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Argumentation, Eureka and Emotion: An analysis of group projects in creative design training

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Abstract: Creativity training has been generally based on avoiding critique during idea generation, although benefits of argumentation have been shown during idea selection and elaboration. The research reported here aims to understand how argumentative interactions involving role-play, with subsequent group reflection on them, contribute to collaborative creative design projects. The study was carried within a specialised Masters course at the Royal College of Art (London), organised jointly with Imperial College London, and focuses on analysing group reflection sessions of two groups of students whose on-going project was initially defined as "communication by touch". Results showed that although students reported difficulties in playing argumentative roles that were not aligned with their personal views, their debates enabled them to arrive at "Eureka!" moments with respect to better grounded and precise definitions of their project concepts. We highlight the complex ways in which emotions circulate with respect to "Eureka!" moments, role-play and grounding. Given differences in ways that groups played out their assigned argumentative roles, we conclude that role play debate and group reflection on it need to be applied and considered as a whole in creative design training.

Keywords: group creativity; collaborative design; argumentation; role-play; reflective activities; emotions

Highlights

- Debates contribute to more precise grounded definitions of creative design projects
- Eureka! moments of project re-definition are associated with shared positive affect
- Role-play debates need to be coupled with group reflection on them

1. Introduction

Traditionally, creativity has been associated with the ideas of great individuals, such as Beethoven, Picasso or Einstein, although many creative breakthroughs have been achieved by duos (such as Marie and Pierre Curie-Skłodowska, de Beauvoir and Sartre: see John-Steiner, 2006), small groups (such as The Beatles or the Alban Berg string quartet) or by teams (for example, the invention of the DNA double helix: see Sawyer, 2007). In contemporary societies, creative design in teams is particularly important for stimulating the development of innovative products and services, often involving geographically distant participants.

The research described here is based on the analysis of the design and implementation of an innovative approach to organising training on creative collaborative design, based on argumentative role-play and group reflection upon it. Our main aim was to explore how this approach could contribute to the elaboration of on-going group design projects rather than, for example, to determine changes in individual participants' general creativity skills.

We carried out the study with students enrolled in a specialised Masters course on creative design at the Royal College of Art ("RCA", London). The Masters is jointly organised with the nearby Imperial College engineering department, and thus involves interactions between students having diverse forms of previous training, in engineering, science, social sciences and arts. Groups (of four participants) were given the general design brief "communication by touch" and had to work together for several weeks in order to design a prototype creative artefact (see §3 below for further details of the pedagogical situation). In collaboration with professors at RCA, we designed a new group-creativity training workshop, called "Argument Clinic" (henceforth abbreviated to "AC"), in which groups of (four) students firstly engaged in a debate, with assigned advocate or critic roles (two against two) with respect to their current project definition, during the second part of which roles were switched round.

The name of the workshop was inspired by the well-known Monty Python comedy sketch called "Argument Clinic", in which a man visits what resembles a psychiatric clinic and pays to have an argument"[1]. This is not to be confused with the *clinical method* in psychology and ergonomics (e.g. Clot & Leplat, 2005), originating in medicine, then defined and used by Freud, Piaget and Vygotsky. Notwithstanding, our main methodological approach to organising and analysing what occurred in the Argument Clinic workshop (see §2 below) does in fact draw on specific clinical methods, such as group reflection (or auto-confrontation) sessions.

The students' group debates were video recorded, and the following day, the same groups carried out a Group Reflection session (henceforth abbreviated to "GR") during which they watched the video and were invited to stop it to comment on what they consider to be "key moments". What we call "Eureka!" moments here (to be analysed below) are key moments identified by students, where they agreed that new, improved and mutually understood definitions of their project concepts had been achieved, events that were associated with the circulation of positive affect.

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[1] The Monty Python "Argument Clinic" comedy sketch can be found on Internet, for example at: https://www.youtube.com/watch?v=ohDB5gbtaEQ&t=11s - incidentally, the sketch contains definitions of what an argument is and is not that are worthy of discussion.

The workshop (AC and GR sessions combined) was co-designed within a pedagogical design-based approach (Cobb et al., 2003; Collins, Joseph & Bielaczyc, 2004) in that, whilst enabling achievement of our research objectives, it also had to be integrated into the curriculum and practice of the Masters course within which we gathered data. Our qualitative-quantitative analysis focuses on the students' perspectives on their own group debates on their project concepts, as expressed in the GR sessions. The analysis approach identifies aspects of their previous role-play debate that students consider significant ("key moments"), their meaning making with respect to them in the GR discussion, and the interactive circulation of emotions, within and across the AC and GR sessions.

The motivations for the design of the AC workshop relate to three main areas of research, to be reviewed in more detail in the subsequent section of this paper. The first area is research on creativity in collaborative design. The common creativity technique known as brainstorming (Osborn, 1953) is based on the injunction to withhold criticism in idea generation. However, whilst some research does show a constructive role for spontaneous argumentation during idea co-elaboration (e.g. Badke-Schaub et al., 2010), there have been few attempts to organise creativity training by specifically provoking conflicts and argument between ideas and persons. In that sense, our co-design of the AC session used a second well-known creativity technique, that of "inversion"[2]: since creativity techniques usually avoid critique, what would happen if we did the opposite of this, using argumentative role-play?

The second area of research that motivated the pedagogical design derives from the study of argumentative activities in collaborative learning situations (see Baker, Andriessen & Schwarz, 2019, for a recent synthesis). Numerous studies in this field have now brought to light the processes by which argumentative interactions between students can lead to broadening and deepening their understanding of the domain of discourse. In addition to studies that correlate incidence of spontaneously occurring argumentative interaction with learning gains, a commonly used approach here is to structure group interactions, and debates in particular, by ascribing roles to students — either opposed argumentative roles, or else roles corresponding to social actors concerned. In recent years, work on argumentation and collaborative learning has been extended to take emotions into account (Baker, Andriessen & Järvelä, 2013), focussing on the interaction between knowledge co-elaboration processes and processes of social regulation of emotions. To our knowledge, such research on collaborative learning has not yet been integrated into the design of group creative design training approaches.

Finally, the use of group reflection sessions in the workshop presented here, was inspired by work on the "reflective practitioner" (Schön, 1983) and use of individual or group reflection on action ("auto-confrontation") as both a means for professional development and a method for understanding subjects' perspectives on their actions (Mollo & Falzon, 2004).

Our main research questions concern the contribution of the Argument Clinic workshop (coupled with Group Reflection) to the definition of the students' on-going project, the general functioning of the group *per se*, the students' perception of the role-play format and the role of the interactive circulation of affect across these different dimensions. More generally, we aimed to understand the distribution of group activity — debate, meaning making, grounding, and emotions — across the two sessions, AC and GR (for example,

[2] For example, in order to stimulate creativity, students on the RCA masters course are sometimes given deliberately contradictory tasks that 'invert' the usual situation, such as "bikes have wheels - design a bike without wheels", or "teapots must hold boiling water – design a teapot made of chocolate".

debates occurring in AC could be re-initiated and further elaborated in the GR session).

In the rest of this paper we firstly present a review of the directly relevant research literature, on group creative design, collaborative argumentation-based learning, the roles of emotions therein and group reflection. This is followed by a description of the situation under study, at the Royal College of Art, and the AC-GR workshop that we co-designed. Qualitative methods for analysing the GR discussions are then presented. The main results obtained bear on the students' analysis and appraisal of the workshop with respect to their groups, their projects and the role of emotions in AC and GR discussions. Students considered that the workshop helped them to elaborate more precise and well-grounded project definitions, despite some difficulties in playing the argumentative roles assigned to them. Given different distributions of debate on project definition across the AC and GR sessions, in two groups under study, we conclude that AR and GR should be considered together as a unified approach to group creative design training.

2. Research background

In this section we further develop the areas of relevant research literature referred to in introduction, on creative collaborative design, argumentation-based collaborative learning, and group reflection.

