

The use of online collaborative tools by students creating visual dialogues

Fiachra O Cuinneagain

Abstract Collaboration is fundamental in today's society and online collaboration is rapidly growing. When done correctly it can enhance the experience for all participants and can negate some of the problems or negative issues typically associated with face-to-face collaboration. This paper is a single cycle action research project looking at the outcomes of the introduction of an online collaborative book project with a class of students taking a design elective. Booki, an online collaborative publishing tool, was used to implement this project. The purpose of the project was to examine three specific questions: (1) Does significant peer learning occur during an online collaborative design project? (2) Do students find it beneficial to digitally document a creative process? (3) Is an online collaborative project beneficial for students in their own development as designers? To explore these questions the students were presented with a project that made them engage with the work of peers and evaluate it. This evaluation would be the basis for the creation of a visual response. Positive results were identified in the three areas examined. Recommendations for subsequent cycles are also given.

Keywords Collaborative Learning Techniques – Peer Learning – Booki – Online Collaboration – Professional Design Practice – Visual Dialogues

Introduction

This paper looks at the use of an online collaborative book project to allow students to learn from each other and in doing so become stronger designers. This project was implemented in a third year elective in design at Dundalk Institute of Technology on the BA in Communications in Creative Multimedia. The module, 'Digital Diversity and Design', is twelve weeks long in duration and traditionally the assessment focuses on print design.

The ability to collaborate is a key attribute in today's workplace, especially in the design sector. The International Council of Graphic Design Associations, which is the world body for communication design has placed a huge emphasis on collaboration (ICOGRADA, 2011), as has the Design Council (2007). The AIGA (c.2008), the American Institute of Graphic Arts, in its outline of competencies for the designers of 2015 state that being able to collaborate productively is key to being a successful designer.

Working on a project collaboratively allows for participants to learn from each other's approaches and work practices and benefit from these particular perspectives. This project aimed to examine what learning would take place within this environment. Specifically the project focused on:

- Whether peer learning takes place during an online collaborative design project?
- Whether students find it beneficial to digitally document a creative process?
- Whether an online collaborative project is beneficial for students in their own development as designers?

Literature Review

Social Constructivism

Collaborative learning is based on social constructivism. Palloff and Pratt (2005, p6) define the theory of constructivism, originally developed by Piaget (1969), as an active learning state where knowledge is constructed rather than acquired. They go on to state that through interaction with the world, learning takes place and that this is not a lone exploration but rather a social one, where interaction with others fosters a deeper learning experience.

John Dewey was another influence on the development of collaborative learning. He “endorsed discussion-based teaching and believed strongly in the importance of giving students direct experimental encounters with real-world problems.” (Smith, MacGregor, N.D).

The planned focus for the students in this project was the act of viewing a piece of work, analysing it and creating a response to it. Meaning is being created in the mind of the participant through their own analysis of a piece of work. This activity is a social constructivist one, one in which “individuals seek understanding of the world in which they live and work. They develop subjective meanings of their experiences – meaning directed toward certain objects or things” (Creswell, 2007, P. 20). We create meaning actively in our own minds and we also create meaning from interactions with others. Creswell also states that meanings “are not simply imprinted on individuals but are formed through interaction with others and through historical and cultural norms that operate in individuals’ lives.”

Collaborative Learning Techniques

Collaborative learning techniques have been used in teaching for a considerable number of years even as far back as the 1920s (Gillies and Ashman, 2003). Collaborative learning has been used in education for the teaching of a diverse range of subjects. For example, Haugwitz and Sandman (2010) looked at how to use collaborative learning to facilitate learning about the vascular system. More specifically, Wang, Shih and Chien (2009) used collaborative learning to support architectural students gain access to peer knowledge. The benefits of this method of teaching have been examined greatly.

On the whole the findings of these studies have shown collaboration to be a positive experience for the learners and facilitators. Baskin (2001) states that groups achieve goals that could not be performed by individuals alone. Groups allow for the processing of multiple views and opinions. They can simulate the energetic and volatile reality of professional life. Groups respond collectively to a problem and in doing so must coordinate the individuals of the group and the purpose of those individuals. Collaboration allows students to learn from each other on a number of levels as Baskin points out. Opportunities to learn from each other can be hampered because of access to location, content or persons but many of these problems can be side-stepped by collaborating online.

Paloff and Pratt (2005) state that working online allows for learning to take place at any time or place, information generated by fellow students can be accessed at any time and a sense of community is created so that learners do not feel isolated by working online. “Students benefit from exposure to learning opportunities that enable them to observe how others authentically behave, act and perform” (Baskin, 2001, p. 68).

