that information", however others highlighted the limitations "they showed a basic way to do the problem but they did not always have the same form of the equation". Whilst the Khan Academy has an extensive range of mathematics screencasts and exercises, this resource is often cited as a popular go-to site, however students were not engaged with this resource in large numbers (5%, $n = 64$, $m = 3$).

Some students mentioned they relied on their textbooks for assistance, whilst others preferred to email their teachers directly or ask for additional tuition from them at lunchtime. One student stated that "the internet can sometimes help but usually an email from my teacher will be the most useful way." Students sought additional mathematical assistance from the internet because such resources "have helped me to get other ways to understand topics other than what teacher has taught me." Students believed that it further cemented their understanding of the topics and provided them with alternative ways of comprehending the topic.

Students did not just rely on one resource, but generally used a combination of resources to ensure they were able to receive the support they needed. One student stated that he used paid tutoring, sought assistance from family and relied on YouTube as he believed that this level of assistance helped him to develop his in-depth understanding of mathematics further than what he would get in a classroom.

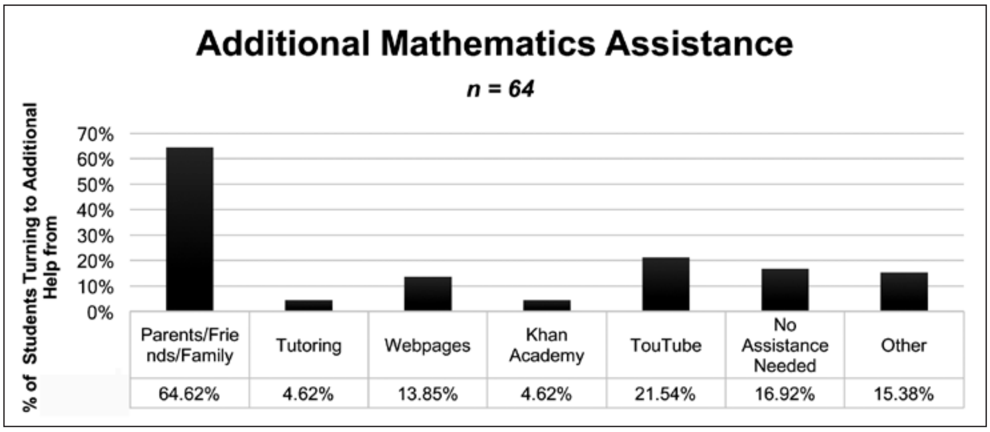

Figure 1. Where do students turn to for additional mathematics assistance outside class?

Overwhelmingly, students preferred to seek assistance through personal and interactive means. That is, students preferred to pursue additional mathematical assistance through human interaction with their parents, family, friends or a paid tutor rather than looking for resources on the internet. Of course this finding is hardly unexpected as Vygotsky (1962) believed that community played an instrumental role in the educative process of knowledge construction. Whilst students established their preference of having two-way interaction when seeking further mathematical assistance, the researchers wanted to know if they could perceive the benefits of using screencasts and how these resources could provide further assistance especially when human assistance was unavailable.

What benefits do students see from creating the screencasts?

Students were asked to comment on what they thought were the benefits of creating screencasts. Four reoccurring benefits students identified from their comments about screencasts were:

- better or deeper understanding of the content (82% of respondents);
- helping others understand (24%);
- using technology (18% of respondents);
- revision/accessibility and repeatability (18% of respondents).

Better or deeper understanding of the content

Traditionally, mathematical classrooms have been teacher-centred with knowledge transmission from the teacher to the student (Brown, 2003; Schuh, 2004). Instead of having a teacher-centred classroom, where knowledge is transmitted by the teacher to the students, the creation of screencasts presented students with the opportunity to construct knowledge by integrating new learning into what they already know. Students found the experience of creating screencasts to be captivating as they were contributing to their learning of mathematics through different ways to what they were used to. Students identified that creating screencasts was beneficial to their learning as they had to understand the topic thoroughly and needed to be confident in describing it. Another student stated that "you learn the topic better as you are revising." Students needed to understand the topic really well before they felt they could explain it as stated by another student: "you have to learn the topic well enough to explain it". Students thought that explaining the topics to others made the topic clearer for them to understand, "the easiest way to learn something and remember something is to teach it". As the screencast was shown to students in their class, they felt the pressure to ensure that the screencast was created to a high standard: "it really makes you learn the required topic inside out because it will be shown to members of the class who you want to impress." Another student reinforced this comment by stating: "You learn while creating them. You feel a sense of achievement when you finish them to a high standard. They encourage you to learn."

