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Abstract: This paper reports on a naturalistic study of peer-to-peer learning, in a live, online-video meeting context. Over a 6-month period a group of international students of animation attended 99 live, online 'study group' events amounting to around 120 hours of live 'broadcast meeting time'. Some meetings were very large, with up to 34 participants, but the average participation was 10 students. These events were entirely self-organized, policed and managed by the student community. Some students emerged as natural mentors, and the group exhibited substantial supportive, mutually facilitative roles. This longitudinal study provides concrete measures of the impact of simple, live videoconferencing in an online learning context. The study also shows that learners can provide 'symmetrical' support for each other in a live non-formal, peer-learning context, even without a formal scaffold of lectures and seminars.

Keywords: cooperative/collaborative learning; adult learning; computer mediated communication; distance education and telelearning; lifelong learning.

1   Introduction

Students now interact online with content, and with each other, in a rich variety of ways. Some students who remain locked into formal studies in conventional classroom settings can, on occasion, join remote interactions within new and innovative collaborative classroom settings. However, it is certainly the case that when they are released from the formal setting, learners of all ages are now able to use sophisticated new tools to interact with content and with others without supervision or support. Much of this informal, or non-formal work is text based, ranging from mobile phone 'SMS texts', through computer instant messaging, to posting to threaded forums of discussion with peers, mentors, friends and family. This contrast between 'formal' models of learning and 'non-formal' learning is an interesting topic of debate. With the advent of newer web technologies that enable the internet learner to seek content and assistance outside a formal programme of learning, modes of non-formal work and learning are becoming increasingly interesting (Colley, Hodkinson, & Malcolm, 2002; Prendes, 2006).

In the 'formal' learning context an impressive body of literature is devoted to the analysis of asynchronous text based student interactions, such as bulletin boards and forums (Meyer, 2004; Pena-Shaff & Nicholls, 2004). Some innovative recent work has even sought to examine near-synchronous text communication in a distance learning context (Holliman & Scanlon, 2006). This work uses text interactions that happen very close to each other in time (hence, near-live) to explore the nature of peer and mentor based learning interactions. Latterly, as there have been significant

improvements in the technology behind desktop videoconferencing systems, remote individual students have been able to interact audio-visually with teachers and other remote learners in much richer group settings. There are some very compelling studies into the use of videoconferencing, in both traditional hardware-supported and desktop software-supported contexts, and into the way in which this medium of communication has an impact on the character and efficiency of live virtual events (Egido, 1988; Fischer & Tenbrink, 2003; Sellen, 1995). However, users are typically studied in a classroom-to-classroom context, in which the roles, contributions and achievements of individual learners are very hard to determine. Video interactions are much richer and more complex than text-only ones, particularly in individual desktop contexts where a number of other parallel communication forms and activities can be freely used alongside the a/v, in support of, or antagonistic to it. For example, desktop video-conferencing students can use instant messaging, text chat rooms, shared browsing, virtual whiteboards etc whilst others are speaking, which makes the data extremely complex to analyse.

With respect to the social models used in these learning studies, many authors have noted problems with the deployment of computer mediated communication technologies into formal education (Pena-Shaff, Martin, & Gay, 2001). In all these studies, effective and carefully designed formal 'scaffolding' has been seen as essential to learning success (Berge & Collins, 1996; Kelly, Futoran, & McGrath, 1990; McGrath & Hollingshead, 1994). In contrast to this, some recent work has focused on the nature of 'epistemic agency' in the processes which are adopted by learners in their 'self-directed' learning strategies (Scardamalia, 2002). It is argued that learners can effectively take significant socio-cognitive responsibility for their own learning, in what is seen as a significant change from 'activity centred' to 'idea centred' learning processes (Russell, 2002). In this paper, we start to sketch a picture of a new type of epistemic community in a rich naturalistic context. We believe that this research is important because the non-formal learning context is becoming increasingly common as an accompaniment to formal learning study programmes. In a wholly online future, this type of non-formal work may even offer some alternatives that will seriously challenge our conventional formal learning models.