Online Tools

The use of online tools to support collaborative learning is a very active research area. The use of forums, blogs and voice-over-internet tools are examples of tools being used to support online collaborative learning (Lambert 2003; Charitos, Korakidou and Meimaris 2010). The online collaborative book project discussed in this paper also supports online collaborative learning by facilitating access to documented visual research, visual development and final design work of students. This allows the students to gain greater understanding of the design process and hopefully allow for a deeper learning experience and engagement with design. Collaborating online also allows reflections to be posted when they occur and discussions to take place when participants are available.

This emphasis on peer interaction links in with constructivism and its focus on social interaction. Research carried out by Astin stated that “the single most powerful source of influence on the undergraduate student’s academic and personal development is the peer group” (Astin, 1993, p.6). Astin goes on to state that “cooperative learning can be viewed as an effort to capitalise on the power of the peer group to enhance student learning”.

Negatives in Collaboration

Negative reactions towards collaborative learning cannot be overlooked. Many pitfalls can be overcome if we learn from them. “Higher education is predominantly a culture of individual effort leading to personalised rewards. The culture and its norms are at odds with the requirements of productive group work” (Lea, Rogers and Postmes, 2002, p55). Lea et al. go on to write that this may cause students to lower their level of commitment to the project because the work does not benefit them wholly. They further discuss that to overcome this problem a strong connection to the group needs to be developed. This connection could be cultivated by negotiating the content, deliverables and assessment of the project with groups. This level of

involvement in the development of the project creates a higher level of ownership of the project.

Research Methodology

Action Research

“The fundamental aim of action research is to improve practice rather than to produce knowledge. The production and utilisation of knowledge is subordinate to, and conditioned by, this fundamental aim.” (Elliott, J. 1991)

Action research is trying to find a solution to a practical problem in a working environment. The ‘practical problem’ examined in this project was the lack of design projects that involved collaboration on the Digital Diversity and Design module. Denscombe (2007, p.126) defines four characteristics for action research:

1. Practical;
2. Change;
3. Cyclical Process; and
4. Participation.

Change is implemented to discover what effect it has on the occurring problem. The findings from this create new possible changes, which creates a Cyclical Process of feedback. This method is an active form of research where the research is implementing change into an environment and so is an active participant in the research.

The online collaborative book project is a single cycle piece of action research. This methodology was used for the project because “people do action research when they want to investigate what is happening in their particular situation and try to improve it. They not only observe and describe what is happening, they also take action” (McNiff, Lomax and Whitehead, 2003, p 14).

Implementation of Project

In late September of 2011, twenty-one third year students were given an assignment to develop an online collaborative book. They were shown an example of an existing collaborative book which had been developed by the artist Oliver Jeffers in 2004 with three other collaborators which served as an inspiration for this project. An initial outline of the project was developed, which was discussed with the class. The book was designed using Booki which is an online collaborative book development tool. Booki, developed by FLOSS Manuals, a non-profit foundation based in the Netherlands, was developed to be a collaborative online tool for the writing of manuals for open source software. The main benefit of using Booki compared to a blog or wiki is that Booki is designed to create content for print. Other software tools that focus on publishing for print were examined but cost and access deemed them unsuitable.

The twenty-one students were split up into five groups of four and five people. In designing the project groups, a mix of capability, sex and nationality (seven French Erasmus students) was evenly distributed within each group. A mix of capability in the groups allowed greater opportunities for peer learning to occur between weak and strong students, and a mix of gender and nationality within the groups helped to ensure a greater diversity of perspectives. Each group was asked to develop a theme for their chapter in the online collaborative book and to choose four techniques (or styles or methods or processes) that they would like to explore in the chapter. The five themes chosen were: International Culture, Music, Escape, Everyday Life and Religion. Nine techniques were chosen: typography, photography, mixed media, collage, textures, painting, stencilling, traditional media and digital design. Groups developed group contracts, the theme they wished to examine, the techniques they wished to explore and the order that they were going to create each response in.

Figure 1 shows the structure of the book which was called Five Conversations (<http://www.booki.cc/five-conversations/info/>). The book was split into two sections: Visual Responses; and Visual Research and Development. Each group had a chapter in each of these sections, named after the theme that they had chosen. Fig. 1 also shows an example of techniques chosen and a breakdown of the due dates. Each member of the group would respond to the previous piece of work. Figure 1 shows how the visual dialogue would occur with student A creating the first piece of work, then student B creating a response based on student A’s work. Student C would create a response based on student B’s work and so on until it returned to student A. The cycle would begin again except that this time student A would be responding to student D. The responses had to have some connection to the previous piece either visually or thematically. Each group decided who would

respond when. The duration of the project and the various due dates are shown in Figure 1. Each student had only five days to evaluate, research, develop and create his or her response. All work had to be posted to Booki. In theory this structure would create a visual conversation exploring a particular theme.

