

A Successive Approach to Multidisciplinary Teamwork in Undergraduate Design Education: From Dysfunctional to Functional Teams

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Abstract

The broadening scope of design is changing ways of engaging with stakeholder groups outside the design disciplines. The multidiscipline collaborative space is acknowledged as being essential for design students to experience whether in practical terms in a design project or when engaging in research-based inquiry. While more research is now available introducing various aspects of successful collaborations in design education there is still a lack of studies that explore how multidisciplinary teamwork can be introduced in undergraduate design education in practical terms. This paper reports on the introduction of a successive approach to multidisciplinary teamwork in an undergraduate media design degree. It provides unique insights on practical implications when preparing design students for a multidisciplinary and collaborative work environment in the workplace. The study explores multidisciplinary team functionalities, the effectiveness of the successive approach and hence explores whether changes in students learning occur though introducing students multiple times to multidisciplinary teamwork. A pragmatic research paradigm was applied to this study which reports on a three-year trial. Perspectives from 235 second and third year media design students who participated in three multidisciplinary subjects are explored. Media design students were surveyed anonymously, using online questionnaires that collected quantitative and qualitative data. Findings suggest that through building on each learning experience students develop greater confidence to participate in multidisciplinary collaborations and learn to work with challenging people. Although some media design students felt they had been part of a dysfunctional team, it was the minority of students across the three subjects.

Keywords: multidisciplinary collaboration, teamwork, undergraduate design education

1. Introduction

Design has been identified as one of the key sectors that can drive economic development and can become a driver for social, public and economic innovation (e.g. Bakhshi and McVitte, 2009; Bason, 2010; Design Council, 2011; Australian Government, Minister for the Arts, 2011). According to Irwin, Tonkinwise and Kossoff (2015) these most recent developments “sparked a proliferation of design related sub-disciplines and new ways of working that include interaction design, experience design, participatory design, co-design, service design and design for social innovation.” (p. 3). Something that is common to most of these design areas is that designers engage with different stakeholder groups that extend beyond a traditional client-designer relationship. These stakeholder groups can be the end users of a product, service or process to be created, other people outside a company or organization and the wider community in general. Therefore, people who benefit from the service, product or process to be developed or improved are actively participating in the creation process. This is different from user-centered design, where the end-user or customer is the subject of observation as a source for development or improvements (Sanders and Stappers, 2008).

The digital revolution has once before changed the design profession resulting in new design areas to emerge (e.g. web design, information architecture, augmented reality) and other areas disappearing (e.g. print plate maker) (Kerlow, 2001; Davis, 2005; McMillan, 2009; Fleischmann, 2013a). These along with newer changes to the design profession have in common that the design discipline has transitioned from being considered a ‘lone wolf’ profession to an often collaborative activity. Developing highly complex technological interactive design projects can require a multitude of expertise (e.g. various IT specialists, photographer, conception, writer, composer, etc.). Engaging in participatory, human-centred innovation processes such as design thinking or co-creation requires, similarly, the input from a multitude of stakeholders from various backgrounds and disciplines areas. Collaborative teams can include experts from multiple disciplines and non-experts such as members of community groups or a citizen designer (Brown, 2010; Lockwood, 2010; Curedale, 2013). Designers therefore need to be capable to navigate and work in a multidisciplinary space and with various stakeholder groups. They need to be able to communicate with people from various backgrounds and disciplines as well as understand and value the contribution of each team member.

