THE IMPACT OF LONG-TERM ICT PROJECTS ON STUDENT ATTITUDES AND CAPABILITIES

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Abstract

This study draws on pre- and post-surveys of 574 upper primary students who engaged in intensive work over two school terms to produce a multimodal narrative using desktop animation software. It was thought that factors such as general ability with computers, interest in composing stories and persistence with long-term projects might be influences of successful completion or higher quality products. Over the course of the project, there is evidence of student growth in the ICT-related skills as well as enjoyment and capacity with story composition. However, concerns remain over the pedagogy of extended project work and the impact of this on student learning in the affective domain. The impact of these findings for classroom teaching and the planning of long-term ICT projects are discussed.

Introduction

Over a period of three years (2009-2011), the 3D multimodal authoring pedagogy (3DMAP) project[1] engaged over 1200 students from 48 level five and six classes across five Australian states in the construction of a 3D multimodal narratives – a sort of desktop-equivalent to live-action filmmaking. Students undertook two units of work, each with a minimum of 20 hours of engagement, using the software *Kahootz* (Maggs, 2008). Details of the program have been described elsewhere (Chandler, O'Brien, & Unsworth, 2009, 2010; Chandler, 2014/forthcoming), but notably whilst it was clearly located as a literacy project for the students (and multimodal semiotics in particular), it would not have been possible except for intensive engagement with Information and Communications Technology (ICT). The departure point for the present investigation occurred as the researchers reflected on the second year of the project, as the engagement with classes in the final year was being planned. Throughout the first years, there were some difficulties with students presenting completed work. Some of that was attributable to intrinsic difficulties with the software (resulting in 'lost' or corrupted files), but to what extent such problems were partly or wholly a manifestation of a broader problem (i.e., students' work habits or file management practices) was unclear. Certainly, a 20 hour unit of work will reveal chinks in the armour of work practices that a one or two hour task would not, and most likely cause greater distress to the student concerned. But equally we wondered about students' familiarity with extended project work (whether involving ICT or not) – is, for instance, maintaining focus and application to projects something that they are used to doing? And furthermore, do students actually like writing stories or enjoy using computers to be creative: could it be that some of the problems were motivational? Broadly, the concerns, then, are the extent to which affective dimensions of student learning and allied areas of knowledge are impacted by, and themselves impact on, student performance in 3D multimodal authoring tasks.

This concern sets the background for the present investigation and which have broader implications. Across the world, literacy is being reconceptualised in response to our increasingly digital, multimodal information and communication world (Australian Curriculum Assessment and

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Reporting Authority, 2013; England Qualifications and Curriculum Authority, 1999; Singapore Ministry of Education, 2010). The 3DMAP project is but one instance of cutting-edge literacy projects which require intensive engagement with ICT in Australia alone (e.g., Ryan, Scott, & Walsh, 2010; Walsh, 2011). Within the use of the term by Grant (2011), the 3DMAP project was also an example of project-based learning (PBL), increasingly a feature of classrooms both within Australia and internationally. Jones and Issroff (2005) have pointed out that affective issues have been viewed as somewhat problematic in studying learning and so they have often been excluded from the frame of research, or studied separately from cognitive learning. Grant (2011), too, has observed that there has been limited attention to the student perspective, including the affective domain, in research into PBL. Attending to those is an important component of advancing the development of 'new literacy' projects and 'project-based learning' practices and pedagogies.

This paper reports on (a) the variation between schools and (b) the impact of engagement with a long-term ICT project on student self-reports which are indicative of:

i. Interest and ability with story writing
ii. Perception of computers as a creative tool
iii. Competence and capability with computer use
iv. Work practice and ethic in relation to long-term project work

We firstly consider connections to the broader literature, and proceed to describe the research methodology used in this study. A detailed and exacting instrument to investigate these features is not presented, but rather a relatively coarse one, which was designed to give a general sense of any issues. Results are then discussed and conclusions, quite positive in relation to ICT use, but less so in relation to the pedagogy of extended project work, are outlined.