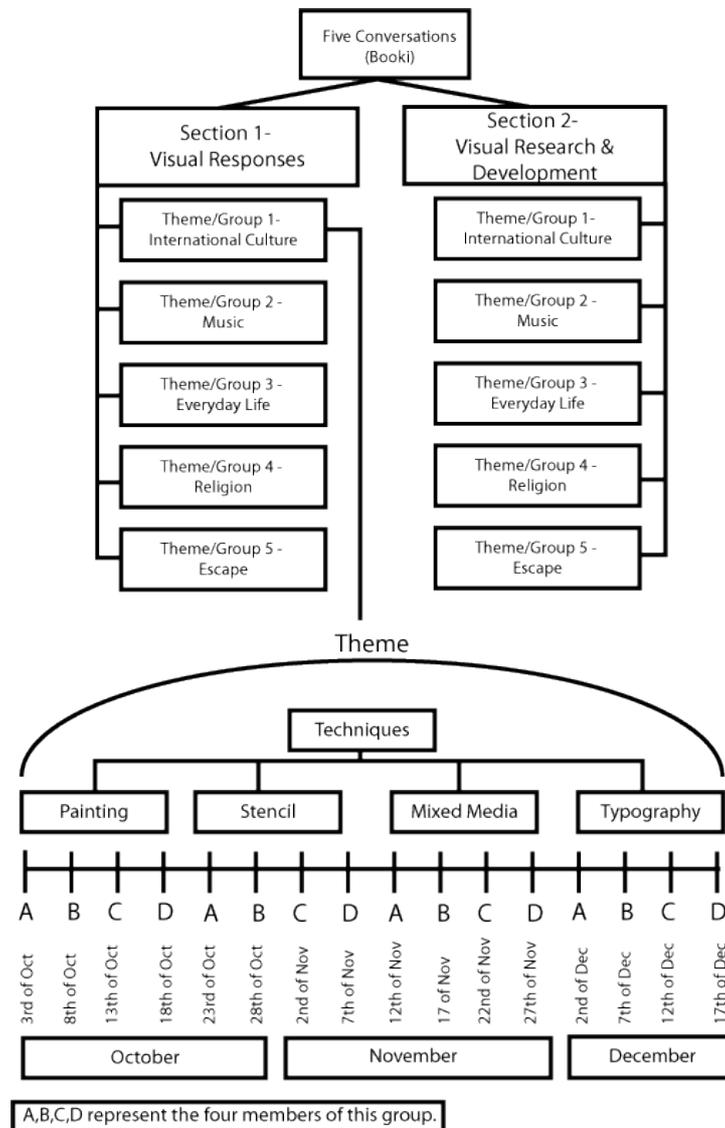


Fig. 1 Structure of Five Conversations

The first set of images were posted to Booki on time but some of the students were posting late by the second due date. This was putting the students after them under pressure. This was raised with the class and it was negotiated that if a deadline was missed that a student could use the previous piece of work as the piece of work they were responding to. The final set of images was submitted on the 21st of December 2011. Eighty-four original images were created and over two hundred pieces of visual research and development documenting their inception were posted to Booki.

A blog (<http://colbp.wordpress.com/>) was set up for the project to support class and group collaboration and to allow the students to disseminate research on techniques that they found helpful. It also held a schedule of all the due dates and topics that each group were undertaking to explore. The students were also asked to post a reflective piece of writing to the blog on each of their submissions. The blog was assessed on participation rather than on quality of posts. A total of thirty-three posts were submitted to the blog with half of these being reflections. The most viewed posts were student reflections with the highest being viewed four times. Figure 2 is an example of a student reflection.

For my second assignment for *Five Conversations* on Booki I had to respond to Valentin's interpretation of 'Escape'. I had to respond through the medium of photography.

As is often the case with these short-turnaround assignments, I had been considering some ideas prior to seeing Valentin's submission and it just happened that one of these ideas seemed like a reasonably good response to his response to Emma's submission. Emma had taken the theme of escaping to a world of her own in a similar way to 'Alice Through the Looking Glass' and Valentin seemed to advocate escaping from this make-believe world. In turn, I responded to Valentin's submission by putting forward the idea of escaping from this world, through astronomy, to Mars, where an Alicesque absurdity of sea Monkeys escaping from their aquarium greeted the viewer from Earth. I used photo-montage to create my image to illustrate this idea, with the Martian landscape made in Vue.

The fact that an idea I had pre-conceived before seeing Valentin's submission formed a suitable response meant that my research and development was to some degree influenced by this idea, rather than my idea being influenced by my research and development. I did explore other ideas, but once an idea fits a requirement, particularly with such a fast turn-around of five days, it is more likely that you will go with your original idea. Photography is also a medium that does not easily facilitate flights of imagination in the way that Photoshop does – one's starting point, at least, has to be a real-world object or person as a photographic subject.