This broadening scope of design and changing ways of engaging with people outside the design disciplines needs to be reflected in design education. Design students need to be prepared for this multidisciplinary and collaborative work environment (Taboada & Coombs, 2013; Fleischmann, 2014; Napie & Wada, 2015; Bailey, Aftab & Smith, 2015). Design programs seem to have adapted, with many programs

offering project-based subjects that engage students in design thinking, involve community groups and have project aims that improve the well-being of people. Due to design also developing into a stronger research discipline, more literature is available showcasing this trend. However, case studies often report on the success of multidisciplinary project collaborations and focus hereby on the project outcome and outside stakeholder satisfaction (e.g. client, community). Often less emphasized and explored is the learning experience of students. In particular research that explores multidisciplinary team performance, team functionalities and issues around design students learning together with students from disciplines outside their expertise area (beyond the creative arts) is still rare to find. This paper therefore reports on the introduction of a successive approach to multidisciplinary teamwork in an undergraduate media design degree. The study explores multidisciplinary team functionalities, the effectiveness of the successive approach and hence explores whether changes in students learning occur though introducing students successively to multidisciplinary teamwork.

2. From digital revolution to social innovation – today's collaborative design education

The speed with which the digital revolution, in particular the internet, changed the way people live, communicate, play, shop and work, was not always reflected in design programs. The teaching and integration of new technologies has been slow. The conceptual creation and production of technology-driven design projects requires often input from different discipline areas which in a university environment often means input from students and educators located across different schools, departments, or faculties. Institutional structures contributed therefore to a slow integration of multidisciplinary collaborations because there is a silo mentality found in many institutions still until today (Szenasy, 2004; Bar-Eli & Jacoby-Volk, 2014). Friedman (2012) argued at the time, “professional design practice involves advanced multidisciplinary knowledge that presupposes interdisciplinary collaboration and a fundamental change in design education” (p.150).

The recent developments in design education which engage students in participatory design processes such as Design Thinking and Co-Creation (e.g. Ligon & Fong, 2009; Mostert-Van Der Sar et al., 2013; Bailey, Aftab & Smith, 2015; Napie & Wada, 2015; Reitsperger, Hestaed, & O'Reilly, 2015) seem to have moved forward much more quickly. The push towards multidisciplinary or even transdisciplinary teamwork to be integrated in design education has become a reality that cannot be ignored. “This is driven by a broad realisation that complex multi-dimensional problems cannot be solved by single ‘siloes’ organisations” or discipline (Bryson, Crosby, & Stone, 2006). There is a stronger realization that “one of the main tasks of academia today is to address the challenges involved in breaking the boundaries between disciplines by encouraging transdisciplinary approaches and allowing as many actors as possible to participate in the process of learning and teaching design” (Bar-Eli & Jacoby-Volk, 2014, p.76).

Collaboration, be it in multi-, inter- or transdisciplinary teams means “to work with another person or group in order to achieve or do something” (Marian-Webster Dictionary). Choi and Pak (2006) explain the “common words for multidisciplinary, interdisciplinary and transdisciplinary are additive, interactive, and holistic, respectively”. In a multidisciplinary team, members contribute different disciplinary perspectives and skills which are complimentary and necessary to achieving a goal or outcome.

The multidiscipline collaborative space is acknowledged as being essential for design students to experience whether in practical terms in a design project or when engaging in research-based inquiry. Irwin, Tonkinwise and Kossoff (2015) comment, “living in & thru transitional times requires a mindset and posture of openness, mindfulness, self-reflection, a willingness to collaborate. It is based upon a new, more holistic worldview and ecological paradigm” (p.20). Chornyak (2015) remarks “working with complex problems for the students reinforces the necessity for design practitioners to be skilled in systems thinking, and further substantiates the need for a multi-disciplinary collaborative approach that is research oriented” (p. 45). Although concurrently design educators debate whether to educate a generalist or specialist designer, there seems to be agreement that for graduating design students today, the “willingness and desire to collaborate and foster positive interactions among groups is seen as an essential skill” (Irwin, Tonkinwise & Kossoff, 2015, p.23). The changing work practices and employers looking for such skill, which is not necessarily specific to future careers in design, undoubtedly inform such thinking.

As mentioned earlier, progress has been made in that more research on collaborative approaches in design education is available. Nevertheless, there is still a deficiency in research that explores practical terms of multidisciplinary teamwork such as the functionalities of teams, for example. This paper contributes in that practical space in that it explores team functionalities in multidisciplinary collaboration and investigates challenges and benefits undergraduate media design students experience within their functional and dysfunctional multidisciplinary teams. Broadly this study explores the impact on the learning experience of undergraduate media design students when they are introduced to multidisciplinary teamwork with disciplines beyond the creative arts in a successive manner.

