Integrating ICT through multimodal discourse in a primary classroom

Abstract
Most children talk to their parents about what they learned at school. Parents hear about books read, pictures drawn, stories written and games played. But how often do parents hear of children using ICT to make multimedia stories with a mathematical focus? In this paper the term “multimodality” will be used to describe such activities. Kress (2004) states that multimodality “deals with all the means we have for making meanings – the modes of representation – and considers their specific way of configuring the world.”

Although digital technology is now available in most Australian schools, classroom use of such technology is not always creative and meaningful for learners. Recent state and federal government initiatives provide teachers with opportunities to integrate various digital technology applications into their classroom practice. In late 2011 a small research project was conducted with a class of Grade 4 students from an outer suburban Melbourne government school. As part of the project students planned and produced a multimedia artefact that explained some aspect of mathematics they had learned during the year.

This paper outlines the planning and production of the multimedia artefacts created by the students, together with a brief discussion of some impediments to teacher use of technology that were identified by teachers at the school. Other issues considered include assessment and reporting in multiple subject areas based on one piece of student work, and the balancing of the relative importance of subject areas in integrated projects and tasks. The authors argue for the development and deliberate inclusion of integrated multimodal activities throughout the primary school curriculum.

INTRODUCTION
There is currently a lot of software available to educational institutions that allow students and teachers to make use of several modes of multimedia to do such things as write stories, create animations, and make presentations. When they use these types of software students are representing ideas, facts, and concepts through combinations of written and oral text, moving and still images, colour, and sound. An example of the use of this type of software with primary school children will be presented. Although English language, art and technology have to be involved by definition, in this report the focus will be on the representation of mathematical concepts with software capable of animation and movement.

In the early 1980s versions of Logo software became for the Apple II and other computers being tried in schools. Contained within Logo, but not necessarily overtly obvious, were a multitude of potentially mathematically rich products and activities that were rarely, if ever, used to their fullest extent. Almost a decade ago the introduction of visual geometric software such as Cabri-geomètre into mathematics classes launched teachers into the world of dynamic representations of material that had been presented for thousands of years in a static, linear two-dimensional way. Sutherland (1995) suggested that ‘some pupils are unsuccessful with school mathematics... because they cannot communicate their visual ideas’ (p. 80). She goes on to note that the converse is also true, as those successful at mathematics seem to be good at expressing their mathematical ideas in natural language and maybe their visualising skills have atrophied (p. 80). Research into the use of animation (dynamic representation) for learning has produced results indicating positive effects on learner understanding, negative effects, or no effect at all (Ainsworth & Van Labeke, 2004).

In December 2011 some nine and ten year old children were set the task of selecting a piece of mathematics and then representing it in a multimedia artefact. An example of the use of this type of software with primary school children will be presented. The same concept will appear again a little later to exemplify (p. 80).

Some of the problems associated with the various modalities the students worked with as they attempted to represent their interpretation of a mathematical concept are discussed in this paper.

Background
Some of the earliest versions of Logo software predated desktop computers with screens. In these versions the Logo ‘turtle’ showed movement by printing a series of asterisks on paper. With the advent of desktop computing the turtle drew lines. When the drawing facility was turned off it was possible to explore elementary forms of movement that eventually developed into computer animation. As long ago as 1987 Papert argued that teachers and researchers needed to focus on understanding what learners do with technology and place this understanding in perspective. Papert (1987) warned against asking questions of the form ‘What is the effect of computers on cognitive development?’ He labelled such questions as ‘technocentric’ and argued that this approach placed the most important components of education, people and cultures, in roles that are secondary to the technology. One of the aims of this paper is to focus on the learners and not the hardware or software that they used. The same concept will appear again a little later when recent research on animations is examined.

The research being reported on involved young learners using computer software to describe some aspect of mathematics they had learned through the creation of an artefact using a specific example of animation software. In this brief look at some previous relevant educational research it will become clear that there are multiple definitions and meanings for animation. Ainsworth (2008) employs a general definition from Bertrancourt & Tversky (2000) that defines an animation as being a ‘series of frames so each frame appears as an alternation of the previous one’ (p. 313). It is also presumed that in animations produced by young learners the notion of ‘success’ includes a creative and meaningful activity that is effective in communicating an interpretation of a mathematical concept.
learners the motion is a simulation or representation of an object, unlike a video which shows real object moving.