Helping others understand

In their reflections on the three key benefits to them, students also thought of the help they were providing to other students through their explanations. This came through quite clearly, in comments such as "It makes me feel good knowing I'm helping", but also looking ahead, a few students comments "helping future students", fully aware that their recordings would be reused by future cohorts. In this way, students were no longer seeing themselves as just the learners, but also as the teachers.

Using technology

As each student had a pen-enabled tablet PC, they were able to create screencasts showing handwriting. Some students were motivated to create mathematical screencasts just by the fact that they had not used their computer for this purpose previously. One student commented, "It's an enjoyable, different approach to maths." Others emphasised the ability to use sound and visuals in their learning. They particularly highlighted that having visual aids assisted them with their learning. One student stated, "It helped as it had a visual as well as a hearing aid explaining how to solve the equation."

Students were able to articulate and identify benefits of creating screencasts for themselves and their peers. The creation of a screencast in mathematics was an innovative approach to learning mathematics in a constructivist classroom. Although students could identify benefits from creating their own screencasts, they were unconvinced that watching other student's screencasts would benefit them.

Revision/accessibility and repeatability

Students remarked that they were able to "watch it [screencasts] over and over again." Students valued the ability to have repeat access to the screencasts they created especially for revision purposes: "I get to create a resource I can easily access for assistance on the topic if I need it". Another student commented "you can look at it whenever instead of having to be at school to get help." Students appreciated the ability to view the screencasts repeatedly as needed at a time and space that suited them. Students also found the experience of creating a screencast assisted with their revision of the topic when there were tangible outcomes: "you gain a better understanding of the topic. Others also gained a better understanding. You can continue to go over it when you need help in the topic." Other students mentioned the advantage of having a recorded resource that could be used "wherever, whenever" and could be reused many times.

What benefits do students see from watching screencasts produced by students?

Whilst students had acknowledged the benefits of creating a screencast, they were less enthusiastic about watching screencasts produced by other students. Only 49% of students selected that they were prepared to watch student-created screencasts. In the open comments, students' views on student-produced screencasts were both positive and negative. Some of the positive comments included that screencasts provided "other explanations on how to solve a problem", and that they "can help to see someone do it differently and in other ways." However, other students felt that watching student-created screencasts was a waste of time, particularly when they themselves had to create the screencast that was to be made available. Pressed further, students were sceptical that the content could not be trusted due to potential mathematical errors or inaccuracies: "I don't trust other students' work, they could have made mistakes." Others still believed that the pedagogical approach of the teacher was seen as superior, and that student explanations were substandard: "some students can't communicate properly and make the presentation seem more confusing." Some students mentioned that the quality of the screencast was important, in terms of explanation and terminology used and this would deter them from watching student created screencasts. Other reasons for watching and not watching screencasts created by students are listed in Table 1. Interestingly, some students remarked that student screencasts had been checked for correctness by the teacher and therefore would be a useful resource. They were therefore prepared to watch those screencasts that had been verified by the teacher and deemed to be correct.

Table 1. Selected student comments on reasons to watch or not to watch screencasts created by students.

Reasons to watch student-created screencasts	Reasons not to watch student-created screencasts
"Their screencast has been checked by a teacher so it is reliable."	"I cannot trust their content to be correct"
"Any assistance is always positive."	"They don't have the knowledge or understanding like the teachers does."
"Students know what they are talking about and they use language and techniques I can understand."	"Other kids get things wrong just as much as me."
"It can help to see someone do it differently/in another way."	"Depends on the type of student they are."
"It might help me and maybe give me an easier way to solve something."	"Other student's screencasts are so confusing."
"To see how other students solve the problem."	"I don't think they would be thorough."
"I can see the way they approach it and revise if I miss a lesson."	"They are not well done and hard to understand."

Even though there were mixed reactions about whether students would be prepared to view and use peer created screencasts, the question was then posed to the students as to who should create the screencasts.

Who should create the screencasts?

