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DESIGNING COLLABORATIONS AT THE INTERSECTION OF ACADEMIA AND INDUSTRY

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ABSTRACT
Since the Bauhaus, industry and product design education have been intrinsically linked. A century later, industry collaborations still form a major component in product design education. In 2016, the opportunity arose for around 50 undergraduate students studying both Product and Digital Interaction Design (BSc) at the University of Dundee to take part in the 2016 Microsoft Research Design Expo. This global student competition challenged the students to explore 'Symbiosis and the Conversational User Interface (CUI)'. Over the course of an 11-week semester, the students were divided into nine inter-disciplinary teams with one team later selected to disseminate their project at the annual Microsoft Faculty Summit conference in Seattle, USA. Through semi-structured interviews and focus groups with a sample of students, tutors and industry advisors, data was gathered to determine the influence of this collaboration on the total learning experience of all participants. In this paper, we briefly describe the background and context of the project before presenting a sample of student work. The paper then goes on to consider; the tension between competition and collaboration both within a team setting and the wider studio dynamic; how students interpret and incorporate input from both academic tutors and industry advisors; and the role prototypes play in the communication of ideas and concepts during the early stages of the design process. Reflecting on the major relationships and behaviours that all participants need to display, the paper concludes with a series of recommendations that we believe are essential for the design and delivery of future collaborative projects between industry and academia.

Keywords: Complexity, Collaboration, Competition, Design, Education, Prototype and Student learning experience.

1 INTRODUCTION

Design forms the natural interface between the resolution of wicked problems and the range of disciplines in which they are found. Designers are therefore encouraged to embrace uncertainty, ambiguity and complexity in their thinking and making processes. In order to nurture a designer's mindset [1], collaborations between academia and industry have formed an integral part of a student's learning experience in Higher Education for many years [2, 3]. They are a *"critical component of an efficient innovative ecosystem"* [4]. Indeed, a successful collaborative experience can provide students with an opportunity to: apply existing know-how to a more relevant problem domain; increase enthusiasm and motivation within the subject area; develop a better understanding of professional design practice and improve their performance in achieving intended learning outcomes. Furthermore, real world collaborations can enhance interpersonal and transferable skills, thereby ensuring a smooth transition between university and commercial design practice: *"It is important for students to understand how to position themselves in the real world. It is important that the university creates a safe learning environment, but it is also important to learn and experience the real world – and to understand the differences."* [5]. Many global companies, with a particular research-intensive focus, have pointed out that accessing the expertise of universities through design-led student collaborations, can not only facilitate the transfer of knowledge exchange, but also stimulate their R&D programmes and learning environments: "*We're trying to push design to the front as a premium discipline in an engineering culture. Teach the engineers in our company what it is to do good design, allowing them to see a diversity of student work, or even the way students approach problems"* [6]. However, despite

these apparent short and long term benefits, legal disputes, funding issues and ownership of intellectual property can be common pitfalls in collaborative partnerships between academia and industry. Not only that, these pitfalls can influence students' motivation and behaviours throughout the operational aspects of team projects, thereby adding to their complexity, confusion and disagreement, particularly if they are not carefully managed by academic tutors and industry advisors. The role of the industry advisor within these collaborations, therefore, makes for an interesting dynamic between student, tutor and advisor, especially in relation to the differences between industry and academic perspectives.

2 CONTEXT AND BACKGROUND

The University of Dundee collaborated with Microsoft Research Cambridge on student design competitions in 2008 and 2009 [7]. In 2016, another opportunity arose for around 50 undergraduate students studying both Product and Digital Interaction Design (BSc) to take part in the 2016 Microsoft Research Design Expo. This global student competition, where 8-10 international schools are invited to respond to a technology-led, Human Computer Interaction (HCI) design brief, challenged the students to explore 'Symbiosis and the Conversational User Interface (CUI)' [8]. This complex design brief required students to design a product or an experience that demonstrated the value of the CUI in combination with machine learning (i.e. products that have the ability to learn and develop new routines over time without being re-programmed) and artificial intelligence (i.e. perceptive listening, intelligent reasoning and understanding the intent implied in words). The 50 students were divided into nine inter-disciplinary teams with one team later selected to disseminate their project at the annual Microsoft Faculty Summit conference in Seattle, USA. A major feature of the project was that students were confronted with the need to collaborate in teams but at the same time for each team to compete for a substantial reward. Over the course of the project, teams encountered three modes of operation: cooperating; competing; and a hybrid state (simultaneous cooperation and competition). For many individual students, operating within any one of these modes was like competing in a rodeo – turbulent, unpredictable and at times disturbing.

