INTER-YEAR TEAMWORK FORMATS EXAMINED THROUGH STUDENT EXPERIENCE

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ABSTRACT
This paper presents inter-year teamwork formats used in the general context of experiential problem-based learning in product design teaching at university level. The aim is to better understand the mechanisms that affect the success of inter-year teamwork among design students by looking at the student experience of team-working. A survey of 5th year product design students relating their experiences of two major inter-year group projects in their 3rd year of study highlights a number of key points. Subjects highlighted by these student written accounts are explored with reference to current academic research on team working. We introduce the notion of student feedback "at a distance" which may be a useful tool in helping to identify action areas in pedagogy without the evident drawbacks of short-term evaluation. Our findings give insights on small heterogeneous student teams and mostly confirm the advantages of inter-year team projects, providing useful building blocks for improving design students capacity to work in future complex collaborative environments.

Keywords: Inter-year teamwork, student feedback, project-based learning, self managed teams

1   INTRODUCTION
This research is limited to design studies at the ISD, (Institut Supérieur de Design) Valenciennes, France. Certain findings may be specific to the nature of the school which has a long history of team working. At the same time the familiarity with teamwork at the school and among students creates a de-dramatised context in which to choose and focus on certain key questions.
The start point of this research project were findings showing the contradictory nature of student experiences of team working, highlighting the more negative experiences of junior team members. [1].

1.1 Context
By the time a design student at the ISD reaches the middle of the 5th and final year of study, she or he will have completed at least 8 long team-based projects. The final four will have been major inter-year and multidisciplinary team projects with live clients. These "Inter-year" team projects at the school are composed of 3 to 6 students in different year groups, mixing for example 3rd and 5th year product design students and also often including one or two digital imaging students. In the semester-long project each team has weekly meetings with an attributed supervisor. At least 8 hours of common in-school time each week are dedicated to the team project. The subjects worked on by these student groups are very varied, and include work with major international companies, small start-ups, research organisations, public health institutions, other specialised educational establishments and local authorities. Generally each team will work with a different external partner.

1.2 Learning theories
The projects in our case study match the description of problem-based learning (PBL) given by Hmelo-Silver [2]; students working in collaborative groups on complex problems that do not have a single correct answer. Students learn through facilitated problem solving, are engaged in self-directed learning and reflect on what they have learned and the effectiveness of the strategies employed.
The model of learning is also close to the definition of experiential learning (ELT) [3] Kolb - the process whereby knowledge is created through the transformation of experience. Learning style assessment as advocated by Kolb is used in some parts of school for team composition - but not yet in the 3 to 5th year long projects. As these projects combine several year groups and also involve the

choice by each student of a subject that interests them, it could be quite complex to find a model for balancing both subject choice and student (learning) profile.

2 TEAMWORK

This research presents a case study of inter-year team-working in design education. Team is used in the sense defined by Guzzo and Dickson [4], and may not be very different from earlier expressions such as "work-group": made up of individuals who see themselves and who are seen by others as a social entity, who are interdependent because of the tasks they perform as members of a group. Current evolutions of the expression "team" suggest that a group becomes a team when there is a sense of shared commitment and a striving for synergy among members.

Team-working ability and communication skills are now highly-prized in job recruitment in design/engineering. These are ABET accreditation criteria for graduates in engineering programs [5].

But clearly team-work is not an answer to all problems as recent debates show. In a 2009 interview in the Harvard Business Review, team-work specialist J.R.Hackman states that having a team is often worse than having no team at all [6]. Susan Cain has also generated debate [7] by promoting solitude and the power of introverts against "groupthink". Team-working is a subject that continues to evolve.

2.1 Inter-year Teams

In the professional sphere the increased complexity of design problems means that today most design is carried out by teams [8] consisting of people with different backgrounds and disciplines and often including non designers (users, for example). For this reason students at the ISD in theory get a certain preparation for these contexts with inter-year team-working where projects are vertically integrated [9] in the curriculum. Giralt et al [9] conclude a case study on inter-year teams of first and fourth year students by saying that they feel the format is a success with learning spreading across the curriculum. They report an increased sense of working together within the school and staff as a whole and students better able to understand learning processes and strategies. A much less positive conclusion is made by Mann et al [10]. Citing recent research they expected these formats to enhance students' learning process by fostering productivity and complex problem-solving. They found in the context of their case study, mixing students of two or three different levels, that four main problems arose: difficulty scheduling team meetings, reduced informal discussion and learning time between same level students, senior students not possessing appropriate leadership skills and team leaders "taking-over" and not trusting junior members to do the work.