3. Implementing a successive approach to multidisciplinary teamwork in an undergraduate design degree

A successive approach to multidisciplinary teamwork was implemented in the media design major in a Bachelor of New Media Arts degree. Media design students engage successively in multidisciplinary teamwork starting in second year collaborating with IT and multimedia journalism students, continuing in first semester in third year collaborating with IT students, and finally media design students experience a culminating capstone experience in their last semester in third year collaborating with up to four other creative arts and three non-creative arts disciplines, education, business, IT, multimedia journalism. The successive approach to introducing multidisciplinary teamwork intends to build up students' practical experience in multidisciplinary teamwork and hence prepare them various multidiscipline team situations in their future workplace.

In the three subjects, learning is based around a project, which increases in complexity in each semester. In subject one, a commercial or community client provides a project brief. In subject two students are given a problem to frame and solve rather than a complete project brief. In subject three, student teams self-select their projects. These can be experimental or responding to a client brief. To enable students to work effectively as part of their multidisciplinary team, supporting teamwork activities are introduced in each subject. Supporting activities go from a more 'holding hands' approach during the first time students experience multidisciplinary teamwork in that the teams are formed by educators and the project brief is provided by a client to leaving students free reign when choosing their teams and projects in their third multidisciplinary teamwork experience. Lectures about effective teamwork, conflict resolution and communication techniques are also taught from introductory level to a more advanced level in the three subjects. A detailed description on strategies for team building and learning and teaching (pragmatic principles) which aim to facilitate an equal learning experience for all participating disciplines utilised as part of the successive approach can be found elsewhere (Fleischmann, 2015; Fleischmann, 2013b). Below follows a short description that outlines the advancing level of support for each subject.

3.1 Subject 1 – multidisciplinary teams consisting of students from media design, multimedia journalism and Information Technology (IT)

Students with no prior multidisciplinary teamwork experience are assisted in their team building. Students are asked to complete a skill and motivation survey. Educators form teams that have strength in design, IT and organisation/management based on the supplied information. Table 1 shows the survey.

Table 1. Skill and motivation question to form functional teams with equal expertise distribution

<p>As a member of a web project team, I would like my role to be in:</p> <ul style="list-style-type: none">● Web design IT● Web design● Management and production of web projects <p>I am competent in</p> <ul style="list-style-type: none">● Photoshop/Illustrator● CSS/HTML● Programming● Writing/researching <p>I am really keen to learn more about</p> <ul style="list-style-type: none">● Photoshop/Illustrator/Dreamweaver for web design● CSS/HTML/Dreamweaver for web development● PHP/MySQL for dynamic websites● Writing/researching/marketing and conceptual development of web projects <p>What is your work style?</p> <ul style="list-style-type: none">● I prefer working on assignments right from the beginning in order to avoid the last minute stress when the assignment is due.● I need the pressure to build up. I often work on assignments during the last couple of days/nights before they are due.

On the day students meet their team for the first time, they engaged in different icebreaker exercises to help them to get to know their peers. This involves an exercise with students from all disciplines outside the computer lab (Figure 1). Some students, particularly ones from other disciplines, tend to be very self-conscious since they do not know the other students. Students might feel uncomfortable in getting together in teams and tackling the project with five strangers, therefore the first icebreaker exercise is introduced to relief students of possible tensions. Educators (from design and IT) also participate in this exercise. After this first exercise students continue with another icebreaker exercise within their team, followed by discussions around work ethics in the teams. For example, each team negotiates what to do when a team member does not show up or arrives late for a team meeting. These discussions also include reaching agreement on communication methods (e.g. email, Facebook, phone) and the exchange of contact details. A completed agreement form from each team is

emailed to the educators alongside a team photo.