In summary, again the quick turn-around time influenced my choice of subject for my submission and limited the amount of exploration I could do in terms of both ideas and creating photographic raw materials with which to work with. I was quite happy with my submission, but might have explored the idea and medium further if I had the time.

P.S.

Having concentrated on the limitations of a quick turnaround in terms of exploring new techniques and becoming more proficient with the required software, there is also the positive aspect that if we become professional graphic designers we will have to work to deadlines and we will have to learn to react and create 'on the run'. This assignment will certainly prepare us for that sort of environment.

[sic]

Fig. 2 Student Reflection

The most viewed page on the blog held the due dates for submission, with fifty-seven views. Only twelve students joined the blog and only ten of the twelve actually posted content. The blog was viewed seven hundred and eighteen times during the course of the project.

Collation and Analysis

Various forms of data collection were used for this study. Table 1 lists these forms.

Table 1 Data Collection

Research Diary	A research diary was kept for the duration of the project. When completed it consisted of eight entries.
Questionnaires	Students were given questionnaires comprising of twenty-six questions. Nine out of twenty one students responded to the questionnaire.
Student Reflections	The students' own reflections were used at the outset of the research to inform the focus group and individual interviews.
Focus group	Eleven students took part in the focus group which lasted for fifty minutes and looked at their feelings towards the project, learning, collaboration, communication, Booki, and the project's effect on them as designers.
Interviews	Individual interviews were carried out in March and May 2012. Seven students were interviewed.

The main focus of research was the meaning the students constructed themselves towards the project. “Interviewing in action research tends to be open ended and unstructured, focusing on what the interviewee has to say, rather than confirming any hypothesis the action researcher might have” (Coghlan, 2001, p.92).

Findings

“The words ‘collaborative learning’ describe a situation in which particular forms of interaction among people are expected to occur, which would trigger learning mechanisms...” (Dillenbourg, P. 1999)

Five visual conversations were created over the course of the project. The level of originality and creativity was very strong. The level of interaction between students and the response is evident throughout the conversations. The level of interaction, analysis and creativity is varied but in all cases, all of these took place. Figure 3 and 4 show a single response from one of the conversations.



Fig. 3 Visual Response from ‘Everyday Life’ Chapter



Fig. 4 Visual Response from ‘Everyday Life’ Chapter

The student discusses what meaning they created from Figure 3 and how their image (Figure 4) responded to it.

“So from her piece...em...and from what I did you can see that the form is very similar so the circle at the top and what I tried to do with the mirror as well, I kind of thought that what was at the top there was a mirror of what we had done, our previous work and so that was where I was trying to link it up...”

Here the student is using the idea of reflection as the theme that they take from their peer’s work and they use this theme in their own response. The student also indicates that visual forms are being ‘mirrored’ in the work through the use of elliptical forms in both.



Fig.5 Visual Response from 'Escape' Chapter



Fig. 6 Visual Response from 'Escape' Chapter

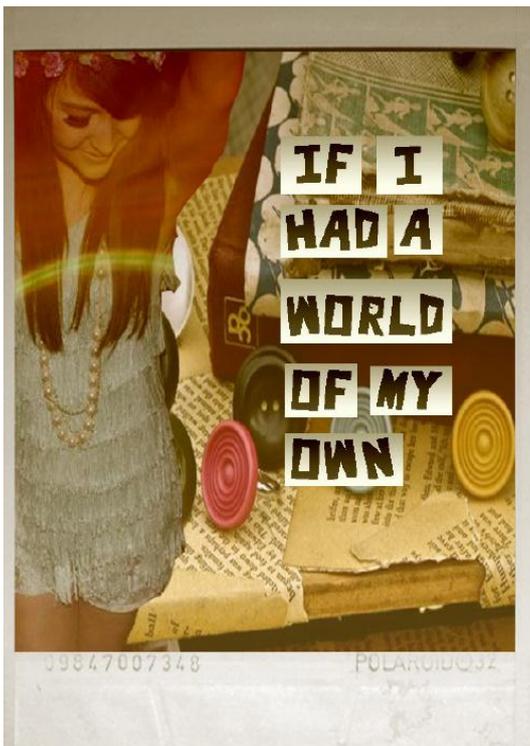


Fig. 7 Visual Response from 'Escape' Chapter



Fig. 8 Visual Response from 'Escape' Chapter

Figures 5, 6, 7 and 8 show the first segment of a conversation and the responses created. The theme that was being explored was 'escape' and 'typography' was chosen as the technical requirement. The comments below are from the student that created Figure 6 in response to Figure 5.

"...The best thing about it was the message...I just got really excited about, just ...the hidden message of the 'No' and exclamation mark was just, like, very clever...I got excited to bring the hidden message into my work."