In their five years of schooling the participants in this research project had not previously been asked to produce an animation. While the children were exploring the software they were shown how to make objects move around a screen and to make multiple pages that played in sequence as an animation. However, deliberately they were not told they had to make a series of pages with minor differences that could be played as an animation. While such an animation was possible with the software being used, no one attempted to do this. Discussion with students after they had worked on the computers indicated that they took animation to mean movement of an object across a screen, and consequently no one produced an animation that really fitted the definition given above. It is possible that this reflects changes in what is possible with software now available in schools.

In this research project the most important questions related to whether the use of animation software helped the learners to demonstrate their understanding of a piece of mathematics, and whether this provided some evidence of such understanding to their teacher. Considering the research then available, Ainsworth (2008) concluded that the question ‘Can animation assist learning?’ is inappropriate and should not be asked. To support this she presented evidence of the existence of at least six levels or types of explanation that need to be considered when investigating learning with animations. Without going into detailed descriptions of these levels, two are noted as examples. Representing activities in a specific sequence, the expressive characteristic can be assisted through animations. This characteristic is often present and necessary in mathematics. In contrast, there is little valid evidence that animation assists the metacognitive characteristic. Researchers most often look for links between metacognition and representation through learner drawings, annotations and notes. Ainsworth notes that ‘animations may produce an illusion of understanding that can interfere with successful learning’ (p. 61).

The project
As a method of offering a clear description of the project and its outcomes, the task set for the Grade 4 participants will be outlined and then the work of two students will be analysed. In order to maintain the anonymity of the two young participants the pseudonyms Kylie and Rhianna will be used.

Task
In a previous project (Jones, 2012) students had been set a very directed and specific task and were given some software resources specially designed for the task. For the project reported on here it was decided to give as much control as possible to the student participants. Initially the plan was to set a hypothetical scenario and limit the mathematical topics students could work with. The hypothetical scenario was that a member of the class had been absent when a mathematical topic had been introduced, and the task was to create an introduction to the topic for this person using a nominated piece of software. Eventually this was dramatically simplified, with the students being asked to choose a mathematical topic that had been covered during the year and then create an explanation of part of that topic using a simple computer program in which it was possible to create various forms of movement, sound, and text.

Before the task was presented to the students they were introduced to the software. Initially the software was only available on the computers in the school computer room. There were enough computers for each student in the class to work on their own at a computer. Following two sessions in the computer room and prior to the students commencing working on the task, the software was also made available on the six desktop computers in their classroom. The reason for this initial set-up was to allow the students to be introduced to the software through a combination of free exploration and directed investigation. The idea of encouraging exploration, both with something new and as an integral part of the learning process, is in line with ideas proposed by Bruner (1974). In part this was achieved by the teacher asking open ended questions, encouraging the students to explore features of the software that took their interest, and then having several sessions when ideas and discoveries were shared.

Once the students had spent some time working with the software they were introduced to the task. As part of a whole-class discussion and brainstorming session several mathematical topics were listed. Two topics were selected and then each was broken down into its important components. At the conclusion of this session students were asked to prepare for the next session by selecting the mathematical topic that they were going to describe using the animation software.

Before students were permitted to start the computer-based part of the task they had to outline their intentions on paper in the form of a storyboard. As noted earlier, the work of two students will be presented to assist in the discussion of research project. The storyboards of these two students are shown in Figures 1 and 2 above.

![Figure 1: Kylie's storyboard](image1.png)

![Figure 2: Rhianna's storyboard](image2.png)
Outcomes

Every student completed a storyboard – some were vague while others were detailed and explicit. While every student commenced the computer-based part of the task, not all produced a completed artefact. During follow-up discussions almost every student commented that they could have completed the task or have added more features if they had been given more time. Because this was planned as a study for a larger project, completion of all the artefacts was not considered essential. The teacher thought it could be a good experience for the students to have to work to a tight schedule, and so no additional time was allocated.

When they began working on their storyboards the students were reminded that it was meant to be an outline of what they planned to produce with the software, and when they started working on a computer they could change anything except the mathematical topic. As a result there are varying degrees of correlation between the storyboards and the computer artefacts.