Connections to the broader literature

Despite Jones and Issroff's (2005) complaint about the lack of attention to the affective domain in the application of learning technologies, a few relevant studies can be identified. None were found, however, specifically in the context of cutting edge literacy work, but rather in the field of PBL more generally. Hernández-Ramos and De La Paz (2009), in a quantitative study of 170 students, found evidence that students' attitudes toward the subject under consideration, and toward working with others, were significantly positively affected by the PBL experience, which is consistent with reports on PBL made elsewhere (p. 167). Hung, Hwang and Huang (2012), also in quantitative work with a similar number of students, found that extended engagement with ICT and PBL enhanced learning motivation, problem-solving competence, and learning achievement. The detailed case study of a small number of eighth-grade students engaging in PBL by Grant (2011) provides the most detailed discussion of relevant issues, however.

Several of the themes identified by Grant (2011) are relevant in relation to extended literacies-orientated projects such as 3DMAP. The first is "internal influences", embracing the issues of persistence, motivation, and self-management skills. His informants (students) explained that, in the context of PBL, the personal relevance of the project/investigation is important, along with the presentation of the project as having an emotional anchor; the students made choices about the topic, its development and the technologies used in its development based on perceptions of that they were "good at". At these points, Grant's PBL project is rather different to the 3DMAP project: 3DMAP provided no choice of technology, did not go out of its way to engender emotional ownership in the process, and provided no alternate trajectories through the material. Whether PBL and 3DMAP are just different in these respects, or whether these are some of the necessary conditions for effective persistence, motivation and self-management is at the heart of the present investigation. It was interesting to read of students in Grant's study who found that the length of the project was too long to sustain motivation – some even expressed a concern of being 'burnt out' by the topic; carefully constructing the length of project to maximise both learning and motivation is probably a challenge for extended multimodal authoring projects.

Two further themes from Grant's informants are also important. One is "beliefs about project work": that they should be fun, engaging, providing freedom and autonomy in work. And yet his informants said that their beliefs in this respect had been 'sobered' by previous and current teacher expectations. The role of the teacher was an important "external influence", in particular a lack of teacher engagement as a key negative impact on project work. The students, in other words, want their teachers to be engaged and supportive and to help them find an enriching experience. Grant's informants also confessed to relying heavily on their prior knowledge and experience in developing their PBL work: finding ways to actually enlarge the knowledge base of students through PBL in ways that are readily welcomed by them, may not always be a straightforward task. The 3DMAP project sought to teach new concepts of multimodal authoring, and given the low knowledge base of students at the commencement of the project (Chandler, 2012) relying on prior knowledge was never going to be sufficient. The role of the teacher in fostering multimodal authoring has been emphasised elsewhere (e.g. Chandler, 2013) and through Grant's study the centrality of effective teacher/student engagement to foster affective development is further highlighted.

Focus for investigation

The investigation reported in this paper is restricted to the impact of extended multimodal authoring project work on affective dimensions of student learning and allied areas of knowledge. The investigation sought to identify if there are differences between classes in these areas, and in which there can be said to be a positive or negative impact as a result of the project. With relatively thin background available, specific hypotheses were not developed, but rather the defensibility of an impact was explored using post-hoc comparison techniques, as described below.

Method

Design

The design was a quasi-experimental study using a pre-test/post-test design (Campbell & Stanley, 1963, p. 7), as we could not randomly assign students or teachers to schools (conditions) and could not alter the teaching arrangement for the comparison. It is represented as $O_1 \quad X \quad O_2$ where X represents an intervention (i.e., engaging in the units of work) and O_1 and O_2 are observations. As Campbell and Stanley stress, this design is an inherently weak approach and so conclusions as to whether any significant change can be attributed to engaging in these units of work will need to be made very cautiously.