The well established presence of inter-year team-working within the school at the centre of our case study does not allow us to explore the holistic effects mentioned by Giralt et al [9]. On the other hand the points raised by Mann et al [10] will be discussed in our results section.

3 METHODS

Our analysis method is close to principles described by Nardi for studying activities in specific contexts [11];1)research timeframe long enough to understand actor's objects; 2) broad data collection, that allows paying attention to broad patterns of activity; 3)use of a varied set of data collection and analysis techniques; 4) commitment to understanding things from the actors' points of view.

Our main focus is on semester-long projects, undertaken by groups of 3rd and 5th year students (referred to as 3|5 projects) or groups of 3rd and 4th year students (referred to as 3|4 projects). We study two sets (3|5 projects and 3|4 projects) undertaken by the same group of 3rd year design students over one year, 2009-2010. Contemporary comments by staff and evaluations of these projects are compared with retrospective student written reports undertaken during their 5th (final) year of study, giving both multiple viewpoints and a long timeframe. Our aim is a certain level of cross validation [12] in our findings. We have also discovered some discrepancies, discussed in the Results section.

3.1 Data Source

16 out of a year group of 34 product design students currently in their 5th year of study gave detailed responses to our survey, of these 4 are female (roughly 20% of design students in the year group in question are female). 7 respondents are students who joined the school at the beginning of their 3rd year of studies which means this group is just slightly over represented (35% in the actual year group). In addition to this recent survey, we have also analysed 23 replies from an earlier survey for comments directly related to inter-year team-working. Both of these surveys, 39 in all, include detailed written

reflection at a distance of at least one and a half years, by students in their final year of study. We have also analysed 30 PPS [13] statements by 2nd year students where group working is widely commented. These samples give us a written source by students covering over 100 multidisciplinary team projects, and also over 100 non self-selected teams.

3.2 Data Collection

All student feedback in this research is "distanced" from the projects commented on and is based on individual experience. Discussing Design Team Self-Reports, Adams et al [12] highlight various problems with "design-log" type project assessment (students recording an ongoing project) and advocate perhaps putting these activities to the end of the project. During a project students may confuse project "goals" with actual processes, and may also omit or under-report certain activities which are less relevant to the work immediately in hand. We hypothesize that students reflecting on projects undertaken over a year before may give more balanced views of the project as a whole.

The process of reflecting is an inescapable part of designing innovating and making [13], and is often part of 3|5 projects, or 3|4 projects: students are encouraged to consider and document their actions and processes during a long team project and to include this in intermediate or final project presentations. Our research demands a different and individual reflection that needs to be clearly distinct from other logs and evaluations. Focusing on the individual experience during the project also might not be compatible with team-building.

A disadvantage of our approach could be loss of detail over time, but previous research [1] suggests this is not the case. Emotions linked to student experiences will affect how they subsequently reflect on and represent an event to themselves [13] ((Austerlitz)). For both these reasons, the method chosen for collecting data was an e-mail exchange, giving a certain invisibility [14] and time to reply. Rautio [14] suggests that written correspondence is an appropriate method for conscious reflection, meaning-making and interpretation of experiences, giving space and time to participants.

Students were sent a survey with three distinct parts: 6 open questions relating to initial team construction and conformity of personalities and methods, 5 closed questions - using a visual layout, and a final comment section for additional reflections. The first section functioned as written prompts for focused reflective comments for some students whereas for others replies were very brief. The layout of the 5 closed questions is closer to a Visual Analogue Scale (VAS) than to a Likert type scale. This method seems suitable for design students, visualising answers, which may help for reflection and remembering the experience. Current research [15] suggests that VAS is as effective as Likert and may reduce "questionnaire fatigue". The final free comment section generated replies of various lengths. Replies averaged roughly 300 words and remained very relevant to the research subject.

4   RESULTS

The following subsections describe the themes most often found in student written reflections and are supported by some quantitative results generated by the closed questions.

The effectiveness of teamwork can be assessed according to Hackman [16], with three criteria: the productive output of the team, the social processes used in teamwork that should maintain and enhance the capability of members to work together on subsequent tasks, the group experience that should on balance satisfy rather than frustrate the personal needs of group members. The results we discuss here fall mainly in the final two areas as these seem particularly useful for validating team project formats as ways of developing student ability to adapt to future complex multidisciplinary work environments.