2.1. Creativity and ideation

A significant body of research has focussed on brainstorming methods supporting divergence/convergence in idea generation in design, based on: (1) neutralisation of inhibition, production blocking and social loafing effects using specific brainstorming scripts, in particular, separating generation and selection of ideas (Paulus & Dzindolet, 1993; Kohn & Smith, 2010) and (2) neutralisation of idea fixation effects by introducing specific task characteristics, e.g. providing extra domain sources of inspiration (Vasconcelos & Crilly, 2016). Creativity workshops aim at producing original and appropriate ideas (Schön, 1992) and they are conventionally based on a consensual and irenic collaboration between participants with diverse backgrounds and skills (Nohara et al., 2017). The quest for friendly consensus between participants is illustrated by one of the rules of Osborn's brainstorming method (Osborn, 1953): *withhold criticism*. The underlying hypothesis is that creativity is enhanced when there is no criticism or disagreement during the generation of ideas and when participants accept other's ideas and build on them rather than criticise them.

Whereas brainstorming (with its numerous variants) is broadly used in design education, other research has been carried out on the role of conflict in design and creativity. One main issue is to understand the benefits and detriments of conflict on team creativity. Several empirical studies show that conflict is productive in design. For example, Badke-Schaub et al. (2001, 2010) showed that creative performance in teams is not achieved mainly by agreement but also needs cognitive confrontation. Yong, Sauer and Mannix (2014) found that task conflict has a positive relationship with creativity whereas relationship conflict has a negative relationship with it. The idea of specifically organising dissent, by ascribing argumentative roles, has been explored to some extent in creativity research. Nemeth and Nemeth-Brown (2003) review experimental research on groups of four persons who were asked to deliberate a personal injury case. In a first condition, one member of the group (a confederate) was asked to consistently maintain a position diverging from that of the other group members, in a second, to consistently play "devil's advocate", systematically opposing others' views (in each condition, the same list of arguments was used by the confederate). In the first condition,

other group members were stimulated to generate new ideas on both sides of the issue; in the second, they acted in a defensive manner, finding ideas that supported those that had been criticised by the devil's advocate. This indicates that the expression of authentic divergent views, rather than systematic gainsaying, can be productive for creativity. Our own approach to role-play, described below (§3) constitutes an intermediary between these two conditions, in that students are asked to argue and counter-argue with respect to their own authentic views in a divergent manner, but possible self-defensive consequences are obviated by exchanging pro-contra roles around in the group in the middle of the argumentative discussion.

2.2. Collaborative learning, argumentation and role-play

In the wake of the theory of socio-cognitive conflict (Mugny & Doise, 1978), research has focussed on the learning potential of the processes by which verbal conflicts between children or students are resolved cooperatively, in and by argumentative interactions. This approach echoes work in the design field, reviewed above, showing that creative performance in teams is not achieved mainly by agreement but also requires cognitive confrontation. Four main types of learning (processes, outcomes) may be associated with argumentative interactions (Baker, 2009; Andriessen & Baker, 2014): (1) subtle changes in cognitive/dialogical attitudes (beliefs, opinions, acceptances), whereby learners come to have more nuanced views on problem solutions; (2) elaboration of more coherent viewpoints, on the basis of individual/group reflexive activities; (3) changes in conceptualisation of problem solutions (e.g. redefinition, dissociation of concepts from each other); and (4) becoming more dialogical, being more open to the integration of others' possibly conflicting views. Notwithstanding differences between tasks traditionally set to students in school and in creativity training, this research would predict that students engaging in the Argument Clinic workshop would develop more subtle and coherent views on their joint project, possibly redefining the meaning of key underlying concepts and, on a group dynamic level, would have better understanding of each others' views.

How, therefore, should situations for collaborative argumentation-based learning be designed (Schwarz & Baker, 2017, chapter 6) to favour such types of learning? Most approaches concentrate on either characteristic of groups (e.g. intersubjective differences between individuals' prior knowledge, number of members, etc.) or else on attempting to structure the collaborative interaction itself by attributing specific roles to each group member. Roles can be defined and ascribed in terms of specific responsibilities for: (i) specific types of knowledge or expertise required for problem solving using the "jigsaw" method (Aronson et al., 1987); (ii) aspects of collaborative problem solving (e.g. solution generation, critique, emotion regulation (De Bono, 1985); (iii) standpoints of real persons in societal/historical debates (e.g. Simonneaux, 2001); and finally, (iv) in terms of opposed dialectical roles (pro, contra) in argumentative interactions, with respect to claims (e.g. Marttunen & Laurinen, 2001).

There are two problems with the latter [(iv)] approach, based on ascribing opposed dialectical roles (Baker, 2015). The first is that rigidly assigned positions may not match the students' own opinions (e.g. a student who agrees with the project idea who is required to argue against it, or vice-versa), which, given the combinations of dialectical roles and opinions, may also lead to heterogeneous groups and learning. The second is that roles must exchange fluidly in groups in order to favour collaborative learning on the part of all members (Bielaczyc, 1994). For these reasons, in the Argument Clinic workshop, we not only ascribe *pro* and *contra* dialectic roles to pairs of students, but also require them, half way through the activity, to exchange roles. This approach has two further advantages: (1) it counteracts the confirmation

bias whereby students are much more able to generate arguments in favour rather than against their claims, thereby encouraging them to be self-critical and to 'think around' the idea; (2) exchange of roles reinforces the idea that this is a (serious) dialogical game, within which criticisms should not be taken too personally, thus attenuating negative emotions and necessity for affective regulation (Baker, Andriessen & Järvelä, 2013). Indeed, argumentative discussions between people involve particularly salient emotions (Andriessen, Baker & van der Puil, 2011) and threats to personal images of competence: a critique of a person's view, depending on its perceived degree of aggressiveness, is, to a greater or lesser degree, perceived as an indirect attack on persons themselves (Muntig & Turnbull, 1998). Thus, with role exchange, we maintain tension at the group level, and shift particular forms of tension among participants.

2.3. Group work and emotions

In design studies, previous research has been focused mostly on emotion as a dimension to be taken into account in users' evaluations of designs and on introducing emotions based on sources of inspiration (positive/negative emotions) for fostering creativity in individual design activities (Bonnardel & Moscardini, 2012). On the basis of Bales work (1950), socio-emotional aspects of group interactions have been identified as important in problem solving processes themselves. In collaborative learning research (Andriessen, Baker & van der Puil, 2011), the notion of tension-relaxation was analysed as part of the development of a collaborative working relation, which would in turn influence knowledge co-construction (Yamazumi, Engeström & Daniels, 2005). In this case, tension-relaxation, emotion and affect are not studied as properties of individuals, but rather as "…interactional phenomena, i.e., verbal, microsocial, made visible in the course of action performed, co-defined and co-managed by the participants" (Quignard et al., 2016).

In the present research, emotions are analysed in two ways. Firstly, in referring to emotions that circulate in the students' AC debates, our object of study is the *emotivity* of the *interaction*, as openly manifested by participants in a group, and perceptible to each of them. As Polo et al. (2017, p. 304) point out, analysing emotivity does not imply "labelling" of particular emotions, but rather identifying the general emotional 'climate' in terms of valence and intensity and understanding emotional positioning (individual or shared) with respect to particular discourse objects. Isohätälä et al. (2018) described a study on the processes by which students try to regulate emotions in groups, attempting to "strike a balance" between preserving a positive emotional climate and deepening cognitive conflicts, and often giving precedence to their interpersonal relations. The nature of the students' interpersonal relations, as they are expressed in interaction, is therefore important in ensuring that the regulation of emotions associated with interpersonal conflict can allow cognitive conflicts to be deepened. Secondly, in analysing students' perspectives on their activity, expressed during the GR sessions, we note the emotions that the students express explicitly, with respect to their previous debates.

2.4. Group refection and auto-confrontation methods

The Group Reflection (GR) session, following the AC workshop, is motivated by both methodological considerations (understanding students' perceptions and appraisals of the role-play debate) and by its developmental potential, i.e. for further developing individuals' and groups' understanding of their projects and themselves. As a methodology, the use of reflection on one's own actions is also termed "self-" or "auto-confrontation". The general principle of auto-confrontation methods consists in providing subjects with a recording of

their own past activity, so that they can comment on it. Mollo and Falzon (2004) highlight two important benefits of this method: ecological validity (recorded traces as natural data) and reflective efficiency. Indeed, confrontation methods are not only a tool for understanding subjects' actions, but also a means for subjects to develop their knowledge. They may be used within a methodological or a developmental objective: (1) as an elicitation method for the researcher to understand better the analysed activity, in particular to understand possibly invisible phenomena such as individually experienced emotions, their intentions; (2) as a reflective method for the participants to become distant from their own activity in a process of reflection-on-action.