“Because it was on typography and the way he had his...em...just his message was hidden and you would have to look at it twice and I tried to bring that into mine...but I did think Amy Winehouse and how she escaped from reality...her way of life was, she was always off escaping from her way of life and her stress.”

The comments below are from the student who created Figure 7 in response to Figure 6.

“The theme was escape and hers was like...Amy Winehouse...like, hers looked like Amy Winehouse to me and I was just thinking, like, what represented Amy Winehouse, drugs and depression, all that sort of stuff and...em...and escape from reality and I just immediately thought of Alice in Wonderland...escaping reality...going into Wonderland and what would I do if I was in a dark place...try and create my own sort of world.”

In each case the student is formulating their own meanings to a piece of work by evaluating it. This new piece of understanding is the grounding for their own creative process and eventual visual response.

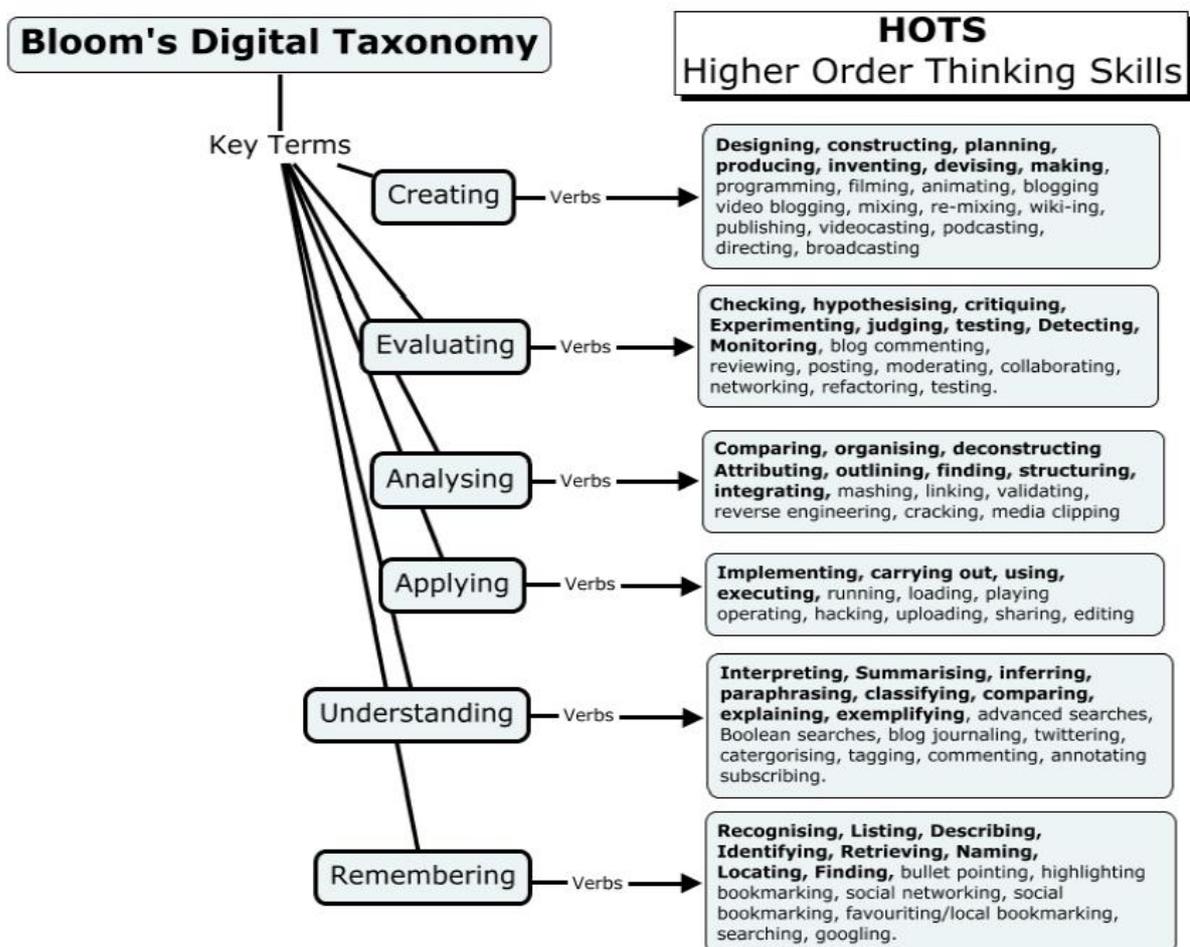


Fig. 9 Bloom's Revised Taxonomy

If these actions are overlaid onto Bloom's Revised Taxonomy as per Figure 9 (Churches 2009) we see that it is at the higher levels, *creation* being the highest and then *evaluation*. The meanings that the students create when evaluating the work allows them to be able to fully respond to the piece of work in question. Their visual response is the physical assimilation of this new piece of meaning into their existing knowledge.