2.1 Curriculum Design

Product Design [9] and Digital Interaction Design [10] at the University of Dundee share a design process that begins with human-centred design research before experimenting and playing with technology to build working prototypes in order to test and share ideas. Over the course of an 11-week semester, the student teams worked through five distinct phases of the project: 1) User Research & Insights; 2) Idea Generation & Concept Development; 3) Experience Prototyping; 4) Design Development; and 5) Asset Creation. Interim deadlines were structured around each of these phases with deliverables submitted ahead of tutorials to allow specific feedback on the team's idea and future direction. Before the start of the semester, students were tasked with researching CUIs by interviewing friends and/or family members. On the first day of the module, students formed teams based on their findings from this initial research task. Each team was then free to adopt their own design process, although this was partially constrained by the module structure and timeline. Time was also scheduled (one day per week for each course) to focus on the core skills of their specialisms (e.g. physical prototyping, model making and form creation for the product design students). Microsoft appointed two advisors to the project from the Microsoft Human Experience and Design Group at Microsoft Research in Cambridge. The advisors visited the students in Dundee three times within the 11-week semester, in week 1 to introduce the brief and provide an overview of work completed at Microsoft Research, in week 6 to critique the students experience prototypes and discuss each teams design concept in tutorial sessions, and in week 11 to listen to each team's final presentation and provide feedback to each team.

2.2 Student Design Process & Outputs

The project generated high quality ideas and outputs. Concepts ranged from a social table to facilitate conversations between strangers in public spaces, to a device for enhancing the experience of bedtime stories for children suffering from deafness, to a spoken word journaling tool to capture thoughts and data from everyday human interactions. The team selected to disseminate their project at the Research Faculty Summit continued to evolve their concept between May and July 2016 with additional iteration and user testing. Their project, *Otto*, was a playful and intelligent device for children with

autism. It '*builds up an understanding of a child and then adapts its responses to the personality and current mood of the child, encouraging them to express emotions through vocal and physical interactions'* [11]. The device can also act as a bridge between a vocally non-responsive child and their parents while encouraging activities to enrich and nurture the parent-child relationship (Figure 1).

Figure 1. Early user prototype testing

Figure 2. Students presenting

3 DATA GATHERING

In order to explore the influence of this collaboration on the total learning experience of all participants, data was gathered through an anonymous online student survey (25% response rate) and semi structured interviews with a sample of students, tutors and industry advisors. In addition, a focus group was conducted with the student team who attended the Expo using a modified version of the POINT Analysis Framework [12] to investigate the factors which facilitated or impeded the learning experience for all participants over the course of the 11-week project.

4 RESULTS AND DISCUSSION

The following sections discuss the key findings of the collaboration on the following themes; competition and collaboration; interpreting and incorporating input from multiple perspectives; the role of prototyping throughout the student design process; and flexible pedagogies for collaborative learning in Higher Education.