As a reflective method, which is 'subject-oriented', the participants can see their activity as an object of reflection. They become aware of their activity, adopting not only a descriptive position but also a more analytical and evaluative one concerning their past activity, which can enable them to elaborate new knowledge. In this case, the approach encompasses mechanisms of elicitation, analysis, evaluation and co-elaboration.

With respect to conflict and argumentation, Clot (1999), inspired by the work of Vygotsky (1978), uses dialogical exchanges and the possibility of eliciting controversies as a resource in the development of the activity: "[i]n this case, what is aimed for above all is the development of individual competencies, by the possibly conflicting confrontation of points of view on experience and the dialogical processing of these controversies, to question, re-evaluate and enrich knowledge and know-how" (Cahour & Licoppe, 2010, p. 13). As a reflective method, auto-confrontation creates a situation of reflection-on-action (Schön 1983), in which reflection occurs asynchronously after the activity itself, with a focus on the evaluation of past experience. It has also several similarities and differences with metacognition. First the "meta" character of such a reflective activity is linked to the distance between the activity and its participants that is induced by the method. However the processes of monitoring and regulation, central in meta-cognitive processes, and embedded in the activity itself, take another form linked to the asynchronous characteristic of auto-confrontation. The distance created by the method supports/triggers participants awareness of their own and others past activity, encourages description and evaluation of it, as well as co-elaboration of knowledge.

In summary, the research reviewed above, provides the foundations for the design of a new group creative design approach, based on argumentation, role-play and group reflection, with potential for favouring the co-elaboration of more refined and grounded project concept definitions. It also highlights difficulties that students might face — in playing their roles and in regulating emotions — and dimensions of group work on which to focus analysis.

3. Workshop design situation and design rationale

The AC and GR workshop was designed collaboratively with professors in creative design[3] at the Royal College of Art, a University in London that offers postgraduate degrees in art and design. The design experiments described here were implemented within the Innovation Design Engineering programme run jointly with Imperial College, and in the present research, with the collaboration of researchers from Tokyo Institute of Technology and Telecom Paris Tech. Within a design-based approach (Brown, 1992), the workshop had to be perceived to be relevant (to the curriculum and educational practices) by the actors involved, i.e. teachers and

[3] The professors were Tim Corvin and Miles Pennington, both authors of the present article. At the time the research was carried out (in 2016), Miles Pennington was affiliated to the Royal College of Art (London), and Céline Mougenot (author of the present article) was affiliated to Tokyo Institute of Technology.

students. This was assured by collaborative design with social actors, by interviews with them after design experiment has taken place, and by subsequent observation of appropriation, i.e. that the actors have become autonomous in their appropriation of the pedagogical design.

In Autumn 2016, all first year and second year students in the Royal College of Art design programme were proposed four types of ideation session (Mougenot et al. 2017) to help them with their on-going group projects, i.e. freely producing ideas around a given general theme.

Beginning from a "brief" (a short theme described with a few keywords), students were asked to imagine innovative technological products around the given theme and represent these concepts in the form of sketches and simple physical models. The themes for ideation are deliberately left open so as to leave space for creativity. Certainly, stimulating creativity requires achieving a balance between freedom and constraint (e.g. Johnson-Laird, 1988); but in this training course — at least at the beginning of the year — it was decided that students should engage in ideation whilst defining their *own* constraints (for example, for what kinds of users are they designing? What are constraints of cost, time, properties of materials, æsthetics?). This is intended to prepare students for becoming independent creators, who can also reinvest such creativity in design situations that are constrained by clients' expressed needs and wishes. In this sense, creative design training differs markedly from many pedagogical situations, as well as controlled experiments in educational psychology carried out within them, that aim to define task instructions in a way that is as clear and unambiguous as possible.

One of the themes for ideation was "communication by touch": students explored novel ways of sharing information with others through the tactile sense and they imagined technological devices that would support this novel ways of communicating. This workshop was held at the beginning of the academic year, to serve as an initial creative 'warm-up' (the term used by the teachers on the course) and training, in support of other activities in the program such as group projects. The students were used to working together in groups for standard group work, but not within structured group ideation tasks specifically. The students working in the groups studied here would be acquainted with each other since the beginning of the academic year (a few weeks previously), not least given the fact that all students work in zones of the same open space (a design studio) in the RCA.

Participation was not mandatory in the curriculum and 51 students actually participated in the workshops. Participants were 30 men and 21 women, from 19 declared countries, including one-third from the United Kingdom. 23 participants were in the first year of their Master program and 28 in the second year. 40% had an academic background in Design (industrial, product or other). 40% in other areas of engineering, and the last 20% had diverse academic origins.

The new creative design workshop comprised two main sessions: Argument Clinic ("AC") and Group Reflection ("GR"). We conducted six Argument Clinic/Group Reflection workshops, from which two groups were selected for analysis, given that both had chosen to follow the general project brief "touch communication". All sessions were held in the same room and videotaped with the consent of the participants, for a total of 31 hours of videos. Two sessions of the AC workshop were followed by a GR session, on the same day of the workshop or on the following day.

3.1. Argument Clinic

The design of the Argument Clinic (Figure 1) was based on attributing *pro* and *contra* dialectical roles (Barth & Krabbe, 1982) to pairs of participants in groups of four, in

discussions with respect to the current formulation of their joint project. The roles were presented to the students as "advocate" and "critic". In order to render these roles as concrete as possible, the RCA designed pictures of critics (an angry man) and advocates (a smiling woman) that students presented on stands placed in front of them, for their opponents to see (see Figure 1, image number 3). An instructor (as well as an experimenter) was present during all sessions. The session was divided into four phases:

(1) *State of the project and topic selection*. After introducing to the goal of the session, the instructor prompts the group to present the state of their on-going project. The selected topic could be for example a direction that their project was taking, a problem encountered, or a concept to be discussed.
(2) *Role Playing Warm Up*. The instructor asked each participant to pick a card where evaluative sentence openers were displayed. The sentences were either positive ("This is the best idea ever because…") or negative ("I think this idea needs to be a little improved because…"). The participants were asked to complete the sentence chosen with very little time to reflect. At the end of the warm up, the instructor asked the participants to state their initial opinions about the topic to be discussed. This initial statement of personal opinions was used to split the group in two sub-groups, one as advocates, and the other as critics, for the start of the Argument Clinic debate. In some cases, given uneven distribution of initial opinions, students' initial role was contrary to their personal opinions (see results, below). Such students would, however, have the opportunity to play the role corresponding to their opinions once roles switched round.
(3) *Argument Clinic Debate.* The instructor ascribed a role to each member of the team, either *pro* ("Advocate") or *contra* ("Critic"). Thus, two participants, seated side by side, played the critic role, while the two other participants, facing them, played the advocate role. Students were asked to make pictures to illustrate these roles, which were placed on small pedestals in front of each of them during the debate. This helped them to remember which role they were supposed to be playing at a given time, since roles were switched round at one point. Interestingly, the students chose to illustrate only the critic role, perhaps seeing this as the most important one; and in this case they chose to use faces that clearly illustrated specific emotions: either a sad woman or else an angry man. For example, in Figure 1, to the far left, the professor moderating the debate holds two "angry man" pictures, during the role attribution phase, that he subsequently gave to the two students who firstly played the critic role. The Argument Clinic debate was done in two steps: first three minutes for team preparation and then ten minutes of debate. During the preparation phase, participants were prompted to write down on a piece of paper at least three strong argument points. After this brief preparation, the advocates initiated a ten minutes' debate. The participants were free to manage the debate. At the end of the ten minutes, the members of the team were required to exchange roles and run again the argument clinic with a new preparation phase and then a debate.
(4) *Debrief***.** The debrief phase aimed to gather together and organise the different arguments around the group's project idea and was supported by the instructor's summary of the key arguments.