4.1 Heterogeneous Teams

The point that generated the most comments in student replies in the 3|5 projects and 3|4 projects is the heterogeneity of the teams. A very large majority of these comments were positive. Adams et al [3] mention that teams with less similar members are often more innovative, but members need to work to value others who are different. The clear link between teams which allowed discovering strong individual skills and an appreciation of heterogeneity is evident in student replies: *"We weren't really alike, but we had complimentary skills"*, *"everyone listened and each one of us brought to the project what he knew best"*, *"there was quite good cohesion...each one had his strong points"*.

Less than a quarter of comments relating to this subject describe difficulties, eg. of reaching agreement.

Another theme in this subject relates to teams with students who get on very well together but where students recognise that the end result was quite weak. This seems to confirm the idea of "group-think" or excessive "cohesion" [3] where a lack of debate creates weaker project outcomes. Current research findings suggest that harmonious groups are not the most successful [6]. Stempfle and Badke-Schaub [17] suggest that one reason why heterogeneous teams are repeatedly found to outperform homogeneous teams may be the questions and discussions generated when team members have different levels of understanding (in our case, different levels of study).

4.2 Individual Experience

One of the more surprising findings is the divergent nature of student experiences within the same team. Clearly when one of the aims is to create heterogeneous teams, different views on the team can be expected. But these differing views seem to cover many different aspects of the overall experience: the creation or not of a "communication space" [3], the presence or not of a team leader, the quality of the final project outcome, the evolution of the team working atmosphere and the learning experience.

We should also note that the fine-grain of these experiences appears to be quite difficult for team supervisors and even other team members to identify. It seems likely that this can partly be linked to confidence. Discrepancies in evaluations between individual contribution grades/comments by staff and self assessment suggest students sometimes undervalue their input and work quality.

One student writes of his 3|5 projects and 3|4 projects that *"to do assessments of what is working or not in the team would be a good way of avoiding the development of problems"* which suggests that teams do not feel able to discuss their individual role in the team easily/informally. This in spite of the student saying that *"the projects went well in terms of getting on together"*.

4.3 Leadership

The question of team leadership demonstrates the variety of viewpoints, and generated a lot of reactions. In the current organisation for 3|5 projects it is generally accepted that the 5th year student(s) will act as group leader. Nevertheless in 20% of cases 3rd year students replied negatively to the question "was there clearly a person who lead the team?" In the case of 3|4 projects, only 40% of students stated there was a "leader". Project supervisors in both cases mostly identified one or more senior team leaders. Junior member viewpoints of the teams suggest quite different dynamics.

Two interesting points also appear in student replies relating to leadership. Firstly many comments suggest shared or rotating leadership and this generally in teams where junior members related their team work experience positively. Shared leadership [18] is seen in current research as an important condition of self managed groups. This is defined as a condition in which teams collectively exert influence and leadership is distributed among all team members depending on their skills, abilities and the task. Behavioural complexity [18] is based on the idea that for a leader to be effective in a team, it is essential that the leader engage in a wide range of behaviours. Very few comments in our study suggest a good level of behavioural complexity in individual team leaders. Generally teams with one 5th year student leader are experienced less positively than those with one 4th year team leader. This is perhaps because leadership is naturally more easily shared in 3|4 project teams. We can also note that teams with 2 senior student leaders tend to generate positive team experiences, except when these two leaders are too homogenous - creating the "taking over" effect mentioned by Mann et al [10] Using tools like the Competing Values Framework (CVT) it may be possible to evaluate the level of behavioural complexity of individuals or teams. In CVT four leadership quadrants; relating to people, leading change, producing results and managing processes, are arranged around a vertical flexibility/control axis and a horizontal internal/external axis. Our study replies suggest that successful teams use shared leadership to better cover the four quadrants. Projects in this case study now regularly include co-design elements, adding to the need for a high level of behavioural complexity.

Secondly good team management is very often mentioned in terms of good organisation. Comments clearly dissociate leadership (in the sense of decision making or orientation, or in CVT terms "leading change") from organisation ("managing processes"). Organisation appears to be highly valued by team members and is not seen as limiting team decision making. Organisation is also mentioned very frequently as a key piece of learning relating to 3|5 projects in particular. Stempfle and Badke-Schaub [17] report that structuring the group process is very important in effective team-working. Teams in their study spent 1/3 of project time on these group processes.