Participants

Participants in the 3DMAP project were students in their last two years of primary school. In total, data were collected from 574 students, but not all students completed either or both of the questionnaires. From the pre-test survey, data were collected from 523 students from 14 schools (26 classes) in both years 5 and 6 (including both single year level and composite classes) who participated in the study. The schools were varied in relation to geographic location and socioeconomic status, but were mainly government schools. The majority of respondents were Victorian: 9 schools with 80% of total respondents, with smaller numbers from Tasmania (2 schools, 10% of respondents), New South Wales (2 schools, 9% of respondents) and Queensland (1 school, 1% of respondents). 304 students completed the post-test survey, with 266 of them having completed both; there was a diminished return rate for the post-test data from all schools, and in addition 2 Victorian, 1 New South Wales and the Queensland school had withdrawn from the project during the year.

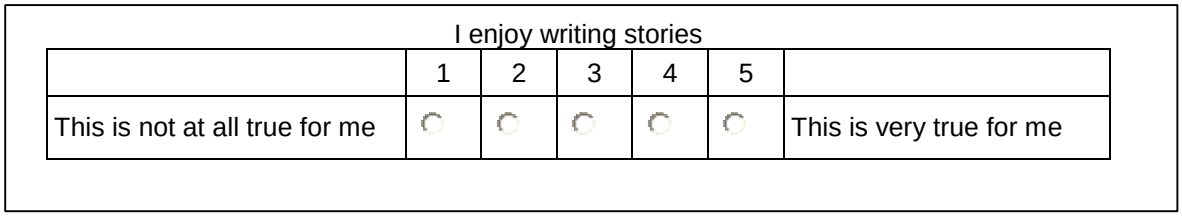
Questionnaire

Ten questionnaire items were used to gather data in relation to the investigative foci, which were

presented as a five-point scale, as illustrated in Figure 1. This is not a fine-grained, detailed and highly calibrated instrument, but the data discussed below shows that even this relatively coarse instrument sheds light on some important issues.

1. I enjoy writing stories
2. Others think I am good at writing stories
3. I enjoy using computers to be creative, tell stories, or make movies
4. How confident are you with using *Kahootz* for telling multimedia stories?
5. I experience frustrations when working at a computer
6. I manage my computer files and know where things are stored
7. Others think I am good at using computers
8. Others think I am an organised and efficient worker
9. I enjoy working on long projects and like to do a good job to get my work finished
10. When I meet challenges in my work I don't give up easily

Figure 1: Sample item



Data collection

The questionnaire was made available online (google docs). The pre-test was completed in the first third of the school year, prior to each class commencing the program of multimodal authoring. All teachers allocated class time for the completion of the questionnaire, leading to a return rate of over 80%. The post-test was completed at the very end of the school year, when each class had completed the project work. One suspects that the busyness of the school year in the weeks prior to the Christmas holidays was the main reason for a diminished return rate for the post-test.

Data analysis

Three statistical investigations were employed for the data analysis:

1. Considering the dataset as a whole, a comparison of pre- and post-test means for each item using a standard *t*-test, was conducted, followed by a calculation of effect size. Following the recommendation of Dunlop, Cortina, Vaslow & Burke (1996) not to use paired tests of significance to determine effect size, a paired *t*-test was not used. The statistical package *R* (R Development Core Team, 2012) was used to perform the calculations.
2. The *t*-test investigation was repeated for each class individually
3. The means for each class on each item were compared using the visual Gabriel comparison interval approach (Gabriel, 1978) advocated by McDonald (2009, pp. 132-136), as is illustrated in Figure 2 (see later in this paper).

Results and Discussion

Changes over the duration of the project

The overall mean for each item before and after engagement with the 3DMAP project is shown in Table 1. These are presented in order of effect size (Cohen's d). An effect size of 0.2 or above is conventionally regarded as "small", of 0.3 or above as "medium" and 0.5 or above as "large". So it can be readily seen from the table that the engagement with the long-term project work provided by

the 3DMAP project appears to have at least a "medium" impact in most, except for confidence with the software, where the effect is clearly "high", and the effect for the enjoyment of long-term projects is negligible.