2   The Study

The data presented here is from a cohort of about 100 students studying a 'wholly online', high quality, and evidently well-respected course on Animation operated by a prominent USA-based company. The company was not directly involved in this study, nor was there any other direct connection between the students and the research team. The teaching company has a 'mentored distance programme' in animation tools and techniques, both traditional and digital. Students from all over the world are provided with online video tools, case studies and discussions with animation professionals. The length of the distance programme is around 18 months and students can use the company virtual learning environment for their work. Within this environment the learner can work through the course materials, use their own web space to publish assignments, post to a forum, use text chat, and a variety of other things. A course has 12 modules, and for each module the student has an online tutor/mentor to guide, support and evaluate them. At the time of the study the company offered live individual interactions between mentoring staff and students, but no live audiovisual group work.

In September of 2005, an individual student studying this programme contacted the FlashMeeting™ research team. He asked if it would be possible to use our web-based video meeting tool independently of his formal studies. This student was issued with an account that allowed him to book unlimited meetings for up to around 25 synchronous live participants at a time. The only constraints placed on their use of the system were the ethical considerations that meeting attendees should understand that these events were 'on-the-record' and would be used for research purposes. The FlashMeeting™ system ensured that all meetings were automatically recorded. The event recordings were available instantly and were made freely available for review by all event participants, and it is clear from the logs that event attendees understood these principles, and made extensive use of the recordings themselves. From an ethical perspective it is an interesting feature of the FlashMeeting™ design at that time, that it was possible for us, as researchers, to know only one student – the 'meeting booker' whilst all others could remain anonymous. For this study, the research team maintained a sufficient distance from the participants and their learning context to ensure that subsequent use was as 'naturalistic' as possible (Hine, 2000). This paper does not detail or examine the 'content' of the participants' interaction in these events, instead we focus here entirely upon the 'context' of that interaction.

This study is naturalistic in that there was no explicit staff input from the researchers or their teachers to guide this community. We provided no rules about the structure of the events, nor for participants. Indeed, the community could only survive in this environment by exercising substantial epistemic agency in 'taking charge' of their own learning. Also, without any external sanctions or rewards for this work, that epistemic agency would have to be of very significant value to these learners, for them to continue to give time to this. The community was left entirely to its own devices for 8 months, but all activity (in our environments) was recorded and logged. In April 2006 we surveyed the students with a short questionnaire, and conducted a detailed analysis of the logs of their events. A series of in depth interviews were then conducted from May 2006.

2.1   The video meeting environment

The FlashMeeting™ research is part of the 'Prolearn Network of Excellence' project funded by the Information Society Technology programme of the European Commission, which is focused on technology enhanced professional learning, (see: http://www.prolearn-project.org/). The Prolearn network brings together both academic and industrial partners with expertise in e-learning, and has deployed a number of cooperative learning and meeting/organizational tools to assist in its work. FlashMeeting™ is a 'lightweight' videoconferencing tool deployed in this network. It is a small applet embedded in a web page. The applet is implemented in Adobe Flash™, which is a pervasive, cross-platform, browser plug-in, and consequently, can be used by most people without any additional software installation. Unlike most meeting software, only one participant, the 'meeting booker', requires an account with the server. All other participants simply join any 'booked' event by clicking on the meeting URL, which is generated by the booking process, and so require no formal account to use it. Also unusually for video meeting software, the FlashMeeting™ model uses a turn-taking, 'simplex' approach to virtual meetings, with only one person talking at a time – effectively 'broadcasting' to all others. Meeting participants wishing to speak click a button to raise a symbolic hand thereby joining a queue. If necessary, users can jump the queue via the 'interrupt' button.

