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# ***Transmission, transformation and ritual: an investigation of students' and researchers' digitally mediated communications and collaborative work***

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## **Abstract**

This paper explores the use of multiple digital tools for mediating communications, drawing on two recent empirical studies in which students and researchers in UK Higher Education worked on collaborative activities. How different tools were used and the quality of the communications and their contributions to collaborative working and knowledge construction are outlined. We draw Pea (1994)'s proposition that communications can be understood as transmissive, ritualized or transformative depending on their impact on other participants. Most of the students' communications were either transmissive or ritualistic, although there were also generative conversations offering mutual support. Researchers' conversations were more often transformative, using tools consistently, for specific purposes. Researchers matched the tool to the specific needs of the task, whereas the students chose tools based on friendship groups and lifestyles. Transformative communications were powerful in co-configuring new knowledge and resources and the importance of the ritual communications in maintaining the social order was also essential to communications in collaborative settings. We conclude that close attention to protocols, social norms and patterns of use in digitally mediated 'conversations' are required to develop collaborative partnerships and support transformation practices amongst higher education 'workers'.

## **Keywords**

Communication, digital tools, socio-cultural theory, reciprocity, meaning making, transformation, social interaction.

## **Introduction**

This paper reports on two recent qualitative studies on the use of multiple digital tools for communication in small group learning in different learning contexts in Higher Education. Both studies are grounded in socio-cultural theories of learning and use participative research methodologies. We explore the use to which the different digital tools were employed, what drove the choice of such tools and the connection between the choice of tool and the quality of the communications. The first study involves third year undergraduate students taking an elective module where they were grouped into small, online special interest groups (eSIGs) and the second involves two researchers who collaborated to analyse video data.

Digital communication is integral to the personal lives of most young people who are or will become university students (Oblinger, 2004; Pedro, 2006). Most students now use multiple digital tools and communication devices habitually (Borreson Caruso & Salaway, 2007) including mobile and instant online messaging. Similarly, higher education researchers also engage in multiple forms of communication (Nentwich, 2003), and for both these groups, choices and decisions need to be made over how, when and where to communicate and interact with others.

Most studies of campus-based students' communications and interactions using digital tools have tended to focus on the use of one specific tool, hosted within institutions (For example, Cox, Carr, & Hall, 2004; Timmis & O'Leary, 2004). Two previous studies, however, have looked at multiple tools, suggesting that students often preferred instant messaging to asynchronous discussion boards and email (Crook, 2002). A wide variety of communication tools were used by law undergraduates to organise work, but no standard pattern was discernible and access to tools was very variable, leading to sharply differentiated patterns of interaction (Jones & Bloxham, 2001). Furthermore, there is considerable existing literature outlining studies investigating computer mediated communication (CMC) in higher education and more broadly. These have tended to concentrate on fully online distance learning contexts, investigating aspects of the social context: for example, community networks (Haythornthwaite, 2002) and the development of social presence (Rourke & Anderson, 2002). However, these studies have again all concentrated on the use of a single communications tool. This suggests that we need more in-depth understanding of the choices and rationales for using digital tools and of the actual communicative activities that learners engage in to support their learning. Herring urges that we take "a step back from examining the parade of passing technologies and consider more deeply what determines people's use of mediated communication" (Herring, 2004, p. 34).

This paper explores the ways in which the multiple digital tools were used by the researchers and learners in two studies and relates these to the rationales the actors gave for the choices they made. We also examine the way in which these communications support the collaborative work undertaken in the studies. The next section discusses our understanding of the relationship between learning and communication in small groups.

## **Learning and communication in small groups**

Both studies focus on small-group 'learning', but differ in the ways learning is constructed. Eraut (2007) uses the concept of 'object' from Activity Theory (Engeström, 1987; Leont'ev, 1981). This "object orientation" is what gives activity its

sense or purpose and distinguishes one activity from another (Kuutti, 1997). This helps us to distinguish between learning that takes place through deliberately designed learning activities (the 'object' is learning) and learning that takes place as a by-product of working (the 'object' is working) (Eraut, 2007); the first project described in this paper can be seen as the former and the second can be seen as the latter.