The artefacts ranged between three and six computer ‘pages’ related to the chosen mathematical topic. In addition most also had a title and a final screen. Some students incorporated the mathematical content into a story, for example selling cats, or sharing things such as marbles, apples, and a pizza. Other students presented the mathematical content as a series of facts or processes, including conversion of metric measures of length and multiplication tables. The four mathematically related pages of Kylie’s artefact are shown in Figure 3.

As can be seen in the example above, the software allowed the use of text at the bottom of a page. The software also allowed text to be placed in a speech bubble, which was used by a few students. It was also possible to add sounds, both from a given set and by importing sound files in an appropriate format. The software also permitted sounds or voices to be recorded and attached to a shape or page. Several of the students included sound effects in their artefact, although none of them made their own sounds or recorded their own voice. The limited time allocated to complete the artefact is most likely the reason why few students incorporated sounds and voice-overs into their work.

Analysis

In this section consideration will be given how the animation products produced by two students could be analysed, evaluated and then reported. First a traditional approach will be presented, then research and ideas about multimodal evaluation will be discussed, and finally the students’ work will be analysed from a multimodal perspective.

Traditional evaluation

One educational ICT issue that many systems, schools and teachers have not yet mastered is how to evaluate and assess an artefact developed by students on a computer or with other technology. Traditional practice has been to evaluate such an artefact in terms of a single curriculum area. Thus a poster about geometric shapes, whether produced by hand on paper or on screen using computer graphics, would be evaluated in terms of the mathematics curriculum, with no credit or evaluation given artistic merit, language use and facility, or any other non-mathematical subject matter. In 2012 this approach is still widely used, and consequently when students produce artefacts using computer software the artefact is evaluated and assessed for the subject area in which the task was given, but not for ICT as well.

Multimodal evaluation

The traditional approach to evaluation outlined above is argued against by teachers who use multimodal products as integral parts of their teaching, and by researchers in the area. Reports over many years from researchers investigating the integration of multimodalities and digital literacy in general into school classrooms have raised issues concerning the assessment of students working in these new modes. Some of the questions that have come up in terms of evaluating and assessing student work include:

- Can a voice-over in an animation be compared with written text?
- Should students produce the voice-over and the written text for assessment purposes?
- Can an animated story be compared to a written story?
- How do teachers assess the ICT creativity of students?

There is a substantial body of research into multimodal practices in primary language education. However in most of these reports students have been questioned about a given multimodal artefact rather than one they produced.
Integrating ICT through multimodal discourse in a primary classroom

An example of a rubric that has been designed to assess both traditional writing and multimodal expression is the Writing Program Rubric from Ball State University (nd). It was developed from a rubric for assessing student paper writing, but has been enlarged to enlarged to include consideration of the use of multimodalities. Although this has been designed for, and is being implemented with, tertiary students, it is valuable in the current discussion. The rubric considers the following aspects of a multimodal artefact:

- Focus
- Organisation
- Development
- Syntax and Diction
- Format and Design
- Research (if applicable)
- Mechanics

Each of these aspects is defined in terms of the original writing rubric and a multimodal project.

**Thesis/Focus**

**Ball State Rubric**: Demonstrates an awareness of audience, is sophisticated, and is clearly established and maintained throughout.

**Multimodal Project**: In a multimodal composition, an awareness of audience is demonstrated through a well-chosen selection of both words and images that best meet their needs and persuade the audience of their argument. The argument—or thesis—will not be presented in a single alphabetic sentence as it is in a traditional essay; instead, the thesis will be evident throughout the essay in the variety of modes that are chosen. Focus will be demonstrated by each mode consistently contributing to the overall argument or thesis of the composition. (Ball State University)

While this rubric might not be suitable for assessing the multimodal work of primary students, it does provide useful suggestions for educators to explore. For the analysis of the artefacts produced in this study, some of the heading given above will be used, but with meanings appropriate for Grade 4. No attempt will be made to assign a value or grade to either of the artefacts being analysed.