4.4 Learning

Two closed questions in the survey of 3|4 and 3|5 projects ask students to rank the project experience in terms of terms of learning and to rank their own contribution to the total team work. Average scores in our study are 3.03 on a scale of 0 to 5 for the learning experience, and 3.34 for personal contribution. This outcome is close to the two points ranked most highly by Vanhatalo et al [19] on student assessment of team working, "learning atmosphere" and "learning by doing".

Written comments mention slightly more peer learning in 3|5 projects as could be expected, but the learning experience score average is the same for both projects. Peer-learning is often mentioned in relation to both (other) junior and senior team-members. The personal contribution score can be seen as "learning by doing", and the average for 3|4 projects here is considerably higher, at 4.13. In terms of general learning experience, students mention time-keeping, organisation and "better team working".

Some students comment on their current situation as 5th year students and how this gives them understanding of previous team leader viewpoints, or a chance to apply lessons learnt in earlier team projects. Two contrasting quotes "*I understand now, being in the same situation... we really feel a big gap with the 3rd years and we don't always have the time (or don't take it) to explain to them...*" and "*I'm trying not to reproduce the errors committed in past projects and teach a maximum to the 3rd years who as a result are implicated and enthusiastic*". The first student had two globally positive team experiences and the second two more difficult team experiences with poor results, suggesting that poor team experiences can be very (or perhaps even more) useful in terms of learning.

4.5 Creativity and working together

Creativity is identified as a problem in many student declarations in the inter-year projects undertaken by years 1 and 2. Reasons cited are lack of motivation, inefficiency, important differences in personalities and generally inability to communicate. This difficulty is not mentioned in the 3|5 and 3|4 projects so it might be plausible to link this to lack of experience in effectively organising group creativity, and the fact that it needs planning.

We can perhaps also link this point to several comments on collective efficacy and the need for both individual and group work. The same third year student writes on her 3|5 projects and 3|4 projects respectively *"working time was nevertheless well managed: we saw each other to work together where necessary"* and *"in this group, we were meant to work all together. We were together very often, but the time was badly managed and we were not at all efficient"*. Managing work hours and team "working together time" is a frequently mentioned criticism, and seems to be an easy mistake for students to make in the relatively time-rich context of the 3|5 projects and 3|4 projects.

4.6 Communication

Comments related to 3|4 projects imply teams with communication involving all team members. In discussing best communication practices in teams, Rapanta et al [8] show that significant team discussions involve over half and often all of a team. Our student comments suggest communication may have been more difficult in 3|5 projects, with junior students sometimes not confident or comfortable enough to express their opinions.

5 DISCUSSION

Results linked to the closed questions suggest that the second project in the year, the 3|4 project, is more positively experienced by junior team members. The scope of this research does not allow us to conclude why this team format appears more successful in terms of student experience. A less important skills difference is no doubt a factor, as seems to be lack of management/leadership skills in some 5th year students. The more important increase in positive experience ratings for the second project by students who join the school at the beginning of the third year (with less familiarity with team working) suggests that the personal experience of team working is cumulative. Students are better equipped to benefit from a team project having completed one long team project.

5.1 Limitations

This research is not a 360° survey, only reflecting viewpoints of junior team members. Earlier studies suggested that junior members tend to experience inter-year projects less positively and so would give more critical feedback. But equally this research is carried out in a school where students expect and

even mention positively anticipating major team projects and their learning potential, so this may give a result with a positive bias.

"Distance" or long time-frame seems useful for students reflecting on projects as a whole, but clearly may also distort results and lack some detail.

5.2 Future research areas

- Studying the holistic effects on the school that inter-year team projects may have [9].
- Using CVT [17] to measure team behavioural complexity, and study the impact of individuals or team composition. This could also become a useful evaluation tool for individual assessment.
- Measuring graduate ability to integrate multi-disciplinary/collaborative environments following their inter-year team experiences.

6   CONCLUSIONS

This research shows a high level of acceptance for heterogeneous teams and appreciation by junior members of inter-year teams regarding the learning benefit of participating in these teams. This research suggests the need to encourage shared leadership in student teams and a separation of organisation and leadership roles. The integration of junior team members and their participation needs more attention, particularly with regard to facilitating communication. Tools to (self) reflect on individual and team performance could be usefully introduced to complement existing evaluations.

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