Small group collaborative learning requires communication between the members of the group to support problem solving and the building of a joint problem space (Roschelle & Teasley, 1995) and communication and coordination of group activity are mutually supporting elements in collaborative work (Davies, 1995). There is a reciprocity inherent in any dialogic communication (Bakhtin, 1999) and Pea (1994) contrasts a transformative view of communication with a view of communication as either transmission or ritual, depending on its impact on other participants. Transmissive communication is, as the name suggests, the transmission of information, a paradigm commonly seen in educational environments. This form of communication is one-way because it does not invite participation from others. Ritual communication, on the other hand, demands the participation of others in 'the construction and continual interactional maintenance of social order by means of seemingly ordinary conversations in everyday life (Pea, 1994, p. 287). However, as Pea argues, even though this type of communication is important in that it considers participation to be significant, it does not 'establish generativity of the kind required for education'. He suggests 'generativity' or evolution of 'ways of knowing' come about through transformative communication, where participants are mutually transformed by the process of communication with the cultural messages of others, and hence go beyond the common body of knowledge, or 'expand the ways of knowing' (ibid, p. 288). Crucially, in transformative communication, each participant offers resources for transforming the practice and meaning making of others which is a key aspect of the co-construction of knowledge (Gunawardena, Lowe, & Anderson, 1997; Pena-Shaff & Nicholls, 2004). Pena-Shaff and colleagues argue that co-construction of knowledge should also include discovery and exploration of dissonance. This view of communication therefore includes the idea of reciprocity and generativity in meaning making which embodies some tension between the needs of the self and others and a means of mutual transformation.

In collaborative group learning, the 'establishment of patterns of interactions to guide communication and to support coordination of the group' (Stahl & Hesse, 2006) are key elements of success, which imposes a task on learners which is additional to attending to the 'problem domain' (Suthers, 2006). In technology enhanced learning, where we aim to establish a learning community, involving online interactions with resources and people, there are additional challenges, such as building social presence (Rourke & Anderson, 2002) and trust (Handy, 1995), and a commitment to the group and the task. Furthermore, approaches to learning may be more complex when people are required to learn both face to face and in online environments and open to more unplanned influences than traditional courses (Jones & Bloxham, 2001). Developing a deeper understanding of the communicative practices that underpin these collaborations is therefore essential.

## **Methodology**

In the two qualitative studies presented here, data had previously been collected and preliminary data analysis had taken place, before the research we now report on, began. In both cases, 'workers' were using digital communications in order to collaborate and the data collected included naturally occurring, authentic communications data. A *theoretical* sampling approach was employed, where the

sample is both theoretically and empirically meaningful and builds in characteristics or criteria in order to develop and test theoretical arguments (Mason, 2002; Silverman, 2000). The two studies were therefore chosen, based on their relevance to the following research questions:

1. What kinds of digitally mediated communications take place in collaborative, small group working practices and what influences the choices people make?
2. To what extent can digitally mediated communications be understood as transmissive, ritual or transformative and what are the roles of these different communicative forms?
3. What are the similarities and differences between the ways in which different groups of 'workers' in higher education communicate and collaborate?

Both studies provided access to similar, authentic communications data (together with interview and self report data) but provided contrasting contexts; one study looked at students and the other at researchers. A secondary analysis of the data was conducted, using a comparative approach to explore similarities and differences between groups of people working in Higher Education. The analysis drew on the sociocultural framework presented earlier and in particular, Pea's (1994) conceptual ideas were used to identify and understand qualitative differences in the communications. A preliminary, grounded analysis of the 'learning conversations' (Gudeman & Rivera, 1995) and self report data was undertaken to identify patterns and trends in practices, together with rationales, timing and choices of digital tools. Co-construction of knowledge was analyzed using an adapted version of two, different socio-culturally informed content analysis schema, developed by (Gunawardena, Lowe, & Anderson, 1997) and (Pena-Shaff & Nicholls, 2004). Further analysis of the communications data was then undertaken using Pea's framework (1994) to identify qualitative differences in communications data across all the digital tools that were used and to examine the relationships and roles of different forms.

The findings for each of the two cases are now presented, followed by a discussion of our interpretation before conclusions and implications are outlined.

### **e-SIG Communications**

The first of the two studies focuses on the digital communications activities of campus-based undergraduate students working in small (typically 4-5 participants), collaborative online special interest groups, known as e-SIGs, during the academic year 2006/2007. The research focuses on the activities of a cohort (68 students) of third year students taking an elective module (in e-Business) at a post-1992 university in the United Kingdom. The module introduced students to the key concepts of e-Business through a combination of fortnightly lectures and a collaborative research project conducted in small groups, based on their choices of research topics. Groups were set up on the university VLE<sup>1</sup> and students were required to provide key updates using this tool. They were also encouraged to use a variety of other personal (for example, instant messaging, mobile phones, blogs) and institutional communication tools and to meet face to face if they wished.