Figure 1. First icebreaker exercise in Subject 1 with students from all disciplines

3.2 Subject 2 - multidisciplinary teams consisting of students from media design and IT

In the successive subject (Subject 2) all media design students and some IT students participated in the multidisciplinary teamwork experience in Subject 1. Consequently, media design students form their own groups and the IT educator groups IT students. Design and IT groups engage then in a Speed Dating process in which they get to ask each group questions. Groups are encouraged to prepare questions to explore work style, motivation and skill of respective disciplinary groups. After the Speed Dating Process is completed each group nominates possible partner groups they wish to work with. The educators then try to match each group with one of their preferred partner group. Table 2 shows typical Speed Dating questions developed by student groups.

Table 2. Examples of Speed Dating questions developed by student groups

Speed Dating Questions – example

- Are you a morning, afternoon or night-time worker?
- Do you work continuously or in a last minute rush?
- How quickly do you usually reply to emails?
- Are you able to attend group meetings on Mondays 5 - 7pm?
- Are you happy to collaborate online?
- What do you think of the term "HTML is poetry"?
- What do you want to get out of this project?

On the day students start working with their multidisciplinary team, they engaged in different icebreaker exercises to help them to better get to know their peers. This includes exploring disciplinary work processes, exchange discipline specific terms/language relevant to the project and discuss teamwork expectations. For example, students engage in a task, which requires each discipline to explain their discipline-specific production process for the project. Each team discusses how different disciplinary work processes can be best brought together on the project.

3.3 Subject 3 - multidisciplinary teams consisting of students from media design, digital photography, digital sound, digital visual arts, performance and education, business, multimedia journalism, IT

Subject 3 is a culminating academic experience (a capstone subject) in which all participating students apply the knowledge they have gained throughout their studies to a multifaceted project/problem. All students in Subject 3 have participated in Subject 1 and Subject 2 and hence are arguably prepared to form their own multidisciplinary teams according to the skill set needed to produce the project or solve problem. The project is a self-selected by students and each multidisciplinary team must consist of at least three members from different disciplines. A project proposal form, which inquires about project goal, expertise requirements and timeline, helps students to build effective teams that are capable of producing the proposed project. An educator panel made up of two to three educators meets with each team before the start of the project to discuss appropriateness of team choice, budget and timeline. The educator panel also helps sourcing missing expertise within the available student cohort if required. Table 3 shows the project proposal form to be completed by student teams.

Table 3. Project proposal form that helps students to build effective teams and plan their projects

Project Name and student participants Major and minor study area/area of expertise What additional expertise is required to successfully complete the project? What type of project is it? (Exhibition / Performance event / film /web site etc.) Briefly describe the project: What are the expected outcomes of the project? Who will benefit from the project and in what ways? What resources will be required to realise the project? List major costs and source of funding (e.g. fundraiser): List the key responsibilities and performance indicators for each team member: List key dates in the timeline of project completion:
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3.4 Subject 1 – 3

Table 4 shows the number of teams formed in each subject.

Table 4. Number of teams formed in each subject during the three-year trial

	Trial 1	Trial 2	Trial 3	Participating disciplines
Subject 1	12 teams	20 teams	26 teams	Media design, multimedia journalism, IT; Each team typically included two design students, one multimedia journalism student and two or three IT students.
Subject 2	8 teams	8 teams	9 teams	Media design, IT; Each team typically included two to three design and IT students depending on enrolment numbers each year.
Subject 3	12 teams	12 teams	16 teams	media design, digital photography, digital sound, digital visual arts, performance and education, business, multimedia journalism, IT; The mix of team members ranged from three students from different disciplines (the minimum requirement for the projects) to teams consisting of nine team members from five different disciplines.

In all three subjects multidisciplinary student teams met weekly with educators to receive feedback on their project. During these meetings time lines are reviewed and team performance and possible issues are discussed.

All students attend lectures on effective teamwork and conflict resolution as part of each subject. The topics advance with the level of experience in multidisciplinary teamwork. Similarly, the requested depth of reflection (as part of submitted project documentations) increases towards the last subject.