Students were asked two multiple-choice questions with the options of selecting yes, no, or no preference. The first question asked if it should be students creating screencasts about mathematics topics covered in class. The second question asked if it should be the teachers creating such screencasts. Students were divided over who should create the screencasts.

Over a third of the students (37%) believed that students should create a screencast about mathematical topics covered in class, the same percentage disagreed and stated they shouldn't and the remaining students had no preference. Many students believed that the creation of screencasts by students was a "waste of time" however equally there were many supporters who could see the benefits of creating a screencast. Those who were in favour of creating a screencast acknowledged that it assisted them with their learning and understanding of the topic whilst using technology. They also referred to being able to go back to these resources, as needed, especially when they needed assistance outside of their mathematics classes. Table 2 lists some student comments in relation to whether or not students should create screencasts.

Table 2. Selected student comments on why students should or should not create mathematical screencasts.

Students should create screencasts	**Students should not create screencasts**
"It can explain the topic from a student's point of view."	"The teacher knows more than the student and they should do their job and teach us"
"It helps us to understand the topic better by getting us to explain it to others"	"It shouldn't be up to the student to teach themselves, the teacher should still conduct their job"
"They help you learn while you make them. They helped me understand things a lot better."	"Students may not fully understand the topic they are trying to teach"
"It allows you to understand and learn more about the topic when making it."	"I spent more time on it than I should have and this affected my understanding of the other areas of the topic.

Asked if the teachers should create screencasts, 70% of students responded yes, the remaining students were equally split between having no preference and teachers not creating screencasts.

In the open-ended comments, some students believed that it should only be the teachers creating screencasts. Students voiced some very strong opinions on why the onus should be with the teacher. One student stated, "It doesn't help because it takes away the point of teaching. We had to make our own mathscasts[2] without assistance, hence defeating the purpose of school." Others preferred it when their teachers created the screencasts as they were much better at explaining, and they thought learning only occurred when teachers explained and presented concepts. Moreover, screencasts were seen as "no substitute for a good teacher" and "the teacher knows more than the student and they should do their job and teach us", placing more confidence in their teacher's mathematical ability than their own. One student commented: "Let the teacher do the teaching." As it was the first time that students at this school were asked to create their own mathematical screencast and share the resource, the researchers felt that the students were not prepared to fully accept peer created resources. The students saw the teacher as the sage on the stage, not the guide on the side (King, 1993). They resorted to their default position that the teacher is the most knowledgeable person in the classroom and s/he transmits this information to the student.

2 A mathscast is a mathematical screencast.

Conclusion

In this paper, we have provided an analysis of student views on the value of student-produced screencasts. The screencast project offered the students the chance to take ownership of their learning by creating their own screencast on a mathematical topic covered in class. Students were encouraged to create screencasts so they could demonstrate their understanding of mathematical concepts but also have a resource they could use outside of the classroom. It provides students with opportunities to not just engage in deep learning, but as importantly, to practice communication of mathematical concepts.

Our investigation into what resources students use for assistance in mathematics resulted in a clear majority of students stating they rely on human interaction rather than online support. This may be the case because Rosco College had been new to the integration of instructional video for teaching mathematics and students were not used to the availability of videos targeted to their studies. We expect that the availability of the screencasts created by teachers and students from this first year of trialling student-produced videos will be the first step towards a paradigm shift to extend human support to online support.

The concept of learning from mistakes, including learning from mistakes made by peers, seemed to be unfamiliar to the students to comprehend. Not one student commented that they may have learnt from seeing an incorrect explanation in a student-produced screencast, although some acknowledged that the teacher had checked the screencasts for correctness. On the contrary, many commented negatively that student-produced screencasts had contained mistakes and were not to be trusted, and that it was the teacher who should produce screencasts to make sure their content was correct. The expectation from the students was that the teacher's role was to teach, and the student's role was to learn from the teacher, and not from their peers. Perhaps further communication and direction from the teacher explaining the benefits of learning from mistakes could overcome the students' negativity towards screencasts produced by their peers. This is an area of research that requires further investigation, for example via student interviews.

None of the students pointed out that they were learning how to explain a concept, but there was recognition that deep learning was occurring as a prerequisite to being able to explain a concept. Students complained that some of the explanations in the screencasts created by their peers were confusing. Such examples could be used to highlight good practice in communication mathematical explanation, from which both the students who produced the screencast and the students who watched the screencast would benefit.

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