4.1 Balancing competition and collaboration

It was noted throughout the module that the pressure of an industry brief could increase motivation to deliver strong projects, as one participant reflected, *"It was great to be challenged and go from zero to a full industry brief in second year."* This increased motivation was, in part, due to the competitive nature of the design project, as one participant reflected, *"If the idea is good enough you'll compete with other design schools internationally – definitely a totally different model to a standard university project"*. Some students commented negatively on the pressures of competing both within the studio against peers and internationally against other design schools, saying, *"It created divisions within the class, as people were taking it too seriously."* It was part of the intention but not clearly stated from the outset that the relationship between participants and the project would generate atmospheres of both cooperation and competition. The industry advisors also provided an interesting viewpoint on this delicate balance, "*It would be nice to keep the groups and the competition aspect, but to also have a collective output afterwards. There is something nice about having so many students from so many departments tackling this challenge."* Clearly then, the balance between competition and collaboration is an area that academic tutors should pay careful attention to, making sure that it remains a positive influence on the cohort (sharpening of intellect under pressure, greater creative input, increase in group motivation and productivity), whilst at the same time encouraging the joy of within-team inter-individual collaboration and competition.

4.2 Balancing feedback from multiple perspectives

The project also provided opportunities for students to draw upon feedback from both academic tutors and industry advisors at key points throughout the project. Students' commented that academic tutors feedback primarily aimed to support the development ("looks-like" and "works-like" prototypes) of the initial concept and how this could enhance their overall learning and performance, *"Academic feedback was more specific to how it looked, how it worked, how it was actually made and what it was*

made from, rather than the concept idea". On the other hand, it appeared that the industry advisors were interested more in the market viability and feasibility of the idea, with one student pointing out, *"Industry feedback was more about the product, where it could go in the market, how it could be positioned, in a sense it was broader"*. Of course, both tutor and industry feedback matters and this was usefully summed up by one student, "*Academic staff are more interested in learning and exploration, but industry can be more focused on the product and why it does what it does."* The students' motivation to consider and prioritise both types of feedback is evidenced in the quality of the work produced. However, the competition aspect and perceived prize of attending the expo also provides insights into the student's motivations for incorporating the feedback. For instance, one student noted that since the industry advisors were also acting as competition judges, the team viewed incorporating industry feedback as essential in developing a 'winning idea'. This balance of providing the students with multiple perspectives is essential in creating interesting concepts and ideas that both fulfil the industry brief and also allow for learning core skills that are important in designing successful collaborations. In addition, it allows students to develop their own skills in synthesising and incorporating, at times, conflicting feedback in their design process – a valuable skill in commercial design practice.

4.3 The value of experience prototyping

Prototyping is an integral component of product design and engineering practice. In the context of this project, it was found the teams that developed a diversified portfolio of prototypes (e.g. sketches, drawings, sketch-models and prototypes) to communicate their ideas, generally received more valuable feedback from the industry advisors. In particular, some teams used a variety of open source prototyping platforms to create experience prototypes throughout the project (i.e. Arduino, Raspberry Pi, and various web hosted API's) for completing live speech processing. In doing so, this allowed the students to learn and refine their ideas through the playful exploration of emerging technologies. One student usefully captured the essence of this, "*Before this project, I would never have known that I could have built something like that. I'm a lot less sceptical now about what can be achieved, and less wary of exploring new technologies."* The length of time the advisors could spend with a team during each visit was limited, and it was observed that using physical prototypes and props to communicate their design intent and direction led to a much more productive discussion with the industry advisor. Teams that were reluctant to communicate through the use of experience prototypes spent more of their allocated time-slots describing and explaining their idea, which subsequently meant less time was available for specific input and direction from the advisors. In our experiences as tutors and researchers, it must be noted that responding to such a complex, technology-led design brief, challenged the students both intellectually and technologically throughout the project and as such led to confusion and lack of clarity during some of the earlier feedback sessions.