The assessment in all three subjects evaluates the project outcome, discipline specific contributions, and team performance. All participating educators assess the project outcome, educators from respective disciplines assess discipline-specific contributions and peer assessment is used to evaluate work ethic, team performance (communication, motivation, reliability, etc.) and contribution towards achieving the project outcome. In Subject 3 students also need to engage in self-assessment. Each assessment part is weighted and can result in final assessment marks that differ within one team.

4. Research Methods

This study reports on a three-year trial, hence every subject was delivered three times. The research aim was to explore media design student perceptions of team functionalities and team dynamics, benefits and challenges experienced during multidisciplinary teamwork and the extent to which a successive approach to introducing multidisciplinary teamwork is effective in building multidisciplinary teamwork experience. A pragmatic research paradigm, which enabled the researcher to choose methods that suit the real-world nature of the situation (Creswell, 2008; Punch, 2009) was adopted in this study.

Media design students were surveyed anonymously, using online questionnaires in the final week of the class. The questionnaire contained closed-ended questions with multiple-choice answers, which were used to generate an initial overview of a situation. A closed-ended question was usually followed by an open-ended question, which explored rationales for answer choice. The feedback to open-ended questions would provide deeper insight into the researched phenomena (e.g., why did you find the experiences beneficial/challenging? please explain).

Data analysis was conducted as follows: For quantitative data obtained using online questionnaires, the survey platform, Survey Monkey, automatically provided basic statistical data, such as the tally of response totals, percentages and response counts. Qualitative data obtained from responses to open-ended questions in questionnaires were coded using the research analysis software NVivo. Typical quotes from students illustrate the identified themes.

Response rate for the three-year trial were in Subject 1: 64%, 66%, 72%; in Subject 2: 80%, 90%, 72%; and in Subject 3: 66%, 56%, 54%.

5. Findings: Team dynamics in multidisciplinary teams

5.1 Functional and dysfunctional teams

Media design students evaluated whether their team was ‘functional’, ‘somewhat functional’ (having some problems during the project but was generally functional) or ‘not functional’ in their final reflection. Table 5 summarises feedback from the three subjects.

Table 5. Student feedback on team dynamics at the end of the project

<i>Q: Do you think your team was functional, somewhat* functional or dysfunctional?</i>						
Subject	Trial	Student Type	Yes	Somewhat	No	Total n
Subject 1	1	Design	43% (n=9)	48% (n=10)	9% (n=2)	n=21
Subject 1	2	Design	56% (n=25)	33% (n=15)	11% (n=5)	n=45
Subject 1	3	Design	60% (n=36)	32% (n=19)	8% (n=5)	n=60
Subject 2	1	Design	44% (n=12)	33% (n=9)	23% (n=6)	n=27
Subject 2	2	Design	61% (n=11)	39% (n=7)	-	n=18
Subject 2	3	Design	50% (n=9)	44% (n=8)	6% (n=1)	n=18
Subject 3	1	Design	45% (n=9)	50% (n=10)	5% (n=1)	n=20
Subject 3	2	Design	43% (n=6)	50% (n=7)	7% (n=1)	n=14
Subject 3	3	Design	92% (n=11)	8% (n=1)	-	n=12

*a somewhat functional team was described as having some problems during the project but was generally functional

Table 5 shows that the majority of students felt that their groups were either functional or somewhat functional. Overall 21 of 235, 9%, media design students across the three subjects in three years stated that they have been part of a dysfunctional team. This is a positive outcome. According to media design students perspective in two of the nine trials there were no dysfunctional teams. Furthermore, there is a slight improvement when comparing the number of media design students who felt they have been in dysfunctional teams in their first multidisciplinary teamwork experience (Subject 1, Trial 1-3) to the number of media design students in their third multidisciplinary teamwork experience (Subject 3, Trial 1-3). The percentage of students who felt they were part of a ‘somewhat functional’ team has as a result increased in Subject 3 in trials one and two and trial three the team functionality has increased to 92%. However, it is interesting that there is no consistent trend visible in changes to the percentage distribution between ‘functional’ and ‘somewhat functional’ teams across the years. Subject 2, Trial one saw a larger percentage of media design students being part of a dysfunctional team (23%). This can be explained due to a high number of international IT students with poor English speaking skills participating in this particular trial, which created tension in some teams.