Figure 1. Argument Clinic activities (Group 2): 1) Role attribution, 2) First debate, 3) Second debate (after roles are switched)

3.2. Group Reflection

After the AC workshop, we ran a GR session (either in the afternoon of the same day or else the next morning) involving free discussions of all members of each group, whilst they watched the video recording of their AC debate (see, for example, Figure 2). A researcher moderated the GR session. The Group Reflection session was itself video recorded. Interactions from AC and GR were transcribed for analysis.

Students were first asked to identify "key moments" in their Argument Clinic debate, either positive or negative, that they remembered from the session. This was intended to highlight the more meaningful moments for the group, either in terms of collective activity, or emotional experience or design experience. The definition of "key moment" was deliberately left open, given our research objective of understanding what the students considered to be important or significant. After a round table discussion to identify key moments, the students were shown the video extracts of key moments they had mentioned; in some cases they simply watched the video and stopped it from time to time to make comments e.g. what was going on at that moment, how they felt, what they were thinking or doing.

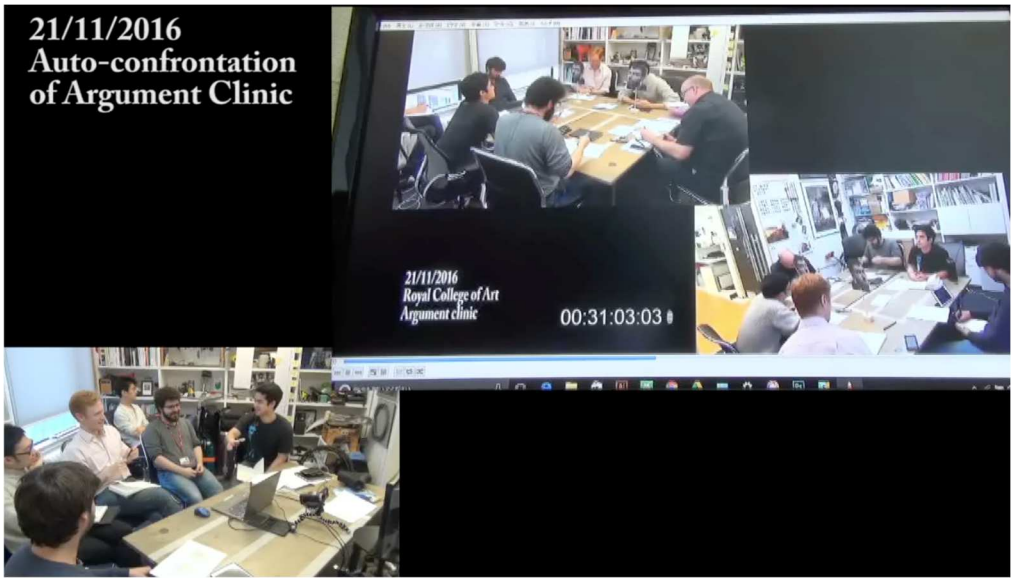

Figure 2. Group Reflection (auto-confrontation) session for Group 2 (video of Argument Clinic debate, two views, top right; video of Group Reflection on Argument Clinic, bottom

left).

3.3. The two groups studied

Two groups were selected for analysis, given that data for them was complete and that they had both chosen to pursue the general project brief "touch communication".

Group 1 chose to debate the idea of "digital communication through touch". Of the four members of this group, in the first debate of argument clinic S1 and S2 were advocates and S3 and S4 were critics. Roles then switched. Each sub-debate lasted 10 minutes.

Profiles of Group 1 members are shown in Table 1.

Table 1. Profiles of Group 1 members (Argument Clinic)

Participant	*Academic background*	*Gender*	*Nationality*
S1	Product Design	Male	India
S2	Industrial design	Female	Mexico
S3	Mechanical Engineering	Male	United Kingdom
S4	Jewellery Design	Female	United Kingdom

Group 2 chose to debate the idea "touch communication", having already decided that the corresponding artefact would be a high-tech glove that enables people to 'touch' things at a distance. The profiles of group members are described in Table 2 (see Figure 2 for their GR discussion).

Table 2. Profiles of Group 2 members (Argument Clinic)

Participant	*Academic background*	*Gender*	*Nationality*
S1	Mechanical engineering	Male	USA
S2	Engineering and ocean sciences	Male	Taiwan
S3	Materials Science	Male	UK
S4	Industrial Design	Male	People's Republic of China

4. Corpus analysis approach

Our analysis focuses on the discussions during the Group Reflection (GR) session. As described above, during this session, the group of students was invited to comment on their previous Argument Clinic debate on the basis of identifying "key moments" during it.

The unit of analysis of the GR discussion is the *comment*. This is a semantic unit (cf. content analysis), comprising a content that is distinguishable from those that precede or follow it. A given speaker may make one or more comments in a given turn and comments may occur across successive speakers in sequences. The comment is the criterion of segmentation of the GR discussion. Comments have referents, the tangible or abstract 'objects' that they designate. The short sequence shown in Table 3 illustrates segmentation into comments

(represented as paraphrases).

Table 3: example of segmentation of GR discussion into comments.

Line n°	*Speaker*	*Dialogue*	*Comments (with paraphrase)*
21	S3:	Yeah	-
22	S4:	If you put that thing on them, maybe, maybe. Because this is all conjecture, … if you put that thing on an autistic person, he'll be more connected to the world	Comment 1: I conjecture that putting [the glove] on an autistic person will make him more connected to the world
23	S3:	uhumm	-
24	S4:	and by being able to touch things remotely he will feel closer to them and bring the barrier down.	Comment 2: being able to touch things remotely creates proximity with them
		But, ... maybe it was to some extent grasping at straws. But maybe they were good straws, that's what I'm saying	Comment 3: I was grasping at straws, but good ones
26	S3:	[nods, makes wry smile]	-

Table 3 shows three comments, all by S4, within or across turns. Backchannel in lines 21 and 23 of Table 3 is not counted as a comment. Nor are the emotions expressed in line 26, which are, however, taken into account in the qualitative analysis of emotions (see below).

Comments may be more or less specifically anchored in the AC debate. At the beginning of the GR session, students made general comments, on the debate as a whole (see below) then proceeded to watch the AC video, stopping it when one or more participant considered that a "key moment" had occurred. In several cases (see the section on extended sequences, below), students identified a key moment, often relating to a problem of grounding in the AC debate, evaluated it, then engaged in more or less extended GR sequences in order to co-elaborate the meaning of the key moment.

We analyse the students' comments in the GR discussion in terms of their *referents*, what they are 'about' with respect to the AC debate. Categories of referents were defined by task analysis (a debate, involving role-play, about project definition, requiring grounding: Clark & Schaefer, 1989) and with respect to iterative analysis of a sample of the corpus.

The analysis categories of referents are defined in Table 4.