The meeting client interface consists of regularly updating thumbnail images, alongside the larger, streaming video feed of the person who is currently speaking. Additional channels of parallel communication are provided via text chat, emoticons and voting, (see: http://www.flashmeeting.com/).
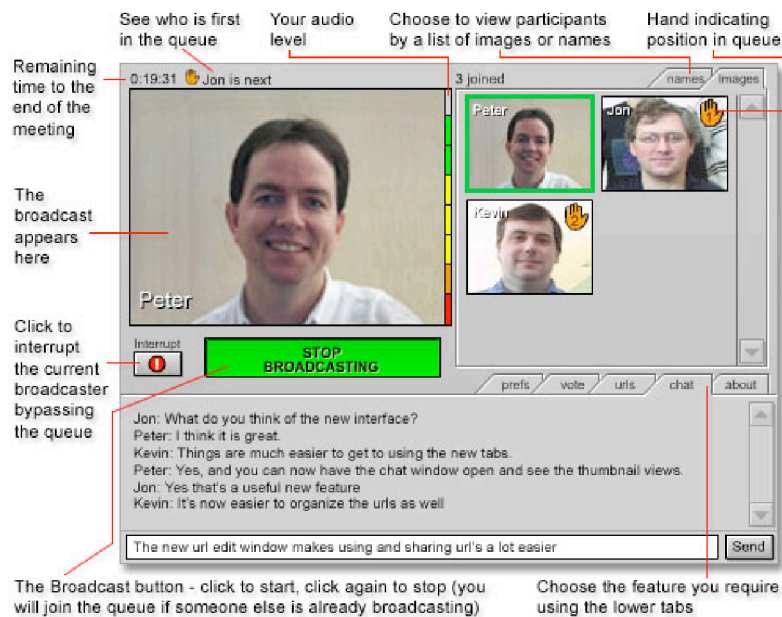

Figure 1 : FlashMeeting™ applet with some key features annotated

The FlashMeeting applet is designed to work adequately with a 56 kbps modem connection, but is best with a DSL connection. Users typically have a camera, but can speak without it, as a blank image can be shown. Users invariably have a microphone, but can contribute to an event without broadcasting sound or audio, simply via the text chat part of the interface (see figure 1). Whilst only one user may speak at any one time, any user may use the text chat, which is common to all participants. No whiteboard, file-sharing or screen-sharing is supported, but users may vote, send urls, and use built-in 'smiley' faces to convey simple emotions.

The 'queuing' feature and 'timing of the event' are strongly dominant features of the user interface. A countdown timer in the top left indicates the amount of time which remains of the booked meeting. This flashes and beeps as the meeting draws to a close to encourage participants to complete the event before the applet disconnects them from the server and closes the meeting. In the model used by this community, users are not allowed to extend a booked meeting. In figure 1, the user 'peter' is speaking (and sees a prominent button beneath his own video image, which allows him to stop doing so). He can also see the raised hands of two other participants, who are waiting to take over. The user 'jon' will automatically 'take the floor' when 'peter' stops, as he is first in the queue. Any user may interrupt a broadcasting user, effectively jumping the queue. All users can see the common text chat, and all other features are public to all users.

In general, users tend to find simplex "walkie-talkie" like interactions to be odd at first, particularly in meetings with small numbers of participants, but readily understand the necessity of the queue and simplicity of 'push-to-talk' style interactions with larger numbers. One significant advantage of simplex interactions is that they provide a very accessible research resource (it is entirely clear who is speaking at any one time). Indeed, every meeting on this server has been automatically recorded.

The recording and publishing part of this system is called FlashMeeting Memo™ (see: http://www.flashmeeting.com/memo/). The 'Memo' replay provides a simple set of visualization tools to assist in the navigation and analysis of the event. The meeting recordings are made instantly available to all event participants, and are a critical asset in our research programme, (Meyer, 2004).

2.2   The questionnaire

A short 20-item online questionnaire was made available to this community in April 2006. The AS-FM meeting-booker student was emailed and asked to circulate the url. He duly forwarded our request for feedback to the course email list and posted it to their forum. Over a period of a month, the meeting-booker student occasionally reminded the AS-FM community of the questionnaire url during meetings and once again in a general email. 39 questionnaires were submitted from an active community of 58 (see below). In the questionnaire survey, 5 items were basic ethnographic questions, 13 were specific probes regarding students' perception of their work, and 2 items related to subsequent interview availability. Questionnaire data was interrogated via SPSS.

2.3   The interviews

In May 2006 we conducted a series of in-depth, semi-structured interviews with a sample of 8 active meeting attendees. All interviewees had agreed to the 'follow up' interview via the questionnaire. Interviews were conducted online using the FlashMeeting™ system. The interview data gives an expanded insight into what was happening within the AS-FM part of this community. Interviews were transcribed from the original recordings and then coded by hand.