Table 1: Means and effect sizes for all items, showing changes over the duration of the project
Presented in order of effect size

Item	**Mean Before**	**Mean After**	**Unpaired t test (n_1=523, n_2=304)**
4: Confidence with *Kahootz*	2.914	3.622	t=-8.7633, df=709.432 p <0.001, d=0.65
2: Good at writing stories	3.069	3.536	t=-6.9481, df=695.551 p<0.001, d=0.52
6: Good file management	3.630	4.109	t=-6.9136, df=745.074 p<0.001, d=0.52
5: Frustrations with computer use	2.576	3.089	t=-6.0828, df=577.237 p<0.001, d=0.52
8: Organised and Efficient	3.307	3.760	t=-6.2678, df=661.435 p<0.001, d=0.50
7: Good at using computers	3.340	3.776	t=-6.2365, df=707.258 p<0.001, d=0.47
1: Enjoyment with writing stories	3.508	3.911	t=-5.7215, df=726.353 p<0.001, d=.43
10: Persistence	3.702	3.931	t=-3.4699, df=692.025 p<0.01, r=0.26
3: Enjoyment of using computers to be creative	3.635	3.901	t=-3.4114, df=702.376 p<0.001, r=0.26
9: Enjoyment of long term projects	3.773	3.855	t=-0.9913, df=653.309 p>0.1

There are two further refinements to the above initial interpretation of the data. Firstly, the effects were not uniform across classes. Investigating the data on a class-by-class basis show that the only item for which there was a significant difference between means for all classes was "others think I am good at using computers" (item 7). This is consistent with Hyun's (2005) work, for instance, who demonstrated that competence with computers increased for kindergarten children due to a longitudinal engagement with project work supported by ICT. An increase in professed confidence with the software (item 4) was noted (p<0.01) for 7 out of 15 classes, which is further discussed below. For all other items, there was no significant difference between means (p>0.1) for any particular class.

The second refinement to the argument is by comparison with Hattie's (2009) use of effect size. In his work on student achievement, Hattie described an effect size of 0.4 as being consistent with 'teacher effects' – that is, the best teachers without using any special strategies achieve an effect size of 0.4. Also, he describes effect sizes of around 0.15 as 'developmental effects' - a student who drops out of school and grows a year older will achieve an overall effect size of up to 0.15; so it is argued that an effect size of less than 0.15 is doing harm to students; anything higher than 0.4 is accomplishing more than the best teacher possibly could without using the particular strategy being investigated. Certainly, the data presented here is attitudinal rather than that of achievement, but it does suggest that engagement with an extended multimodal authoring project is:

- highly effective for developing confidence with the software being used
- quite effective for improving student attitude towards story writing, their proficiency with computer use, and their self-organisation
- better than maturation alone for developing persistence with tasks and fostering enjoyment in the use of computers for being creative; but
- in real terms, adversely effected the enjoyment of long-term project work, and the experience

was actually highly effective for promoting frustrations with computer use.