4.4 Supporting collaboration with flexible pedagogies

Collaborations with industry provide students the opportunity to understand the context of their studies whilst appreciating the differences between higher education and industrial practice. According to one of the industry advisors, *"It's important as university can feel like a safe bubble, but it's also important to learn and experience the real world – to understand the differences."* Designing meaningful collaborations should therefore combine an exciting blend of studio learning and working on real-world experiences in an industrial context. Integrating an industrial visit within the teaching curriculum is an important facet of product design education, as it allows students to gain a first-hand appreciation of the company itself (e.g. business philosophy, management styles, design process and R&D programmes and so on) as well as future career opportunities. Following the completion of the module, the opportunity arose for two student teams to travel to Cambridge to see the offices and lab facilities at Microsoft Research. One student remarking on this experience explained, *"It was really valuable going down to visit Microsoft down in Cambridge, interesting to see where and how they work. I thought, 'I could definitely see myself working here' when we were at their offices."* The theme of providing flexible learning provision between the Higher Educational Institution (HEI) and industry partners also emerged through discussion with the advisors, *"It would have been good to have the opportunity to work with the students in a more collaborative way, for example us organising a workshop in-between presentations to allow critical discourse or a hands-on experience where Microsoft and the University meet rather than it always feeling like the students are presenting their*

work to us." This idea of integrating collaborative workshop sessions with students, advisors and tutors also came up in conversations with students, *"It would have been great to have taken part in brainstorming exercises and work with the advisors in workshops within the class, rather than just receiving feedback."* The impact of a flexible, innovative learning environment on collaborations cannot be understated, and although there are various practical / logistical challenges in allowing a whole year group to travel, it would be interesting to explore curriculum development and studio approaches for making this happen.

5 RECOMMENDATIONS

What follows are a series of recommendations that we believe are essential for the design and delivery of future collaborative projects between industry and academia within an educational setting which will always be wicked in nature [13, 14]. These characteristics of wicked problems have recently been reduced to six major properties: multi-dimensional; multiple stakeholders; multiple causes; multiple symptoms; multiple solutions; and constantly evolving [15]. The following recommendations therefore reflect the major behaviours that all participants - tutors, advisors and students - need to display in their active participation during a live industry-led collaborative project.

1. We recommend careful communication and management of the tension between operational modes of cooperation, collaboration and competition in order to ensure that the positive advantages are not lost in this hybrid state. It is also important for tutors and advisors to provide a stimulating and celebratory conclusion to the proceedings [16].
2. We recommend that participants should actively engage in the full documentation of all aspects of the project in multiple ways (e.g. through the use of videos, diaries, websites and blogs) which will capture the hidden moments of reflection and celebration. This documentation should be open and available to all participants, and tutors should facilitate multiple sharing opportunities within the timetable to aid inter-team open collaboration.
3. We recommend crafting a careful balance between the implied 'winning team' and the rest of the cohort and ensuring each participants work is celebrated in a collective output, i.e. a shared, open publication when the project concludes.
4. In order to cope with emergent situations which are characteristics of wicked problems, tutors need to act flexibly not only in the delivery of pedagogical theory and practice but also in the facilitation of their interactions with students and teams. Likewise, but from an industry perspective, advisors also need to act flexibly in their contribution to the processes ongoing in the different teams but without providing any one team with a direct advantage.
5. We recommend tutors and advisors should actively facilitate opportunities within the curriculum for the student teams to work collaboratively with the industry advisors, e.g. planning creative workshops at key times within the curriculum. Additionally, we recommend that student teams are able to immerse themselves in the environments of the industry partner.
6. We recommend that tutors should encourage students to reflect carefully on the role and value of prototypes and methods of prototyping during the different stages of the design process. In other words, prototypes should be seen as tools for capturing and integrating different sources of feedback whilst encouraging positive interpersonal relationships and strong team coherence [17]. Schrage (2000) usefully emphasises the importance of prototyping as a way of building cohesion and increasing productivity in teams, saying: "*The prototype plays a more influential role in creating a team than teams do in creating prototypes"* [18].

In a changing world with constantly shifting lines between learning and producing, perhaps we need to rethink everything we assume about collaborative learning experiences. It is our experience that these principles can have a major impact on the effectiveness of student teams. We would welcome further opportunities to compare, reflect and refine our recommendations for the betterment of students everywhere.

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[12] Similar to SWAT analysis, POINT Analysis Framework is a structured tool developed by Martin Bontoft and Colin Burns (ex-IDEO in London) as way to capture conversation around a particular subject area. POINT stands for Problems, Opportunities, Insights, Needs and Themes.

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