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1 Virtual Learning environment

A study group of ten students collected their personal communications data at two key points in the module and also reflected on their own practices through a series of video-recorded student-led group interviews, supported by completion of preparatory questionnaires a week in advance. Postings from all the e-SIG VLE discussion forums and one e-SIG blog were also collected.

The students reported using a wide variety of personal digital tools: MSN messenger and Skype<sup>2</sup> (both voice and chat facilities), personal email, blogs, mobile phones, and, to a more limited extent, social networking sites, such as Facebook<sup>3</sup>. The most commonly used tools were MSN and Skype. There were also very blurred boundaries between study and personal conversations but this tended to be where ad-hoc discussions on the e-SIGS emerged and did not generally include premeditated discussion on the project work. The choice of tools was closely related to membership of particular friendship groups. Choices also related to home context (where students with their own home were more likely to have a PC that was always on and therefore tools such as MSN were readily available). Institutional tools such as the VLE and email were used for more formal communications (each group was required to post a number of specific items on the VLE group discussion board). The university email was primarily used for communication between students and tutors and not for peer to peer conversations. A blog was set up by one group who used it as the main vehicle for communication. The use of this was very similar to their use of the VLE and it almost acted as mirror site. However the students set this up because one student in the e-SIG could not post to the VLE and also because they wanted to receive email alerts for new messages. This was interesting as many students in the group interviews felt that the VLE was difficult to use because you could not tell easily whether anything new had been posted, resulting in a need for constant checking. Only one e-SIG reported having spent time getting to know each other face to face early on and this group saw the main benefit of the e-SIGS as being a way of having made a new friend. The postings on the VLE can be seen to become progressively more relaxed and dialogic as the module proceeds, in contrast to other groups which retained a more formal tone.

Figure 1 presents a matrix of tools and their uses within the study. The matrix maps categories of interactions between the students against the use of tools. The categories of interaction build on the work of (Gunawardena, Lowe, & Anderson, 1997) and (Pena-Shaff & Nicholls, 2004), as discussed above, but also draw attention to 'social' interactions. The matrix also shows the wide variety of uses the tools were put to and the large areas of overlap between tools.

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<sup>2</sup> Skype is an synchronous communication tool which includes both instant chat (text) and voice functionality.  
<http://www.skype.com>

<sup>3</sup> The limited use of Facebook and other social networking tools can be explained, in part, by the timing of this study. In 2007, Facebook was still a relatively new phenomenon.

Method/tool	1. Make new contact	2. Intimate social chat	3. Group co-ordination/grounding	4. Elicit/offer support/empathy	5. Elicit/offer information	6. Share/compare information	7. Test/modify ideas	8. Agree new ideas
Face to face meetings								
Uni Email				with tutors				
VLE groups								
MSN Chat								
Skype Voice								
Skype Chat								
Blog								
Personal email								
Mobile txt								
Mobile voice								
Facebook/MySpace								

**Figure 1: Summary of digital tools in use in e-SIGS and their purposes**

The eight categories range from making initial contacts with people in the e-SIG they did not know (1), having close and intimate conversations with existing friends in their own e-SIG or in others (2), communication to establish and maintain group coherence and activity coordination (3) to communications that elicit and offer either empathy and support or information (4,5). It can be seen that communications that support the social and affective aspects of the relationships, together with the transfer of information were conducted using a wide variety of tools. As stated earlier, the choice of these related to friendship groups, home context and access and economic factors.

Categories 6 -8 show the uses of the tools for knowledge construction activities. It can be seen that these are confined to a more limited group of tools. This reflects the fact, in part at least, that the students reported low levels of collaboration generally; the data shows that collaboration was largely confined to agreeing a specific topic and project title. There were examples, however, on MSN and Skype, where students were working together to share and develop ideas, particularly when preparing their assignments. The areas where there was less evidence of collaborative activity to support knowledge construction, is in resolving arguments and differences. The absence of communications that show arguments and dissonant discussions or a struggle for resolutions might therefore be an indicator of the quality of the collaborative work and learning taking place.