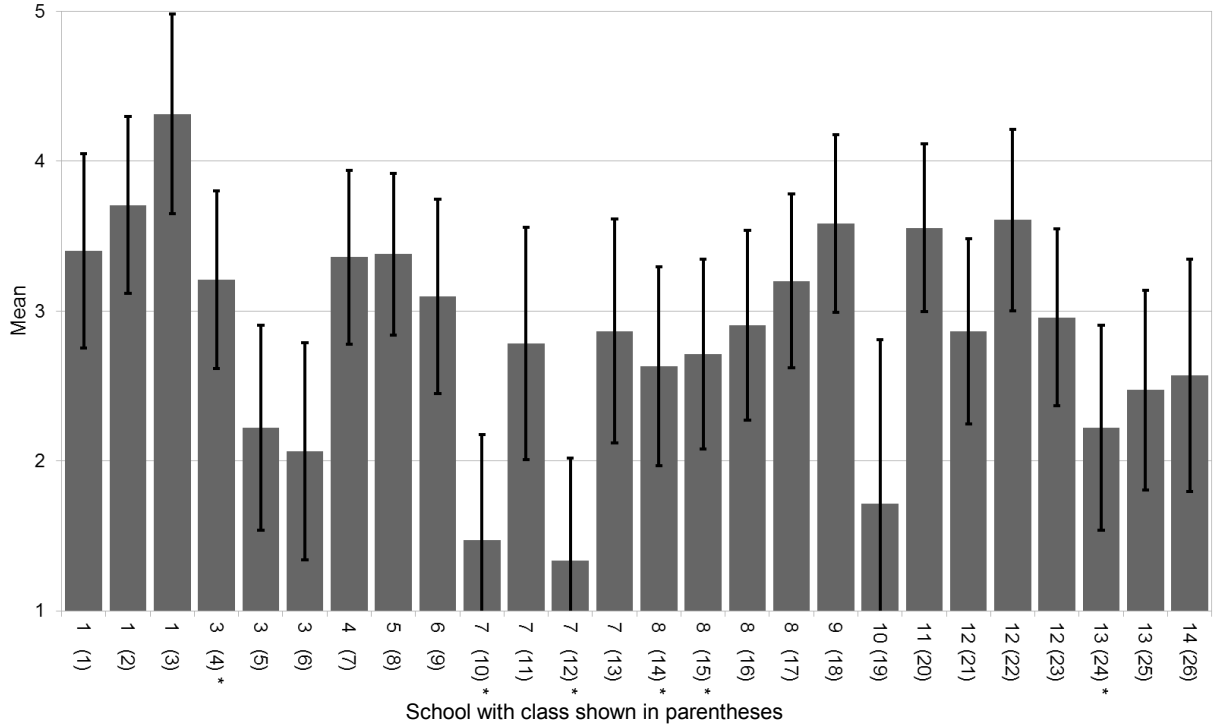
These types of results have been in the published literature for some time, though these are probably stronger results. For instance, Proctor and Burnett (1996) studied attitude to computers in the context of extended project work in Australian classrooms. In their study, attitude was considered to have 3 components: 'importance', 'confidence' and 'liking'. The extended project work: had no effect on 'importance', no effect on 'confidence' and there was a decline in 'liking'. Slightly surprised by the lack of apparent impact, Proctor and Burnett refer to even earlier research which indicated that game playing, when appropriated for a school purpose, was not rated as enjoyable by students. Insofar as multimodal authoring is a task which frequently uses software which is either exactly what students use for out-of-school game-play (e.g. *Minecraft*, *Second Life*) or is very similar to it (e.g. *Kahootz*, *Alice*, *Scratch*), it is reasonable to suggest that this same concern is echoed in the present research. What this study achieves is to confirm and reiterate the findings related to the complexity of attitudinal studies so that that each generation of teachers understand that integrating computers in extended project work requires careful planning and may result in many affective and cognitive effects that were not initially anticipated.

Variations between classes

The analysis which compares the means between classes at the commencement of the study begins by considering item 4, 'confidence with the software', which is the most interesting case. The means for each class are shown in Figure 2. Primarily, this reveals considerable variation between classes. A large proportion of this probably arises from certain classes having used *Kahootz* previously (either earlier in the year of the study, or in previous years). Broadly speaking, the means for each class in the same school are not dissimilar. The classes where the mean for item 4 was significantly higher at the post-test are shown with an asterix. This tends to be one or two classes at a school which are lower than the others at the start and are in effect 'catching up' to others in the same school as the study proceeded. There was no class where a decline in the mean for this item (let alone a statistically significant one) was noted, so it is reasonable to suggest that confidence with the software is either maintained or increased by prolonged engagement. The larger effect size for this item overall may well be due to a 'catching up' effect.