These evaluations were also supported by access to the documented visual research and visual development that each student undertook. Figures 10 and 11 show the evaluation process and the meanings created by the students.

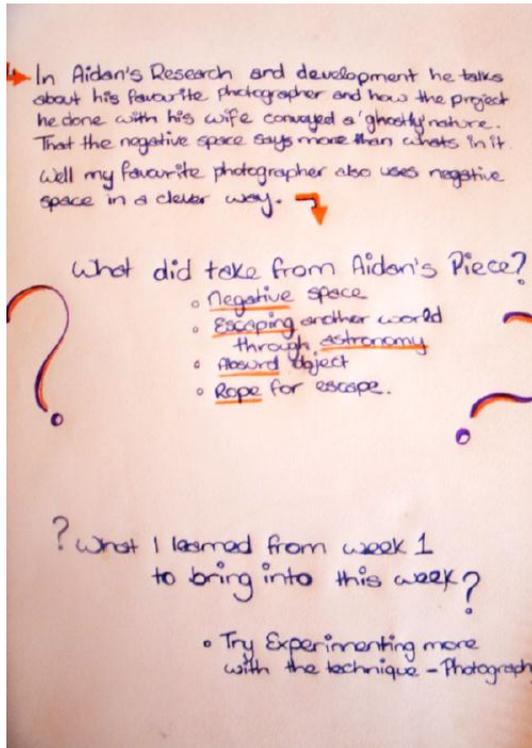


Fig. 10 Visual Development for 'Escape' Chapter

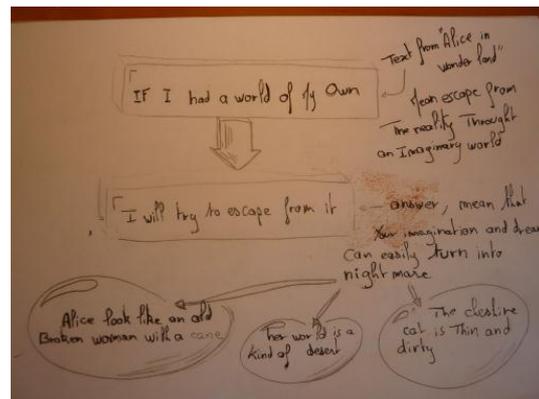


Fig. 11 Visual Development for 'Escape' Chapter

The ability to access their fellow classmates' creative processes allowed for a deeper evaluation of the final submission to occur and allowed the students to witness the creative process of their peers.

Results

Some of the results relate to all three questions posed by this paper rather than only one particular question. Therefore this section has been structured under thematic headings that came out of the research. For example, under the heading 'Time', the findings reported relate to all three of the research questions posed.

Insight Into Peer's Creative Process

From the outset of the focus group and then subsequently the individual interviews the most dominant theme to come out of the project was that of "different ways of looking" or "seeing" how a peer creates a piece of work. When asked if they had learned anything from members of their group or from classmates, students responded with "Yes; the different approaches that people can have on a project" or "Yes. You always learn from seeing others' work". Other comments made by students were:

"She got the ideas that I had put in my work..but (normally) they don't try to understand it and don't take time to understand it".

"You just learn other people's perceptions on what they are going to create like...you wouldn't even have thought of some things they would have done with typography or any other theme...it would not even cross your mind to go there".

"Being able to look at people's stuff online, being able to look back at where the conversation is going, being able to look at other groups and where they are going was excellent".

This insight into the creative practices of peers was the dominant learning experience that the students had from the project.

Creative Freedom

The project put onus on the student groups to develop their own focus for the project and what technical areas they wished to explore. The only constraints placed on the students were they had to have a connection

between their own piece and the piece they were responding to and to incorporate the technique that had been chosen. In every other way the students were free to respond in whatever way they wished. Figure 12 is a good example of this.



Fig. 12 Visual Response to 'Escape' Chapter

Some comments made by students were:

"It was good the way it gave you free reign".

"I enjoy this project because I try to mix my interests with that work, for example I used the cartoon animation with the first work and then the games with the loop [Fig. 13]....I learned how to do serious work with my interests" [sic].



Fig. 13 Visual Response to 'Everyday Life' Chapter

This freedom obviously had benefits for the students' experience of the project and the work they were able to create but it also had other effects.

“Three or four times throughout that project I was faced with a direction I never [would] have even thought of myself.. someone else had taken it there and I had to respond to it”.

The level of freedom created challenges for the students responding as the direction taken in the visual conversation was brought in unexpected directions which made it more difficult to respond to. These new directions also caused frustration.

“And then the next person after them would just close it off and the work the two people had done previous to that, and their research showed that...was out the window, which was probably four or five hours of work from both myself and another member of the group and then, the next person literally chopped the whole head off...and that annoyed myself and the other person”.