5.2 Team dynamics: altering challenges and advantages over time

Analysis of the qualitative feedback provided by students in ‘dysfunctional’ and ‘somewhat functional’ teams identifies the following common challenges. Table 6 shows these identified themes across subjects and trials and provides typical comments.

Table 6. Altering challenges over time experienced by design students in ‘dysfunctional’ and ‘somewhat functional’ multidisciplinary teams

Challenges in ‘dysfunctional’ and ‘somewhat functional’ teams: Changing themes identified			
	Subject 1	Subject 2	Subject 3
Trail 1	- difficulty in understanding the methods of other disciplines - poor communication	- poor communication - lack of contribution	- time management - unequal distribution of labour - poor communication
Trail 2	- personality clashes - lack of contribution	- poor communication - lack of contribution	- poor communication - unequal distribution of labour
Trail 3	- group dynamics: unequal number of discipline members - lack of contribution	- poor communication - lack of contribution	- poor communication - unequal distribution of labour
Typical comments			
	Design students and IT students function differently in expressing ideas, how they work and communicate and pretty much everything as a whole (Design Student 8, Trial 1). Three members of our team worked exceptionally hard to pull together our finish project. Unfortunately, we had two members (1 of whom dropped out and never told us) who did not contribute (Design Student 7, Trial 2).	We all got along fine, but we seemed to have trouble communicating anything properly. The designers didn't even know the IT girls were having troubles until the night before, when we actually sat them down and asked (Design Student 14, Trial 1). One IT member failed to show up to most meetings, didn't keep in contact and failed to produce any work (Design Student 5, Trial 3).	Each team member had different levels of commitment and work ethic (Design Student 6, Trial 2) A group member took the project on board as her own. This resulted in a lack of communication so that the group was kept uninformed about changes or problems that should have been discussed (Design Student 9, Trial 1)

To identify the advantages students experienced, students from ‘functional’ and ‘somewhat functional’ teams were asked to answer why the multidisciplinary team environment was working well for them. Analysing the qualitative feedback identified the following themes which are presented in Table 7 with typical comments.

Table 7. Altering advantages of working in ‘functional’ and ‘somewhat functional’ multidisciplinary teams as experienced by design students

<i>Advantages in ‘functional’ and ‘somewhat functional’ teams: changing themes identified</i>			
	Subject 1	Subject 2	Subject 3
Trail 1	- learning or benefiting from other disciplines - people can do what they are best at	- focus on pertinent project aspects - motivation - different skills	- group dynamics - passion - good communication - different areas of expertise
Trail 2	- learning or benefiting from other disciplines - better problem solving	- focus on pertinent project - - good communication - good team dynamics - working with different styles - being more innovative aspects	- different areas of expertise - innovation
Trail 3	- people can do what they are best at - gaining a different perspective	- good communication - good group dynamics - motivation - organization	- different areas of expertise - passion - motivation
Typical comments			
	The best part about having a multidisciplinary team is that as a team, you'll have more minds to work out problems and a lot more skill sets. (Design Student 11, Trial 2) I think our team was functional as most times a person from each discipline knew what they had to be doing and the work got done. (Design Student 4, Trial 3) It was great to work with people that have a different way of thinking so bring something different to the table. (Design Student 17, Trial 3)	We had a pretty good mix of skill sets within the group. We talked about the project A LOT. We were constantly questioning if things made sense, and how we could improve them. (Design Student 12, Trial 2) Team members were cooperative, highly skilled as well as hard working. We also all got along extremely well. There were never any conflicts. Discussions always resulted in really good ideas. (Design Student 8, Trial 2) Working in a multidisciplinary team worked well as we were able to focus on our own strengths instead of trying to complete all of the work individually. (Design Student 6, Trial 3)	Everyone was also very open and receptive to each other's visions and needs, thus compromise was a huge aspect of our team environment (Design Student 9, Trial 1) Multidisciplinary teams allow for such great ideas to be developed! (Design Student 2, Trial 2) Every team member was very like-minded, passionate, creative and enthusiastic. Not being able to work in such a group would indicate that you are destined to fail in any team environment. It was an almost perfect group. (Design Student 12, Trial 2) We were all motivated to achieve a common goal and we were competent enough to split the workload and work on our sections independently. (Design Student 1, Trial 3)