Table 4: Content-related categories of students' comments on argument clinic debate

Category	*Definition*	*Examples*
Debate	Comments on the argument clinic debate	Group 1/S3: "There is a lot of back and forth here" Group 2/S4: "It was a nice discussion"
Role-play	Comments on imposed roles (advocate, critic), their meaning, difficulties in playing them, their relations to personal opinions	Group 1/S4: "… but it is really difficult for me [to play the opponent role] because I'm always the one to insist we need to introduce touch into communication" Group 2/S3: "… you were saying positive points, and I was having other ideas about that

		but I wasn't allowed to say anything positive”
Project definition	Comments on what the argument clinic debate contributed to the definition of the project concept, including technical aspects	Group 1/ S1: “I personally think this was the moment of realisation for us that, you know, that …we should be thinking about the interaction on a much broader scale …” Group 2/S1: “… it, helps flush out, you know, how this project could develop”
Group	Comments on how the group functions in discussions, either as a whole or as particular individual ways to intervene in the group	Group 1: S3: “We don't really have discussions like this outside of here you know what I mean.” Group1: S1: “I realize you know I've noticed this. She (S4) is a bit shy try to be a little bit more dominant about your ideas. Your ideas (S4) are really good.” Group 2: S4: “I know that if I concentrate and I can understand it, other people can. That's why I like to be absolutely clear. But when I'm not ready, with my clearness [sic], it can become precisely the opposite, nobody can understand me.”
Grounding	Comments on what one participant understood about others’ statements or views, about mutual understanding	Group 1/ S1: “I had no idea what you guys were doing, I was confused at that moment.” Group 2/S4: “I still don't get that point. I don't get what you mean: what's the problem you're referring to?”
Other	Comments that relate neither to the group nor its debate; mostly concerning practical issues of organisation of the GR session	Group 2/ S4: "It's weird … I had no problem following you [S1] live, when I was there, but I have trouble following you when it's on the video” S1: "yeah, as with TV shows"

We do not attempt to quantify expressions of emotions, nor to label them specifically, but rather analyse their expressions qualitatively in terms of valence (positive, negative) and intensity. Three cases are distinguished: (a) comments, in the GR discussion, on emotions expressed *in* the AC debate (e.g. “We looked really pleased when we got to that point!”. (b) Emotions expressed in comments in the GR discussion, *on* the AC debate, that did not concern emotions in it (e.g. [disappointment] “I sounded like a real dick when I said that”). (c) Emotions that circulate in the interaction *between* the participants in the GR, usually once it becomes emancipated from direct reference to the AC debate (e.g. [wry dubitative smile] following other student’s account of what he meant to say in an AC key moment). Figure 3 represents this complex configuration of the circulation of emotions within and between the GR discussion and the AC debate.

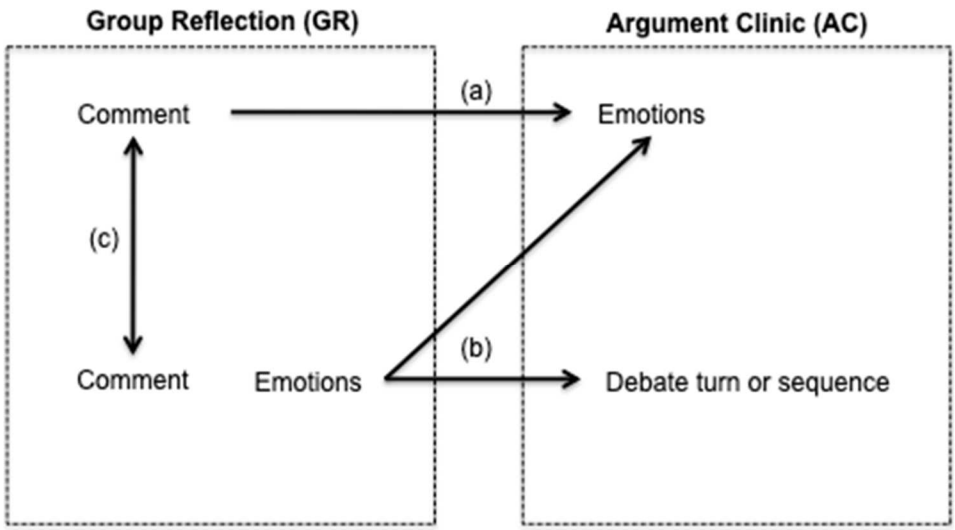

Figure 3. The circulation of emotions in the GR discussion and the AC debate.

5. Results

The GR discussions of Groups 1 and 2 were segmented into comments and analysed using the categories described above (Table 4) by two researchers (the first two authors of this paper), who collaboratively resolved any differences between their codings.

5.1. Quantitative results

Table 5 below shows the distribution of comments in the main analysis categories across the two groups analysed. These are purely descriptive and indicative of the main focus of each GR discussion.

Table 5: Distribution of comments in the main analysis categories for the two groups

GR referents	*Group 1*		*Group 2*	
	N	*%*	*N*	*%*
Debate	7	13	3	4
Role-play	21	40	16	20
Project definition	10	19	44	55
Group	11	21	5	6
Grounding	4	7	10	13
Other	0	0	2	2
Total interventions in GR discussion (*N*)	53		80	
Key moments, GR discussion (*N*)	6		9	

On the basis of the results presented in Table 5, it can be seen that the two groups had quite different profiles in terms of the distributions of the aspects of the debate that they referred to.

Group 1 focussed its comments principally on role-play — how it was carried out, difficulties

experienced with it — with respect to 6 key moments. Next in magnitude, it was focussed approximately as much on the functioning of the group as a whole, as on project definition. During both AC and GR sessions, this group appeared to be very "groupal" and to have a generally positive emotional climate

By contrast, Group 2 was more centred on project definition, with respect to 9 key moments identified, followed by role-play then issues relating to grounding. As will be seen in the extended sequences analysed below, in Group 2 it was the GR discussion that contained extended debates on project definition, rather than the AC debate, initiated by identification of key moments concerning grounding issues.

In general, therefore, in the GR sessions, Group 2 was more centred on debating the project definition, whereas Group 1 was centred on the group and role-play.

In the next section we present qualitative analyses in order to interpret the two groups' GR sessions.

5.2. Qualitative analysis

We present a qualitative analysis of students' comments in the GR discussion, organised according to the main categories described in Table 4. In addition, we present the different roles that emotions can play, according to their interactive contexts of expression, and conclude this main section with a discussion of illustrative extended interaction sequences from the two groups' GR sessions.

5.2.1. Comments on the debate

Over both groups, students made general comments that were only positive about the value of their previous AC debate as a whole. For example:

Group 1:

S3: this is interesting watching this

S1: it's a proper debate … argument

S3: yeah

Group 2:

S4: It was a nice discussion

Group 1 commented that the general difficulty of the debate as a whole related to having to debate, adopt standpoints, with respect to an idea that was not yet sufficiently defined:

Group 1:

S3: I think most of the difficulty came out because of the topic of the argument … it was kind of very confused

This relates to a general paradox of collaborative argumentation-based learning (Nonnon, 1996; Baker, Andriessen & Schwarz, 2019): how could students genuinely adopt firm argumentative stances with respect to knowledge that is currently under co-construction?

5.2.2. Comments on role-play

Students underlined their general difficulties in playing particular argumentative roles, especially in the case where their personal views were in contradiction with them. For example:

Group 1:

S4: but it is really difficult for me, because I'm always the one to insist that we need to introduce touch into recommendation and now I envisage … I am always like … how can I … ((laughs))

S1: you are giving a kind of counter argument

Group 2 nevertheless commented on the positive effects of having to exchange argumentative roles:

Group 2:

S4: When you're forced to be super positive then super-negative, it forces you to decide what you actually think

Students related their negative or positive experiences in playing particular argumentative roles:

Group 1:

S4: yeah I think when we go that's that's why I just couldn't bear to be opposite

Group 1:

S4: I'm looking at you guys and thinking can I change the side?

S3: I quite enjoyed playing that part

They also related their difficulties, including a sentiment of artificiality in playing particular roles, as well as their perceptions of how others played their roles:

Group 1:

S3: Yeah I think it was like a kind of you were like have to argue against

S1: you didn't really know what to put forward

S3: it didn't feel like a valid precedent. I just feel it was irrelevant

S1: We were just forced. I was just preaching my idea to find a counter argument and not beginning an argument.

Group 2:

S3: It feels to me that you were constantly on the defensive ... or batting it back. It's not like you have thought that this is the best one or that this is the best answer to this question. It feels like you're basically answering impulsively.

In Group 2, one student said that arguing in favour of their project concept was easy, precisely because the role-play enabled distancing oneself from it:

Group 2:

S4: But it's also kinda easy to argue for … because you don't actually have to argue for the idea, you can also just go abstract and say it's super nice and it's a real problem that's so important

5.2.3. Comments on project definition

Group 2 considered that, in general, the AC debate helped in project definition:

Group 2:

S1: it helps flush out, you know, how this project could develop

Students in both groups referred to specific key moments where the group had advanced in defining its project ("Eureka!" moments):

Group 1:

S3: Argument-wise that was the moment when what we were arguing about, it clicked you know, broke that new ground

Group 2:

S3: For me it [a key moment] was when it came out about what the sensations would be on your hand. And it started to, sort of, make the idea more real

Whereas for Group 1, the advance concerned definition of the project concept, for Group 2 this concerned understanding of a technical issue (concerning the high-tech glove).