Professional Development

“To adapt under pressure of time” was a recurring comment, as was “time management”. The short window to respond was felt by the students to be a beneficial element in their development as designers as they felt that this would be a recurring aspect of working in industry.

“That was the benefit I felt I got out of it. I felt it forced me to have to stream-line my creative process, cut out all of the noise, cut out all of the rubbish and bring it down to, ‘okay I have to clearly communicate a visual response to X or Y or Z’ and at times I had to pull stuff out of it saying ‘oh no, I’m over complicating it’ and times I had to put stuff into it...that was the bit I enjoyed, the fact that you only had five days to produce something”.

Time

Time was the most recurring negative response about the project but it also had positive aspects. It was enjoyable “because it was spread” over the semester but it was “tough” to create a response over the five days.

“I kind of like ongoing projects because if you are someone who does not leave everything to the last minute it suits you”.

“Hanging over your head...sometimes your response would fall on the same day as another project...always running in the background...even the three weeks you were off it was still there”.

“There was a certain element of that as well, of challenging yourself but in the end of the day if you have a project due in at the end of the week...you go out and take a photo...you just try and rush through it because you have to have it in for the next person to get on with theirs”.

“Sometimes Booki was the last thing we wanted to do because we have the big project like 3D studies and at the last moment we thought ‘oh crap I have to do the Booki thing and I have to post something today, I forgot’ because I was so in the project and, yes sometime it was, like, in the background and it was a bad thing because we had to work fast for Booki...sometimes it was bad”.
[sic]

The quality of work that was created for the collaborative book project was affected by the semester long duration and the deadlines of other modules. The duration of the project also lowered the priority of the project for the students at points.

Communication

Poor levels of communication within the groups was raised on a number of occasions. The groups had set up Facebook pages and had swapped mobile and email addresses. Most contact was concerning when a particular student would have their work up or who was up next. This lack of discussion within the groups raised the question whether the project was a collaborative project or an individual project. Communication and discussion was occurring, not within groups but between friends within the class.

“I really enjoyed... sitting down together critiquing work created in the project...it got people talking about ‘where will they go with that’ and what they thought about it”.

The other issue raised was of access in relation to the lack of communication. Access to both the visual research and visual development and the final piece online made redundant the need to communicate in some student's minds. Students deemed it unnecessary to have verbal/written interaction with peers because they were already interacting visually with them through their work online.

"You were only waiting only for the image...I did not understand why we were in a group because there was no communication in the group".

"All you had to know was what the idea of the person that went before you had...you did not really need to communicate".

Collaboration

Some people were on the same "wavelength" and others were definitely not. The questioning of the project as a collaborative or individual project was raised again. There were mixed opinions about this.

"Because the other members of the group wanted to do traditional media...I felt confined...I am not getting anything out of it".

"I went into each piece being as open as possible and kept trying to open it out..."

"No, I do not feel like I made a book but I made something with the group and the class".

Techniques/Skills

75% of students improved in certain technical/skill areas. Students who responded to the questionnaire improved in the following areas during the course of the project: painting; photography; mixed media; stencilling; collage; digital imaging.

Virtual versus Physical

Half of the people asked whether they had made a book replied positively. This left the other half feeling that they did not.

"I do not feel like I created a book...maybe in its physical form you might feel some sort of ownership of it but uploading pictures onto a site, you do not get a book".

The various editorial and technical issues with the formatting, size and production of a physical book in the time constraints of the collaborative book project made it impossible to go to print. Many of these issues have been overcome during the subsequent months since the completion of the project. The lack of a physical artefact does seem to have caused a disconnect between the students and the project.

Conclusions

This paper looked at a number of questions. Firstly, it examined whether peer learning would take place during an online collaborative design project. Peer learning did take place during the course of the project through access to the online book. The book was documenting the creative processes of twenty-one individuals and this allowed fellow students to gain insight into new approaches in the development of design solutions to design problems. As Baskin (2001) states, students gained new knowledge from being able to witness the behaviour of fellow students as they created design responses.

Secondly the project examined whether students would find it beneficial to digitally document a creative process. The documenting of the creative process was beneficial because it allowed for continuous access to an ever-developing resource of visual research, visual development and final submissions. This allowed students to gain insight into different thought processes, be inspired by fellow students' visual research and development, and techniques and styles. As Palloff and Pratt (2005) discussed, unobstructed access to this online material allows for learning opportunities to occur. This pooling of visual content by the twenty-one students created a source of inspiration that no one individual could have created which concurs with Baskin's findings (2001).

Thirdly the project examined whether an online collaborative project would be beneficial for students in their

own development as designers. The project was beneficial to the students' development as designers because skills were developed or improved. Various professional bodies have clearly highlighted the importance of collaboration in becoming a better designer (ICOGRADA 2011; Design Council 2007; AIGA c2008). As a result of this collaborative project improvements occurred in areas such as their technical/skill levels, time management, experimentation, new insight into creative processes and the improvement of analytical skills.