Figure 2: Comparison of pre-test means for each class on 'confidence with *Kahootz*' (item 4)

Means are shown with Gabriel comparison intervals (Gabriel 1978);
pairs of means whose comparison intervals do not overlap are significantly different (p<0.05).
Asterixes indicate classes for which the mean had increased significantly
when the post-test was compared with the pre-test (p<0.01 by the t-test)



Charts such as Figure 2 were produced to compare classes for all ten items in the pre-test. . These are not presented individually as the results are not especially startling. No statistically significant difference between pairs of means for classes could be identified for items 1 (enjoyment of writing stories), 2 (being perceived as good at writing stories), 3 (using computers to be creative) and 6 (managing files). The significant differences which are identified do not point to any systematic trend, but were: class 6 stands out as being statistically different to some others (lower ratings) in terms of being good at computers, personal organisation, liking long-term projects and persistence; one class at school 13 (25) also has a lower rating of liking project work; the other class at the same school (24) has a lower rating of being good at computers; and one class at school 12 (23) also has a lower rating for persistence. There is, really, a good deal of similarity on most of the measures amongst the schools and classes in this study at the pre-test.

There are significant differences in the study data, though, and these are identified between classes in the same school. It is possible that, under the oversight of one teacher compared with another, some classes responded differently to the survey compared with their peers. This may not be the only explanation. One cannot help but think of Grant's (2011) students who were 'sobered' by the reality of teacher expectations and who valued strong, informed engagement by teachers. Class-to-class differences in liking project work, being persistent and perceiving themselves as being good with computers by different ways in which teachers interact with their students – particularly when ratings of other matters which may well be more intrinsic to each teacher (such as 'enjoyment of story writing') are mainly invariant from class to class. One needs to be careful that the manner of the teacher and the nature of the work is not dampening down student perceptions of extended project work as fun and engaging, and having an adverse effect on persistence, perception of ability and ultimate success and enjoyment in the prescribed task.

Reliability and Validity

It is important to consider issues of reliability (can it produce similar results if used again in similar circumstances) and validity (whether it examines what it claims to examine) in relation to this investigation, and within that the matter of the instrument being a self-report. The advantage of a self-report approach is that it gives the respondents' own views directly – their perceptions of themselves and their world which are unobtainable in any other way. The main disadvantage of self-report is that there are a number of potential validity problems associated with it because each respondent's understanding of the items may be idiosyncratic, so the responses may bear little relationship to "reality", as seen by the researcher or others. Self-reported answers may be exaggerated (one way or the other), with a tendency to provide 'socially desirable' responses.

There is evidence within the data presented for the reliability and validity of the general indication that this study has considered (and these briefly stated 10 items are no more than that). Principal among this evidence is the considerable consistency between classes on items which are likely to be intrinsic to each student: enjoyment of writing stories, using computers to be creative, and so forth – no matter which class is considered, the results are much the same (i.e., reliability). If students have rated their knowledge of the software or their degree of persistence as low – and they have – then that speaks more to an honest response than a socially-acceptable response. If anything, it is likely that students have under-estimated their capacities with the items presented, and a more nuanced understanding of the affective domain in relation to long-term ICT projects will require a more carefully constructed and well-calibrated instrument. Nevertheless, this relatively coarse instrument has provided some important insights.

Conclusion and Recommendations

The specific findings are that, in a long-term project which involved intensive engagement with ICT, for upper primary school students:

- a perception of being good with computers, and being confident with the software tool both show a strong increase over the course of the study;
- potentially positive allied outcomes such as being good at 'file management' and being generally 'organised and efficient' are positively regarded, and improve modestly over the course of the study;
- Students perceive themselves positively in regard to the competence at writing stories' and having enjoyment with writing stories, and this perception shows a modest to strong increase over the course of the study;
- The perception of the computer as frustrating tool increased substantially; in addition, a sense of enjoyment to use computer to be creative, a persistence with difficulties, and enjoyment of long-term project work were in real terms probably adversely effected.