**Analysis of the task**

In this report the focus is on ICT aspects of artefacts developed by students about a mathematical topic. However, as has been argued in a previous section, the student work loses much of its educational value and meaning if it is evaluated simply as a mathematics task or as a piece of ICT. In what follows each of ICT, mathematics and language will be considered. Drawing on the previous discussion of the Ball State Writing Program Rubric, the following aspects were applied:

- **Focus**
  - Does the chosen mathematical topic remain pivotal?
  - Is the language relevant to the story and the mathematics?
  - Do the modes chosen assist the viewer to follow the story?
- **Organisation**
  - Is the mathematical topic approached in a logical way?
  - Is the language clear and appropriate to the content?
  - Do the modes used support the story?
- **Mechanics**
  - Are the mathematical concepts accurate and correct?
  - Is the text or spoken language free from errors?
  - Do the modes used work effectively and show what is intended?

In the following sections these three aspects and their sub-aspects will be used to make simple analyses of both the storyboard and computer-generated artefact developed by Kylie and Rhianna.

**Storyboards**

Kylie's storyboard is shown in Fig. 1 and Rhianna's in Fig. 2, and both have similarities and differences to the related computer artefacts. Neither storyboard includes either a title or a conclusion screen, although these exist in both artefacts. Both have been simplified to some extent. Kylie changed from four cats in the story board to three in artefact, and she reduced the amount of text. Rhianna also reduced the amount of text, as well as reducing the number of figures on some of her screens.

In her storyboard Kylie appears to have no mathematical or spelling errors. On the other hand Rhianna misspells 'quater', and in the final frame of her storyboard claims that the 8 pieces of cake divided among 4 people (Matt, Jo, Jackie and mum) will give each person 4 pieces. This mathematical error was corrected in the computer artefact.

**Computer-generated artefact**

It is evident that a computer-generated artefact that contains movement and sound can only be properly analysed by running the artefact on a computer. However that is not possible in a paper-based report, so comments will be included to describe any animations and sounds.

Both students concentrated on the mathematical story they were telling and there were no digressions. In general the language they used was appropriate, although Rhianna described dividing the cake into 'quaters' but does not mention the term eighths. In a similar fashion the design of the artefact presents the mathematical concept in a logical way. One issue that can be argued is that the simple animation used is incidental to the story. For example there is no obvious connection between the arm movements of the figures in Rhianna's artefact and the mathematical story she is telling.

In terms of the mechanics of the artefacts there are some issues. While they were both mathematically accurate, each had at least one spelling
error, and Rhianna had grammatical errors on every screen. From an ICT perspective it could be argued that by continually changing the colours of the shapes representing people (Kylie), and by not have a constant background, both students might have allowed the technology to slightly impinge upon the story.

**Conclusions**

This particular research project arose from an observation that much of the research into multimodalities and learning concentrated on aspects of language, especially reading and writing. In the conclusion to his report, Vincent (2006, p 56) says,

> I have argued here that multimodal composition is not just a desirable extra, but should be brought into the mainstream of literacy teaching for two main reasons. Firstly it is the way in which students see the world, and secondly it releases certain children from the trials of monomodal, verbal expression where they are unlikely to succeed.

Thinking about these comments raised a series of questions about school mathematics and appropriate multimodal experiences for learners, particularly at primary and middle year levels. If students see the world in a multimodal fashion, does this have implications for learning mathematics? This project was planned as a small pilot study to investigate the possibility of introducing primary students to the idea of expressing mathematical concepts in a multimodal format.

Examples of student work were analysed based on selected components of a rubric designed for evaluating multimodal writing at tertiary level. The analysis indicated that while there were very few errors of mathematical content or process, the text included in the artefacts contained a significant number of errors in spelling and grammar. However it appears that both students told their mathematical story competently using several different modes.

This pilot study suggests that it is possible for primary school students to use technology to create multimodal artefacts that tell a mathematical story. Due to the way the project was set up it was not possible for the teacher to gain much insight into the mathematical understanding of individual students. As is exemplified in the two artefacts presented here, most students chose quite simple mathematical concepts for their story. Perhaps in a future project all the students could be asked to work on the same mathematical concept, or perhaps the teacher could pose an open ended problem that required a mathematical solution. Both of these options presume that the teacher wants to directly compare the work of students with each other. This was not a desire of the class teacher involved in this project.

**References**


**Authors Note**

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Tony Jones is a Senior Fellow of the Graduate school of Education at the University of Melbourne. He has taught in both primary and secondary schools, and has been involved in initial teacher education and teacher development for more than three decades. Tony began using computers with a Year 10 Mathematics class in 1968, and since then has continued teaching with and learning about ICT.

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