2.4   The Events

The AS-FM community began to meet using FlashMeeting™ for their events in September 2005. They have used this system to conduct a large number of peer-support events during which students show their work to each other and comment and critique it. In April 2006 we collected the logs of all their meetings, and issued a simple questionnaire to the community. For the purpose of this study we have sampled a period in the middle of the students' 8-month interactions up to the May 2006 interviews. The first month of data was discarded as it contained a number of 'testing' and exploratory events. The last month was incomplete at the time of the sampling. Therefore we have chosen to focus upon a 6-calendar-month period to study in detail (from October 2005 to March 2006 inclusive). Over this 6-month period 99 meetings were conducted, ranging from 90-120 minutes each. Between 2-34 people attended each individual event in this sample, with an average attendance of 10 per meeting. The total amount of live 'broadcast meeting time' in this 6-month period for this community was around 120 hours. All event logs are captured as individual MySQL database tables, and all event analysis has been programmed directly via php, and produced as web pages.

Looking in detail at the last of these months, March 2006, there were 21 AS-FM group events during that month (excluding 3 meetings which were person-to-person meetings, not 'public' to the whole group). This represents more than 4 events each week.
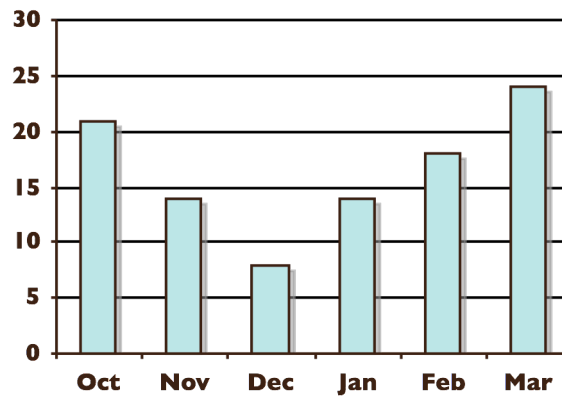
Figure 2 – Number of AS-FM events (Oct 05 to Mar 06)

Figure 2 shows the distribution of the events over the 6-month sample period. Overall, the graph indicates a fairly stable and high level of activity, and an astonishing amount of 'real time' devoted by the students to this environment. Between 2-34 people attended each individual meeting in this sample, with an average attendance of 10 per meeting. The average length of a meeting was 1.5 hours. In an average event, participants 'broadcast' 107 times, (that is, took a turn to speak using the video and audio channel). But they also typed an average of 275 text messages in each meeting. Voting, shared urls and emoticons were not extensively used in this community (on average 3 votes cast, 1 shared URL and 5 emoticons used per meeting). These users also appear to queue very politely for their turn to 'broadcast' in all these meetings, with the 'interrupt' feature rarely used.

2.5 The community

The recipients of the animation student course mailing list (used by the 'booking' student to contact his community, but not available to the research team for confidentiality) numbered about 100 students at the start of this work. However, that number changed through the course of the study. Furthermore, students did not need to login (with a stable identity) to the applet, in order to use it. They connected with a variety of login names, from a variety of locations. Some students even joined events from different countries through the course of our sample. Because of this naturalistic aspect of this study, we cannot be precise about the numbers of our maximum possible sample, but we have assembled and coded over 900 connections to our system in the sample period from this group (see below). From this data we estimate that indeed about 100 identifiably different individuals appeared to connect to at least one meeting.

Refining these logs, we can be more precise about users who attend more than one event. We do know that 58 different individuals attended more than 3 meetings in this survey period. Henceforth, we will refer to this 58 as the 'active' AS-FM community for the purposes of this study. Of these, some 27 students attended more than 10 events, and 11 of these attended more than 20 events. No student (including the meeting-booker) attended all of the events. It should be noted that all students were anonymous for this study and so we will refer to the questionnaire survey to complete the demographic picture of this community. Surveyed users (in our questionnaire) were all active AS-FM

community members (with regard to the logs), with half of them attending at least one event every single week of the six-month sample (19 of the 39 surveyed respondents).

Most of our sample (71.8%) described themselves as full-time students. The remaining 11 respondents were in full time employment, of which 8 were company workers (6 being office-based and 2 mobile) whilst 3 described themselves as self-employed (2 office-based and 1 home worker).