The data was further analysed to identify transmissive, ritualistic or transformative communications (Pea, 1994). The following examples are from conversations using MSN, Skype and the institutional VLE. The first conversation (Figure 2, below) is indicative of many similar examples in the data and shows an intimate chat between two students who already knew each other before the e-SIGS module began. This kind of empathetic conversation was common amongst students who already knew each other and many of these conversations took place intermittently during the day or throughout the night, particularly when assignment deadlines approached. The study group reported, however, that they did not establish this level of rapport with students who they did not know before the module began and this kind of activity (with one exception) only took place between existing friends. In Pea's terms, this appears to be an example of ritualistic communication where meaning is shared at the pre-existing level. In Figure 2, there is reciprocity in the dialogic exchange but there are no resources offered between participants or any search for new meaning

demonstrated, although they do show commitment and support for each other as members of a community (ritualistic communication).

However, in contrast to the ritualistic communications that were in strong evidence, there were more limited evidence of transformative communications, mainly in the instant messaging conversations, in the VLE, email and blog data, examples were scarce. Figure 3 (below) provides an example of typical instant messaging conversation. Here the two students identify a common problem and work out a solution, although one participant is doing most of the work. Nevertheless there is an exchange of both the problem and an agreed solution and a new understanding is created and shared so it can be seen as generative, reciprocal and transformative.

<p>hey [name], howz ur e-biz going?</p> <p>hi mate, slowly</p> <p>you!</p> <p>lol i only just e-mail my assignment title</p> <p>yeah i had a panic this morning managed to send it by about 10 o clock, what title have you suggested doing</p> <p>ha thats what i did.. ive been doing one of my law essays and forgot about e-biz, didnt really put forward a title, just said copyright and the internet... im sure i will get an e-mail bk asking me to explain - haha</p> <p>what did u suggest?</p> <p>well i suggested Phishing and the way it affects eBiz</p> <p>Cool</p>	<p>lol; Ive never referenced a BLOG before</p> <p>yeah thats a new1 to me as well</p> <p>check out leeds university harward guide</p> <p>will do, thanks 4 the tip</p> <p>i'll find the URLs</p> <p><a href="http://www.leeds.ac.uk/library/training/referencing/harvard.htm">http://www.leeds.ac.uk/library/training/referencing/harvard.htm</a></p> <p>cheers</p>
<p><b>Figure 2: Extract from MSN Chat conversation – 12/3/07 16:24</b></p>	<p><b>Figure 3: Extract from Skype Chat conversation - 5/4/07 20:28</b></p>

Figure 4 (below) is indicative of a large number of VLE discussion board posts which received no reply. Although there was activity on all of the e-SIG discussion boards students reported that they did not know people in their group and were therefore unsure who they were collaborating with. The student presents his personal ideas and then tentatively asks for reassurance, which is never forthcoming. The group is not addressed at the beginning of the message and it is signed off “regards” which also betrays a lack of group cohesion and grounding. This message is mono-directional and therefore a transmissive communication in the sense that it is informational, without reciprocity or dialogue. Furthermore, the message reflects a tension in this module between the individual assignment that students were asked to undertake and the requirement to work collaboratively, meaning that their commitment to the group and the task were quite weak.



<b>Thread:</b> My idea for my part of the project <b>Post:</b> <a href="#">My idea for my part of the project</a> <b>Author:</b> [CD]	<b>Date:</b> Wednesday, February 28, 2007 <b>Status:</b> Published <b>Overall rating:</b> Not rated
<p>I have been thinking about possible ideas that incorporate HCI/Usability and looking at the other ideas already stated. I am going to look into the different Operating Systems available, i.e. Mac/Windows/Linux etc and how they can each benefit a company. I will talk about the pros and cons of each and how each is setup for the user to use i.e. GUI (Graphical User Interface) or command based.</p> <p>Hope this OK with everyone??</p> <p>Regards</p> <p>[student C]</p>	

**Figure 4: VLE Discussion Board Message (initial message, no replies received)**

In summary, the students used a wide variety of digital communication tools to engage in communication activities. However, the choice of tools related to friendship groups, home context, access and economic factors rather than the task. Transmissive, ritualistic and transformative communications were found but there were relatively few that could be said to transform the resources of other members of the group.