Tables 6 und Table 7 provide a good insight and understanding of the student experience particularly when comparing overlaps of themes. Some themes emerged in earlier trials as being challenging but students identify them as also an advantage in later trials. Communication, for example, is identified as being challenging (poor communication) across all cohorts but emerged also as theme ‘good communication’ starting in Subject 2. This suggests perhaps that learning has occurred and teamwork skills have developed. Analysing student comments further, the theme ‘poor communication’ describes different occurrences including communication is “limited” and communication is “difficult at times between designers and IT”. Limited communication is independent of disciplines and refers to student’s lack of communication, such as not responding to emails. Difficulties in communicating with the other disciplines point to two problems; firstly, that of not understanding the other discipline, which also emerged in one instance as a theme itself in Subject 1 trial one, and secondly, the lack of English speaking skills of an international student cohort in two trials, which caused Australian students to complain.

It is pleasing that themes such as ‘passion’ and ‘motivation’ emerged in Subject 3. This suggests that students feel comfortable in the multidisciplinary team and have developed an understanding of the teamwork and communication processes which were built up though participation in earlier trials.

It is notable that a ‘lack of contribution’ occurs mainly in trials of Subjects 1 and Subject 2. This theme changes to ‘unequal labour’ in trials of Subject 3. While the themes are similar and relate to motivation of students and their willingness to learn, the earlier instances (Subject 1 and Subject 2) include situations where students discontinued a subject after the teamwork had already started due to the subject being an elective

subjects for these students. The success of multidisciplinary collaborations is to a certain degree always dependent on institutional factors that are beyond the control of participants or educators.

6. Findings: Effectiveness in building multidisciplinary teamwork skills through a successive approach to multidisciplinary teamwork

Students of Subject 3 were asked at the beginning whether their previous two multidisciplinary teamwork experiences had better prepared them for entering their third multidisciplinary subject. Table 8 shows the feedback from media design student.

Table 8. Effectiveness of preparing design students for multidisciplinary teamwork as successive approach

Q: Do you think that your previous two experiences with multidisciplinary collaboration have better prepared you for Subject 3?

Subject	Trial	Student Type	Yes	No
Subject 3	1	Design	85% (n=11)	15% (n=2)
Subject 3	2	Design	100% (n=14)	-
Subject 3	3	Design	94% (n=16)	6% (n=1)

Media design students felt that they were better prepared for the most advanced multidisciplinary teamwork experience in Subject 3, with only three of forty-one students disagreeing. Although the cohorts were small, qualitative feedback gives some insights why the majority of students felt better prepared to participate in the most advanced multidisciplinary collaboration (capstone experience). The most common themes that emerged were the following:

- Better understanding of multidisciplinary teamwork
- More confidence
- Experience working with larger projects drawing on multidisciplinary expertise
- Experience in working with difficult people.

Typical comments from media design students illustrate that students have developed an understanding of how to work in multidisciplinary teams including working with people from areas beyond the creative arts, with a different subject culture to their own. A media design student stated, "Working with IT has taught me to look at a project through a different perspective. It has allowed me to develop my communication and collaboration skills, and I learnt to work with lots of different people and personalities" (Design Student 10, Subject 3, Trial 2). Another student commented, "We are now able to work with disciplines like IT and understand the process that we have to go through to reach our goals of the project" (Design Student 4, Subject 3, Trial 3).