There are some individual classes where the indicators on several of these measures are concerning, but the results from classes are very similar for each of the 10 items.

From an ICT point of view, it is quite good news: more exposure to computers leads to greater confidence and an elevated perception of competence, and this seems to be unaffected by genuine challenges or frustrations encountered in the process.

From a literacy point of view, the news is also good, but the effect not quite as strong as for the ICT items. The capability with, and enjoyment of, writing stories are both enhanced by engagement in a longitudinal multimodal authoring project. Also, there is no basis for suggesting that classes with a greater sense of being good, or enjoying, story writing will perform any better than classes that don't: the data for these measures is quite similar, and yet considerable variability in the quality of multimodal work between classes has been described elsewhere (Chandler, Unsworth, & O'Brien, 2012).

Yet despite all of that, the students are not likely to have come out of the 3DMAP program singing the praises of extended project work: their desire to be persistent has not been enhanced and their urge to be creative with the technology has possibly been diminished. That is hardly good for the child, the teacher nor a good advertisement for the approach. It resonates, though, with other studies in which student enthusiasm has been 'sobered' by teacher expectation and engagement – and places the spotlight clearly on the teacher to develop the student affectively as well as cognitively. We note, though, the finding of Jamieson-Proctor and Burnett (2002) who found that 'purposeful integration' of computer technology positively affected the personal creativity characteristics of students. In relating findings about extended project work and ICT to a next-generation of teachers, one of the important issues is about organizing the teaching and learning of multimodal authoring such that it is, and is seen to be, highly purposeful.

The study, by its nature, does not give any insight into the impact of various affective or allied areas of knowledge on the quality of student outcomes in their multimodal authoring work. It is possible that the initial speculation that capacity with factors such as file management, personal organization and persistence were nevertheless important. One therefore wonders what the quality of the product would be if the teachers deliberately taught these allied areas alongside the main agenda of a multimodal authoring product. It may be simply providing a context in which these aspects might develop is insufficient – that teachers need to be more deliberate about teaching the teachable, allied areas of knowledge and attitude which are associated with certain units of work. Further investigation is required to investigate these interactions.

In the current era, when multimodal authoring is an increasingly important component of literacies curricula, most frequently implemented through extended project work which includes intensive use of ICT, recommendations from this investigation are directed to both the teacher and the curriculum designer. To the teacher: it is important not to be over-committed to the destination at the expense of the journey. Persistence, motivation, self-management skills, personal relevance of the work, an emotional anchor, and choice are reasonable expectations that students have of extended project work, and may interact in important ways with the quality of the end product and students' long-term motivation for engaging in such projects. Affective and allied content knowledge should be not only valued wherever possible, but actively taught as necessary. Curriculum designers (and researchers), too, need to be conscious of the journey as well as the destination. For instance, design of project work which is of optimal length which maximizes learning and motivation and avoids students being 'burnt out' by the topic is important. It cannot be assumed that certain allied learnings will be naturally emergent through such work, and matters such as file management, personal organisation and persistence will need to be explicitly planned for.

In conclusion, we might ask 'was the 3DMAP project a success?' The answer has to be 'yes'. Other data from the project (Chandler, 2013) clearly indicated that students commenced with a very limited prior knowledge of *Kahootz* or related software – they learned the basic tool required for construction of multimodal texts because of what they were taught in class, and report an increased confidence in using and with computers in general. In the face of this overhead, indicators of competence and confidence with both ICT and story composition suggest strongly positive growth. We know that keys to further enhancing the impact of such work involve minimizing frustration with the software and maximizing persistence and enjoyment of long-term project work.

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