5.2.4. Comments on the group

Group 1 stated that the value of the AC debate to enabling the group to become less one-sided:

S3: There is a lot of back and forth here we don't really have

S1: that's true. I feel we are one sided within a group

They also commented on the group as a whole with respect to divergence and convergence in group-creativity, referring explicitly to the general credo of brainstorming (see the introduction to this paper):

Group 1:

S3: we didn't explore enough

S1: yeah we never shut down any idea … every idea is …

S2: good

In Group 1, extended sequences occurred during which participants commented on the general manner in which they and others intervened in the AC debate, their shyness or confidence with respect to sharing ideas, politeness, emotions, and so on (see the extract below).

Group 1:

S1: Could you pause it? I think I know where we all stand now you know you did guy that stops everything in question, everything. She [S4] only speaks when she has something extremely valid to say but none of her points were invalid you know, like you guys speak on everything you get. She is really polite and I feel you restrained the ideas you are giving you know you are afraid of sharing your own ideas you know

S4: No sometimes I want to share but nobody is listening so like sometimes I've got ideas, I've done some research. I think I'm more confortable to speak with persons like to one person rather than in a group

S1: Because you know you're very shy and even if you're making a point you are not so confident about it and we are not also confident about your point

S4: Uh because I'm not ... In this debate I'm not confident about anything

S1: I realise you know I've noticed this. She's a bit shy try to be a little bit more

dominant about your ideas. Your ideas are really good.

5.2.5. Comments on grounding

Participants in Group 1 indicated moments when they were confused, did not understand what the others meant, or expressed what they thought they had meant.

Group 1:

S1: I had no idea what you guys were doing. I was confused at that moment

S3: I thought you were kind of saying

Group 1:

S1: you've gone a bit quiet around that time

S2: Yeah I ran out of ideas. When we were against I was just trying to think that much that I could

S1: let's see what you are doing further on ((plays AC video from 01:16:27 to 01:16:59))

S1: we were doing that, we were doing exactly what you just said

S3: I thought you were talking about like making a warm like a package that just did everything

Group 2 pinpointed specific utterances that were not understood during the AC debate (see also the section on extended sequences, below):

Group 2:

S4: ((stops AC video)) I still don't get that point. I don't get what you mean: what's the problem you're referring to?

S3 : I, I, … it's like the calibration … put your palm out; imagine that you're looking at something with your palm ((S4 holds out right hand palm facing outwards))

They also expressed their general attitudes towards others' statements, often leading to explanations of what was meant:

Group 2:

S3: ((laughs)) "Yeah, at that point you can always pull out the autistic card, and then you said dolphins and so on and I was like, what the fuck

S4: "No, but did you not get the point? It's that dolphins, can kill fish, with sonar, so you can make this not only … we can extend our senses beyond what is merely evolutionary"

5.3. Two key moments for project definition

We present two extended interaction sequences resulting from identification of two key moments, one from each group, both of which related to project definition.

5.3.1. Sequence 1, Group 1: touch should not be taken literally

The following (Table 6) is an extract from the second AC debate (once roles had switched round) of Group 1, which was identified as a key moment by this group in the GR session.

Table 6. Group 1, AC debate extract

Line N	*Speaker*	*Utterances*
14	S2	yeah ok so starting touch is like the natural way of human communication so it it it's the natural way of of enhancing this com-
15	S1	experience
16	S2	you know connecting people is is is is always like better hh ah hhh when you when you have that touch in the that connection to someone so trying to mimic like in the future in the digital world might actually break this this horrible path we're taking where people don't even touch each other
17	S1	breaking this digital barrier that have already started to exist you know so touch will definitely enhance the age of communicative
18	S4	but .. but .. but now we have the tendency that people to prevent uh touch they:: they want to keep their own personal space and they they got their privacy they feel uncomfortable with touch and how would you guys why would you guys want to force people to have touch with others
19	S1	that's the beauty of it you know without any else touching you it's gonna be your own (de-) it's gonna be your own property it's gonna transmit the exact sense of touch and you know that the person can communicate with friends and send you over without invading the person space
20	S2	uh uh I think it's more of a a a touch you're confortable with and not like a random touch like you'll might forget about like you know it's a controlled thing may- maybe you're with making touch as a very literal thing so when you did this I can feel you're going ahead it it it's a physical presence we're in
21	S1	ah
22	S2	the room that that's a kind of like the touch big concept of it not not the fact I have been touching your hand and you can literally feels skin to to skin it's more the the thing that I know you're here because I can feel you .hh moving .hh around .hhh .hhh and that's part of touch
23	S3	damn that's
24	S1	[ha ha ha ah]
25	S2	[ha ha ha ah]
26	S3	[ha ha ha]
27	S4	[ha ha ah ha]ha ha ha ha .hhhh
28	S1	[brill]
29	S3	[okay] uh ah ah

Figure 4 shows student S2 of group 1 shaking the table in order to illustrate what she meant by touch communication as feeling co-presence, during line 22 of Table 6.

Figure 4. S2 (on the right), Group 1, shaking the table to illustrate feeling of co-presence in space

In the GR session, Group 1 made the following comments (Table 7) on the sequence of their AC debate shown in Table 6.

Table 7. Group 1 comments in GR session, on their AC debate sequence (shown in Table 6).

Speaker	*Excerpt*	*Referent*
S3	Argument-wise that was the moment when what we were arguing about, it clicked you know, that broke new ground	PROJ-DEF
S1	It was here at this very moment, we had not discussed this	PROJ-DEF
S2	I don't know where it came from [laughs]	PROJ-DEF
S1	But I'm glad it came because I personally think this was the moment of realisation for us that, you know, that vision is absolutely useless …we should be thinking about the interaction on a much broader scale …because before we were just all sceptical of the idea of using touch, this is where we touched on it	PROJ-DEF

In the above debate extract, S2 (advocate) proposes that touch communication could break down barriers between people. S4 (critic) objects that people don't want their personal space invaded by touch. What S3 describes in the GR session as the moment when it "clicked", and they "broke new ground" was when, in the AC debate, S2 says that "touch" should not be taken too literally: it is more about feeling a co-presence in space, of the other moving around. This is their *Eureka! moment* for the re-definition of their project. Interestingly, the students evoke surprise at the emergent properties of their dialogue: "I don't know where it [the new idea] came from". We shall return to the emotional aspect of this event below (§5.4 below).

5.3.2. Sequence 2, Group 2: technical issues and defining users

Whilst the key moment described above, with respect to Group 1, involved intense interactive work in the AC session itself, in the example shown below for Group 2, a large part of such interactive work, on grounding and reaching agreement on a crucial aspect of the project definition, was mainly carried out during the GR session itself.

In the following extract from Group 2's AC debate (32 minutes from the beginning), S3 was one of the two critics:

> Extract from Group 2 AC debate
>
> S3: when you're doing that you can see your hand on the thing how do you have a visual feedback how do you know what you're touching with this? Is it enough? How do you know which part of it is giving you which feedback?

S4 stopped the AC video at this point, stating that he did not understand what S3 had meant during the AC debate, and the following GR discussion ensued (Table 8):

Table 8. Extract from Group 2 GR discussion.