Recommendations for Second Cycle

Scope of Project

The scope of the project was far greater than initially thought. The time commitment involved in the monitoring of the project needs to be re-examined for the second cycle. There were sixteen submission dates over the course of the semester each of which, if missed, had repercussions on other members of the class. This area needs to be examined.

Use of Blog

The use of a blog to support the learning of new techniques and skills was merely satisfactory and could be improved. The concept of the class pooling their research on techniques/skills did not take hold within the class to the extent expected. If new techniques/skills were improved it was through online text based tutorials that were found by the individual. The majority of these were not shared. This area needs to be supported to a greater extent.

Technical Issues

Booki is an open source piece of software and is still developing and therefore it can be temperamental. There were a lot of technical issues resolved since the commencement of the project concerning the creation and publishing of the book using Booki. This should allow for a more productive second cycle of the project.

Assessment

The realignment of assessment within the project must be examined to place a higher importance on each of the chapters of the book and the book itself. More emphasis must be placed on collaboration and communication. Cutting down the amount of deliverables within the project must also be examined.

Acknowledgements The author would like to thank Hilary Barrett and Damian Gordon for their helpful suggestions and the students who created this project and were so giving of their time.

References

- AIGA. (c.2008). Designer of 2015 Competencies.
Retrieved from: <http://www.aiga.org/designer-of-2015-competencies/>
- Astin, A. W. (1993). What Matters in College? *Liberal Education*, 79(4), 4 -17
- Baskin, C. (2001). The Titanic, Volkswagen and collaborative group work: Remaking old favourites with new learning technologies. *Australian Journal of Educational Technology*, 17(3), p265-278.
- Charitos, D. Korkidou, V. Meimaris, M. (2010). The E-MobiLart Project: An Experiment in Collaboration at the Intersection of Art, Science and Technology. *Leondardo*, 43(5), 480-481
- Churches, A. (2009). Bloom's Digital Taxonomy.
Retrieved From:<http://edorigami.wikispaces.com/file/view/bloom%27s+Digital+taxonomy+v3.01.pdf>
- Coghlan, D. Brannick, T. (2001). *Doing Action Research in your own Organization*. Sage Publications, London, United Kingdom.
- Creswell, J. W. (2007). *Qualitative Inquiry & Research Design* (2nd Ed). Sage Publications, London, United Kingdom.
- Denscombe. M. (2007). 3rd *The Good Research Guide*. Open University Press, Berkshire, England, SL6 2QL
- Design Council. (2007). High-level skills for higher value.
Retrieved From: <http://www.designcouncil.org.uk/publications/high-level-skills-for-higher-value/>
- Dillenbourg P. (1999) What do you mean by 'collaborative Learning'?

- Retrieved From: <http://hal.archives-ouvertes.fr/docs/00/19/02/40/PDF/Dillenbourg-Pierre-1999.pdf>
- Elliott, J. (1991) *Action Research for Educational Change*. Open University Press, Buckingham, UK
- Gillies, R. M., Ashman, A. F. (2003). *Co-operative Learning*. RoutledgeFalmer, London, United Kingdom.
- Haugwitz, M., Sandmann, A. (2010). Collaborative modeling of the vascular system – designing and evaluating a new learning method for secondary students. *Journal of Biological Education*, 44(3), 136 -140.
- ICOGRADA. (2011) ICOGRADA Design Education Manifesto.
Retrieved From: http://toolkit.icograda.org/database/rte/files/PR_IEN_Manifesto2011_webres.pdf
- Lambert, S. (2003). Collaborative Design Projects: Evaluating Students' Online Discussions. *Proceedings of the 20th Annual Conference of the Australasian Society for Computers in Learning in Tertiary Education*. Adelaide, Australia.
- Lea, M., Rogers, P., Postmes, T. (2002). SIDE-VIEW: Evaluation of a system to develop team players and improve productivity in Internet collaborative learning groups. *British Journal of Educational Technology*, 33(1), 53-63.
- McNiff, J., Lomax, P., Whitehead, J. (2003). *You and Your Action Research Project*. RoutledgeFalmer, London, England.
- Palloff, R. M., Pratt, K. (2005). *Collaborating Online*. Jossey-Bass, San Francisco, United States of America
- Smith, B., L., MacGregor, J., T. (n.d.). What is Collaborative Learning?
Retrieved From: <http://learningcommons.evergreen.edu/pdf/collab.pdf>
- Wang, W. Shih, S. Chien, S. (2010). A 'Knowledge Trading Game' for collaborative design learning in an architectural design studio. *International Journal of Technology, Design and Education*. 20(3):433-451