### Trinity (MiMeG)

The second project (Trinity), was an analytic autoethnographic study (Anderson, 2006) in which two of the authors of this paper collaborated to research the ways in which they used a range of tools to research the use of computer software in primary school classrooms<sup>4</sup>. Trinity took place under the umbrella of MiMeG (Mixed Media Grid), an ESRC funded project<sup>5</sup> which is a node of the e-Social Science programme. MiMeG's agenda is to investigate the way social scientists analyse video and audio data and to produce software to facilitate that analysis. Some of the features of MiMeG software are that it allows researchers in different locations to view video data jointly, to mark up the video on screen with freeform scribbles notation, symbols etc and to make annotations and transcriptions linked to the video. When using MiMeG, researchers usually use a communication tool such as instant chat or VOIP. We used both the chat and VOIP aspects of Skype to 'talk' to each other as we worked on the video. In our Trinity research, along with MiMeG, we also used a range of other digital tools throughout the research process, including instant chat (MSN messenger and Skype), email, a blog, a wiki, and an online shared document service (Google documents and spreadsheets). Where practical, we saved our communications for later analysis.

The focus of each of the 'learning conversations' was a different aspect of the research process (preparation and planning, which includes literature searching), analysis (including transcription), writing up, reviewing and housekeeping). Although the planning and housekeeping conversations were of crucial importance to the smooth running of the project, we see the other conversations as more cognitively demanding.

The content of the communications data was analysed, again using notions taken from (Gunawardena, Lowe, & Anderson, 1997) and (Pena-Shaff & Nicholls, 2004),

<sup>4</sup> We use the first person plural to report this research to maintain an authentic voice when reporting autoethnography

<sup>5</sup> <http://www.ncess.ac.uk/research/video/mimeg>

and again drawing attention to social interactions. First we looked for instances of transmission such as ‘telling’, ‘giving information’; then for instances of greeting, establishing protocols and ways of working together and for examples of, negotiating meaning and building understanding (co-constructing knowledge). We also took into account the main purposes and achievements of each conversation. These three sets of interactions can, we suggest, be seen as transmissive, ritualistic and transformative, respectively.

The analysis of the conversation data is summarised in Figure 5 (below). The depth of colour in each cell relates to the importance of the type of communication in the conversation. As this mapping demonstrates, transformative communication dominated in the cognitive research stages of the project, whereas in the other areas the ritualistic and transmissive communications were more important.

	Plan and prepare	Analyse	Write up	Review	House keeping
Transmissive					
Ritualistic					
Transformative					

**Figure 5: Summary of conversation analysis**

We also found that all conversations were characterised by high levels of reciprocity, with each of us making contributions and developing ideas. We suggest that this is explained by a number of factors: the small group size (in which dialogue was essential to keep things going), our joint commitment to the project, mutual respect and friendship. These last factors may be particularly significant because they mitigated much of the need to establish social presence. However, we would also like to draw attention to the importance we placed on the house-keeping conversations, in which we developed ways of working together and established mutual trust.

We also mapped our use of tools onto the learning conversations (see Figure 6 below), which shows which tools were used in each kind of learning conversation, and also provides an idea of how important we perceived each tool to be (the darker the shading, the more important). The tool map shows that a range of tools was used in all conversations. In the MiMeg project analysis phase, the MiMeG software (plus Skype) played an important role. The way we used this tool was as a thinking space, or as an environment to work in. By using annotations which linked to the video, we were able to view selected episodes in detail, knowing that we were both viewing exactly the same part of the video. We also developed our analysis through shared writing, for which we chose to use Google documents. We found it easy to work on a joint document in this way; we only had one version of the document, ensuring we were working on the most recent. For the same reason, we used Google documents in writing up our analysis and our wiki, on which we shared our semi-formalised, developing ideas and recorded the ideas we had already discussed. We also had a blog, a space for sharing our emerging thinking in a more formal form with the rest of the MiMeG team. For reviewing our ongoing work we used the same tools in the same sorts of ways, but we also used MSN as a much more informal review tool; where we felt safe to make suggestions, bat ideas around and debate our emerging ideas.

	Plan and prepare	Analyse	Write up	Review	House keeping
MSN	Red	Yellow		Red	Red
Blog			Orange	Red	Red
Wiki	Yellow		Yellow	Red	
Google docs	Orange	Orange	Red	Orange	Red
Skype		Red			
email				Orange	
MIMeG	Orange	Red			

**Figure 6: Tool map in Trinity**

This analysis emphasises the multiples modes of communication we used and the complexity of the relationships between these different modes. Further, the findings suggest that there is a relationship between the formality (as we perceived it) of the tool chosen and the level of commitment we were prepared to make in sharing our emerging ideas. We found that the tools we chose and the ways in which we used them were influenced again by the factors of our relationship and by the efforts we put into developing protocols for working together. This means that we deliberately chose different tools to record and share our ideas depending on the degree to which we were committed to our developing findings and on the audience for whom we were presenting our work.