Speakers	*Excerpt*	*Referent*
S4	[S4 Stops video] I still don't get that point. I don't get what you mean: what's the problem you're referring to	GROUNDING
S3	I, I, … it's like the calibration … put your palm out; imagine that you're looking at	GROUNDING

	something with your palm" / ((S4 holds out right hand palm facing outwards))	
S3	Right; where is your palm looking now?	PROJ-DEF
S4	there, there ... ((points outwards with finger of left hand))	PROJ-DEF
S3	exactly, so you're looking over there! ((points outwards vaguely)) exactly, so how do you know ...	PROJ-DEF
S4	because it's my palm!	PROJ-DEF
S3	yes but how does the device know?	PROJ-DEF
S4	because it's on *my* palm". ((pause of 5 seconds))	PROJ-DEF
S3	((S4 continues holding palm upwards)) ((shared laughter ends long pause)))	PROJ-DEF
S4	so the device is looking in a *normale* [sic] direction ((holds palm upwards, indicates upward movement with other hand)) from the centre of my palm	PROJ-DEF
S3	ok, so basically, what I'm saying is that you need a laser sight to know where it's looking	PROJ-DEF
S4	Well, in a way, yeah; but finally, we have proprioception, so I know that I'm pointing there ((with palm of hand)) as long as like you have your laser sight, which doesn't have to be like a pink dot, in reality	PROJ-DEF
S3	hmm	
S4	if it's like a kinect thing you could cover the front of it that knows what's where, ... anyway [S4 restarts debate video]	PROJ-DEF

The interactive sequence of Group 2's GR discussion, shown above, is triggered by S4 stating that he did not understand the objection raised by S3: with the glove electronic device that is supposed to enable touching things at a distance, how would the user/wearer know (sufficiently precisely) what the glove was pointing at/touching? A sequence follows that enables grounding between S3 and S4: a laser sight is needed on the device, for the user to know what is being pointed at/touched. S4 is not, however completely convinced, and evokes the possibility of using proprioception with a *kinect* device. The issue of proprioception leads the group to discuss (in the GR session) the possibility, in this case, of designing the glove for blind people. S4 again stopped the AC debate video, and the following discussion ensued (Table 9):

Table 9. Extract from Group 2 GR discussion (continuation of Table 8)

Speaker	*Excerpt*	*Referent*
S4	((stops AC debate video.)) No but, no no no, your point was, like obviously, if the only thing that blind person has is the glove then you will not know what he's looking at … unless its in his home and he knows where his stuff are [sic] … but this is not supposed to be a substitute, it's another layer of experience. So we add something	GROUNDING
S3	That's a decision that we need to make	PROJ-DEF
S4	Sure. ... because if it's about re-introducing touch, NOT about substitutioning vision	PROJ-DEF
S3	Right, ... but then we can't talk about blind people and autism ... because we're not designing for them	PROJ-DEF
S4	Why not!? You can design something for blind people without substitutioning	PROJ-DEF
S3	Ok, right, yeah ... but we can't pretend that we are designing for blind people in this project. We're saying that this is an extra sense rather than a replacement	PROJ-DEF
S4	Yes. But that's fine.	PROJ-DEF
S3	we were saying that we were designing for a group of people, but basically, we're designing for ourselves	PROJ-DEF
S4	Yeah, I was gonna say that like designing for the blind is actually not really my goal in any way, because I'm not really actually into medical design in any way	PROJ-DEF
S3	Ok but then we should not use it in any way as a source of memory	PROJ-DEF

S4	Yes yes, not primarily	PROJ-DEF
S1	It might be better not to bring that up at all, because it's a real kind of ...	PROJ-DEF
S4	Yeah, well you could look as if your desperate, sort of 'it's also good for blind people and autistic people and autistic blind people and poor autistic blind people" ((laughs all round))	PROJ-DEF
S3	and people in townships	PROJ-DEF
S4	people in third world countries, blind people in third world countries ...	PROJ-DEF
S3	Imagine that you're in a Kenyan village and the school is on the other side of the ravine and you can use your haptic glove ((gestures open palm)) to feel for it	PROJ-DEF
S4	Ah ha ha ha! Poverty. Sorry ((laughs all round))	PROJ-DEF

This second GR session extract (Table 9) continues on from the first (Table 8), in raising the question "are we designing for blind people or not?". S3 states that it is a decision to be made together. The group achieves grounding and agreement — not during the AC debate, but rather in the *GR session* — on the idea that their project is not about substituting for sensory deficiencies. In part, this decision is based on S3's mockery of S4's discourse in the AC debate (where S4 evokes dolphins as well as helping with autism as aspects in favour of their project concept), which is finally agreed to be absurd.

In sum, for Group 2 the key moment in the AC debate was a lack of shared understanding about S3's critique of S4's presentation of the project concept: how could the wearer of the glove know what it was 'touching' at a distance? In a sense, the GR session then leads to an extended debate, continuing on from the AC debate, that leads to important new decisions on the joint project definition (the glove device needs to know what it is pointing at; the device does not aim to substitute for sensory deficiencies). The AC debate for Group 2 was in fact more like an exchange of long uninterrupted discourses, for then against the project concept, with little interactivity. Such a lack of interactive debate in the AC is remedied in the GR session.

5.4. The circulation of emotions in interaction

Figure 3 (at the end of section 4, above) shows the circulation of emotions, within and across the AC debates and the GR sessions.

Firstly, in the GR session, students commented on their emotions experienced and expressed during the AC debate (case (a) of Figure 3). The following are examples of negative then positive emotions of displeasure and enjoyment expressed in the GR session, with respect to role-play in the AC debate:

> *(Group 1) S4: yeah I think when we go that's that's why I just couldn't bear to be opposite*
>
> *(Group 1) S3: I quite enjoyed playing that part*

Secondly, students expressed emotions in the GR session, with respect to their interventions in the AC debate. In Group 2, for example, S3 expressed humoristic derision and astonishment about S4's defence of the project, with which S4 concurred by saying that he now considered his own statements to be pretentious:

> <u>Group 2, GR session</u>
>
> S3: ((laughs)) "Yeah, at that point you can always pull out the autistic card, and then you said dolphins and so on and I was like, what the fuck ((smiles))

S4: No, but did you not get the point? It's that dolphins, can kill fish, with sonar, so you can make this not only … we can extend our senses beyond what is merely evolutionary"

S4: I sound like a bit of a dick, don't I? When I talk about what's evolutionarily prescribed. It sounds a bit pretentious

Such emotions are expressed in relation to students' *evaluations* of their own or others' interventions in the AC debate.

Thirdly, as we saw with respect to the key moment of Group 1, discussed above, positive emotions, in the form of laughter circulating amongst the students, are expressed in the AC debate, following "*Eureka!"* moments, with respect to project definition.

Finally, depending on the group, as new discussions and debates arise in the GR session (case (c) of Figure 3), emotions circulate within the GR session in two main cases. The first is where disagreement occurs in the GR session, and the students arrive at a stalemate (see Extract 1, Table 8, from Group 2 GR session above, §5.3.2): the circulation of laughter around the group, here, can be seen as *tension release* (cf. Andriessen, Baker & van der Puil, 2011) given that the two students are at a deadlock. Secondly, within the GR session, when students arrive at a new project definition, this can be associated with shared laughter, as the previous project definition is rejected.

In summary, the AC debates and their associated GR sessions involve role-play, verbal conflict with associated debate and attempts to define the shared project concept. The circulation of emotions, within and across AC and GR sessions, can be understood with respect to these three aspects, namely:

1) *Role-play*. Students expressed their negative or positive emotions with respect to playing argumentative roles that either did or did not correspond to their own views. Sometimes, in GR, they expressed negative emotions, but in a humorous manner, with respect to how others played their roles.
2) *Verbal conflict and debate*. When verbal conflicts could not be resolved, at least at that point in time, the circulation of laughter enabled tension release.
3) *Project concept definition*. What students saw as breakthroughs or "*Eureka!*" moments in project definition, were associated with shared laughter signalling pleasure.

The two groups analysed here had very different distributions of interactive activity across the AC and GR sessions — Group 1 had a very interactive AC debate, in Group 2 the lack of interaction in AC was compensated for in GR — and these distributions naturally affect the way that emotions are expressed and circulate.

6. Discussion

The main aim of the research reported here was to understand what and how a workshop session, called "Argument Clinic" ("AC"), based on argumentative role-play, could contribute to group creativity projects. AC was coupled with a subsequent group reflection ("GR") session, in which students, as a group, were invited to identify key moments of their AC debate (whilst watching a video recording of it) and to make any comments on it that they wished. It is important to note that our aim was not to promote "creativity", considered as a characteristic or competence of individuals or groups, but rather, as just stated, to pursue the more modest aim of understanding how the AC debate contributed to the group creativity projects that were already under way. In aiming for such understanding, we focus on

analysing the students' own point of view, as expressed in their GR sessions. The students studied here were at early stages of definition of their joint projects. However, the precise stage of project development at which the AC/GR workshop would be useful remains an open question.