The qualitative feedback also illustrated the evolution in students' learning, developing skills, and understanding of effective multidisciplinary teamwork. A student stated, "I think we have all matured over these three years and have learnt what works in a group situation and what doesn't, and we can now see the signs of when a project is about to go horribly wrong" (Design Student 8, Subject 3, Trial 1). The following comments illustrate the progression of student learning. A media design student commented, "All collaborative projects have aided us as we are now aware of certain pitfalls involved (such as identifying 'slackers') and how to adequately deal with the situation. It is also much easier to 'get the ball rolling' earlier and to take charge if needed" (Design Student 2, Subject 3, Trial 2). Another student stated, "The large scale projects have prepared us for what is expected of us and built up experience with teamwork over time. I think that if I had not done the previous two projects my reaction to this huge project would have been 'WHAAAT?!' and total confusion...however thanks to the previous experience I feel a lot more prepared and confident" (Design student, Subject 3, Trial 1).

7. Conclusion

The implementation of a successive approach to multidisciplinary teamwork in undergraduate design education through introducing students in three successively taught subjects to multidisciplinary collaboration is considered effective in that design students feel increasingly confident and better prepared when participating in complex multidisciplinary collaboration. Through building on each learning experience in three multidisciplinary collaborations, media design students were able to develop a better understanding of multidisciplinary teamwork processes. They had learned to draw on multidisciplinary expertise when working with larger projects. Over time, media design students developed greater confidence to participate in multidisciplinary collaborations and learned how to work with difficult people.

Team dynamics have been surprisingly satisfactory across the three subjects. Although some media design students felt they have been part of a dysfunctional team, it was the minority of students across the three subjects and trials. The majority of students experienced learning as part of a functional team or as part of a team that experienced some minor challenges. That multidisciplinary teams experience some tensions or challenges is

to be expected in most team environments in particular where members have not been working together previously. Benefiting from the two multidisciplinary learning experiences, there was a slight improvement when students participated in the third multidisciplinary collaboration; fewer students felt they have been part of a dysfunctional team.

Student feedback provided evidence for changes that occurred in students' learning experience through their successive engagement in multidisciplinary teamwork. For example, the identified lack of contribution from some team members during the first two subjects changed to media design students feeling that all team members contributed to the project outcome but not equally. While this is an improvement on one side, it also highlights that future interventions might be needed to monitor the lack or unequal contributions. This can be achieved through either educator intervention or through giving students more responsibility for their learning. Student teams could assign detailed tasks and responsibilities to members and link these to timeline milestones, which are reviewed weekly. This could facilitate a more balanced contribution from each team member and make monitoring contributions easier.

That learning took place can also be seen in media design students developing their communication skills. While for some media design students poor communication skills remain a point of frustration throughout all subjects, good communication skills of team members were also identified alongside, starting with the second multidisciplinary teamwork experience students engaged in. It is positive that in the capstone experience (the third multidisciplinary teamwork experience), media design students described their team member as passionate and motivated.

It needs to be pointed out that team functionalities are very dependent on team formation processes, supporting teamwork lectures and the introduction of icebreaker exercises. Although throwing students into the deep end of multidisciplinary teamwork (e.g. giving students autonomy in team selection and working out their team issues) can result in valuable learning experiences, in case of the successive approach to learning to participate in multidisciplinary collaborations, team forming strategies, supporting teamwork activities and discipline specific learning activities are part of contributing to team dynamics that work (see Fleischmann, 2013b; Fleischmann, 2015).

Findings from this study will inform future developments of the successive approach. Further research is needed to also explore the perspective of students from other participating disciplines in depth to introduce changes in each stage of the approach that are effective for all participating disciplines. Furthermore, future research can focus on the viability of the approach in context of the changing work environment. Perspectives from students of all participating disciplines could be explored once they have graduated and are working in the industry hence are able to reflect on their learning experience within the workplace context.

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