## Discussion

Drawing on Pea's (1994) concepts of transmission, ritual and transformative communication, it can be argued that most of the students' communications were transmissive or ritualistic. Most messages on the VLE, email and the blog were mono-directional and information-oriented. They were often formal in tone and not addressed to others in their group. There were, however, many examples of instant messaging conversations where students offered mutual support to each other, often over long periods of time, showing established reciprocity and mutual trust. There were some communications showing evidence of transformation, where new meanings were negotiated. These were mainly confined to the instant messaging conversations where students exchanges and transformed resources within the shared space. In contrast, the researchers' conversations were more often transformative, and there was stronger evidence of co-construction of ideas and interpretations and of the negotiation of meaning and shared goals. The blog and the wiki were designed for public use in transmissive communication. The researchers used the tools consistently, deliberately and for specific purposes, explicitly matching the tool to the specific needs of the task. Whereas the students did not overtly choose at all, their use of the tools was based on friendship groups and lifestyles, economic and access factors and they did not consider how this matched the task. The only exception was the use of the blog which performed a similar function to the VLE discussion groups, but the intention of the blog was to improve access rather than being selected for its suitability for the task itself.

Collaborations in the e-SIGs amongst the students were often hindered by a lack of commitment to the e-SIG group and task. This may be because, although the project was set as a collaborative activity, in fact the students viewed it as a co-operative task. Co-operation supports every member of the team to attain their individual goals with a fixed conception of a task and clear roles, whereas collaboration is based on setting a common goal (Lewis, 1997), together with a low division of labour (Dillenbourg, 1999). The object of the e-SIG activity was to achieve an individual

outcome, rather than a group project with clearly defined roles. In contrast, the two researchers showed very high levels of commitment and investment to a professional project. They had a shared object and recognized the need for collaborative goals and a low and changing division of labour. However, whilst the transformative communications (where they emerged) in both groups allowed them to mutually and reciprocally generate knowledge and resources, this would not have been possible without the continuous ritual of social communications where trust and shared understanding were established and maintained. These social maintenance rituals were frequently found in the instant messaging conversations in both the student and researcher groups. Crook (2000) highlights the importance of a shared history in motivating people in collaborative learning partnerships. Both intimacy and shared meaning were developed over time by the researchers and maintained through their routine communications. The instant messaging conversations of the students were also part of a longitudinal and habitual communicative practice in an intimate space, where shared history and shared language were continuously constructed and updated.

## **Conclusions**

We conclude that the choice and use of communication tools is related to the development of reciprocity, mutual trust, and shared goals. The researchers worked together to clarify goals and explicitly matched the tool to the task. The students did not establish clear goals for the collaborative task required for the e-SIGS, which evolved into a more co-operative task where students were focused on their individual goals. At the same time, they continued to engage in frequent conversations with friends including about the e-SIG task, using tools that were habitually in use. They did not match the tool to the task but might be thought to have matched the tool to the group. Transformative communications and co-construction of knowledge occurred frequently in the researcher communications, where they deliberately chose tools with specific aims in mind. In the students' communications, such transformations arose during the course of informal and continuous conversations with existing friends and were not deliberately or consciously planned. The importance of the ritualized communications, in developing shared meaning and engagement, was observed in both these groups and played a critical role in maintaining the social order. We, therefore we conclude that both ritual and transformative communications are necessary in the construction of collaborative work and relationships.

Transmissive communications have been the most frequently represented in educational institutions but the evolution of communication technologies is influencing the representations and meanings that can be produced. Pea has called for multimodal conversational learning environments, to support meaning making that allows for the transformation of affective, cognitive and social relationships (Pea, 1994, p286). The use of a wide range of digital tools for communication and collaboration is now becoming increasingly commonplace, many offering increased potential for dialogic exchanges. The results from this joint study demonstrate, however, that although these tools can be used productively in Higher Education, it cannot be assumed that they will be appropriated in the same ways by all groups. For example, students may not choose the tool that is best for the task but may instead migrate towards tools that fulfill their social needs. It is therefore important to be aware of the complex ways in which 'conversations' using digital tools require subtly different setting up and operationalising and the increased complexity that a *mélange* of multiple tools can add to the task. An awareness of the characteristics and potential of different digital tools and the role of communicative transactions in mediating collaboration and shared meaning are also needed, if we are to work

towards more transformative and mutually supportive practices amongst all of those working and learning in higher education.

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