On the basis of detailed and systematic qualitative-quantitative analysis of AC and GR sessions for two groups of 4 students, each of which was given the general project brief of developing a design of an artefact for "touch communication", we discuss the main results, within the limitations of our restricted corpus under analysis. Bearing in mind these limitations of the present study, it emerges clearly that the two groups analysed were very different in terms of the nature of their debate (AC) and group reflection (GR) discussions, as well as the relations between them. Group 1 had a very interactive AC debate, with frequent interactive exchanges within both sub-debates, as roles switched, with critics replying to proponents during their defences in each phase. The main emphasis of their debate was refining the project *concept*. The emotional climate of their AC debate was generally positive and 'lively'. Group 2, however, seemed to carry out the role-play format in a rather rigid manner; and their debate consisted of quite long speeches of advocates followed by critics. This group focussed mainly on technical aspects of the artefact being designed, but also on defining target users' characteristics.

These differences are reflected in the corresponding GR sessions. For Group 1, the emphasis was on role play and the group itself; Group 2 was more centred on project definition: grounding issues were identified in the AC debate, which led to new debates within the GR session that seemed to compensate for the lack of interactivity in the AC debate.

As described in the literature review above, group reflection sessions have both methodological and developmental potential. The results of our analysis lead us to consider that the "AC+GR" sessions should be considered as a *whole*, given that debates on project definition can be distributed differently across AC and GR, depending on the group. In particular, Group 2 advanced its project definition above all in the GR session. The group creativity workshop format could forthwith be described as a *reflective* Argument Clinic.

With respect to these two groups, the contribution of AC+GR to better mutual understanding of redefined project concepts appears clearly. In the case of Group 1, the AC debate enabled the group to not take "touch" communication too literally: it could also be understood as feeling co-presence in space. In the case of Group 2, debate — but this time, occurring in the GR session — enabled the group to resolve a technical issue (how would the person using the glove device know what was being pointed at?) and to better define the projected users (they discarded the idea of designing for people with sensory impairments).

A second issue to be discussed relates to the role-play procedure used for the AC debate. On the one hand, some students expressed difficulties with playing an argumentative role that went against their own views, whilst others expressed their pleasure in playing such roles and, in general, considered that role switching helped them to 'think around' the project. The role play format, therefore, seemed in this case to at least provide a clear procedure to be followed by students, where difficulties associated with it, or else following it too literally, in a rigid manner, could be obviated during the group reflection session.

The students' general comments also indicated that the AC+GR sessions had a positive role with respect to constitution and cohesion of the group *per se*. In informal discussions with the experimenters following the GR sessions, students also said that although they had group projects to be achieved, they actually rarely met and confronted their ideas in close interaction. Similarly, one student (S3) in Group 1 made the following remark at the

beginning of the group reflection session: “we don't really have discussions like this outside of here, you know what I mean”. As mentioned above (section 3), the students at RCA work together regularly in groups (for example, in brainstorming sessions and project supervisions), each group having its own zone in an open design studio (a whole floor of the building). However, this does not necessarily mean that students regularly engage in close discussion with respect to their projects: according to the students, as well as their professors’ observations, students mostly ‘group together’ in space, whilst nevertheless working individually. The first two authors of this paper also made the same observation with respect to groups of engineering students working on group innovation projects at Télécom Paris (reported in Détienne, Baker, Vanhille & Mougenot, 2016). We therefore conjecture that for many students, it does not go without saying that participating in ‘group work’ involves intensive synchronous *discussion* of their project, i.e. *collaboration* (see Crook, 1994; Dillenbourg, 1999; Andriessen & Baker, 2020), rather than loosely coupled individual work. In other terms, whilst educational institutions do organise small group interactive sessions, students rarely engage in collaboration outside of those sessions. Thus providing specific occasions for such collaborative discussion, structured, for example, using role-play, fills a clear educational need. In addition, this invites reflexion in the Covid-19 era on how the value and the experience of intensive face-to-face collaboration (Crook, *ibid.*), with all the circulation of affect it involves, can be preserved when students are encouraged to remain distant from each other, behind their individual computers.

Finally, this study casts light on the complex roles of emotions in the AC and GR sessions, with respect to the groups and their projects. As discussed in the previous section of this paper, the circulation of positive emotions around the group was associated with break-throughs, “*Eureka!*” moments with respect to grounding of new shared project definitions. The circulation of shared positive emotions also served as a means of relaxing tensions associated with unresolved differences of opinion with respect to project definition. In other terms, shared positive affect, indicated by laughter, can express pleasure and relief on achieving an objective, and also tension release when faced with unresolved socio-cognitive conflicts. Furthermore, negative emotions expressed by students in some cases, with respect to difficulties in playing and switching argumentative roles, do not seem to have prevented the abovementioned contributions to more precise and grounded group project concepts.

The detailed analyses presented here, of the discussions of two groups of students at the Royal College of Art, provides indications for possible improvements to group creativity training based on argumentative role-play. The first was mentioned above: consider the AC and GR sessions as a whole, in order to ensure that benefits to group projects occur, as a result of argumentative confrontation and subsequent reflection on group communicative action. A second direction for improvement would be to introduce more frequent switching of argumentative roles, in order to prevent long speeches and increase interactivity. It may also be advisable to consider the role-play format in an even more flexible way, as something to be followed initially, to spark off dialogue, to be abandoned under teacher moderation once a constructive interaction is under way.

7. Conclusions

Notwithstanding the limited corpus of interactions analysed here, we propose five main conclusions emerging from this research on how group creativity projects are impacted by situations involving argumentative role-play discussions and subsequent group reflection on them.

Firstly, *groups can elaborate more clear and mutually understood project definitions*. Such an interactive process works on conceptual as well as technical (feasibility, target user characteristics) planes and corresponds to what we term "Eureka!" moments here. This provides empirical evidence for theoretical proposals in argumentation research, according to which argumentation dialogues do not reduce to strategic exchanges of (counter-)arguments, but also involve introducing new conceptual distinctions (Perelman & Olbrechts-Tyteca, 1958) and elaborating more precise definitions of the objects of debate (Naess, 1966).

Secondly, in order to give rise to the abovementioned outcomes, *argumentative interaction based on role-play is alone not sufficient, but also requires group reflection on the students' previous interaction*. This is so given differences across groups in terms of how strictly or openly role-play is interpreted, whereby group reflection can enable, in some cases, the introduction of interactive meaning making that did not occur in the discussion itself. As mentioned above, therefore, *it would be advisable to consider role-play argumentative interaction and group reflection on it as a whole*, a single indivisible approach to group creativity training.

Thirdly, although students experienced difficulties in playing argumentative roles that did not correspond to their personal views, *switching roles nevertheless allows students to "think around" the issue* (to quote one student's own verbatim). In addition, even within particular role assignments, students do not always play them strictly, and in any case it may be advisable to be flexible, using role-play as a starting point to be left once the dialogue 'gets off the ground'.

Fourthly, within the 'life-cycle' of group creativity projects, *the organisation of specific face-to-face dialogue sessions on shared projects has a positive function with respect to constituting the group* per se. As we discussed in the previous section, it is not obvious to students that group work involves close collaboration on project definition and implementation.

Finally, *the occurrence of "Eureka!" moments* (see our first conclusion above) *was associated with the circulation of positive affect*. Such shared affect is an additional important dimension of the constitution of the group per se (see our fourth conclusion, above).

This research opens up several avenues for its continuation. A first objective for future research is to understand how to train trainer/moderators of groups working on debate and reflection, such that they would be able to help students to focus better and deepen verbal conflicts in a more constructive manner. A second, currently under way, is to implement the argument clinic and group reflection workshop, first designed in London, in other academic institutions that participated in the research described here (Télécom Paris, France, and the University of Tokyo, Japan) in order to explore the ways in which it would need to be adapted to group dynamics in other cultures (Détienne, Baker, Vanhille & Mougenot, 2016).

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