In the questionnaire, 25 (64%) of the respondents were male and 14 (36 %) were female. Most of our surveyed respondents (26, 66.7%) were in the range of 20-30 years old, with 8 more (20.5%) between 31-40. Only 3 participants are less than 20 years (7.7%) whilst 2 (5.1%) were in the 41-50 years range. Half of our sample were citizens of the USA (20 respondents). The remaining half (19) represented the rest of the world, with two Austrians, and then one of each who was Belgian, Brazilian, Canadian, Danish, Ecuadorian, German-Italian, Indian, Italian, Kuwaiti, Mexican, Sri-Lankan, Swiss, and finally 5 who declined to report their nationality. Interestingly, 71.8% of respondents were resident in the USA, with the remainder as widely distributed, as their nationalities would indicate. According to our log data, participants attended the 99 live meetings over the 6 months sample from a total of 24 identifiably different countries (measured by the IP network address of their Internet Service Provider).

2.6   A meeting example

In one specific example meeting, shown in a chart in figure 3, the visualization represents a 2-hour event conducted in December 2005. The event had 10 participants (2 females, 8 males). The event had one participant connecting from New South Wales in Australia, two from Canada, and the remainder from the USA (the states of Alaska, California, Florida, Missouri, Oregon, Virginia and Washington).

The top line of this figure shows a series of shaded bars, indicating the audiovisual contributions summed from the lines below. As the line is fairly solid, this means that the experience of meeting participants is of someone 'speaking' (broadcasting audio/video) pretty constantly through the 2 hours. The bottom line shows the 'speaking queue' and represents the number of users who are waiting to speak (with their "hand up" in the FlashMeeting interface). The lines in between (numbered 1-10) show the activity of each individual user, with a thin central horizontal line indicating when they joined and left the event. On each line you can see a thin bar indicating them queuing to speak, a thick bar indicating when they are speaking, and a thin vertical line, above the 'join time' line indicating a text message from this user to the public text chat.
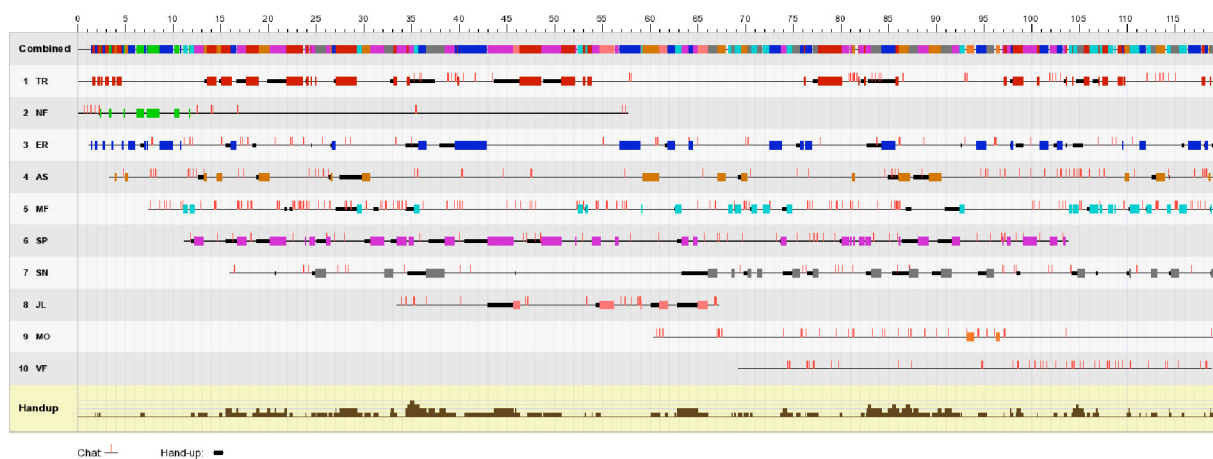
Figure 3 : Example AS-FM Event, December 2nd 2005

This figure lists participants by their 'joining order' to the event. So, users 1 and 2 joined as the meeting was 'opened', whilst user 6 joined 11 minutes into the event. User 8 was only present for the middle half hour. Users 9 and 10 joined only for the last hour and contributed actively via text to the event with very little audiovisual interaction.

The speaking queue indicates that queuing was used frequently in this meeting, with participants queuing to take turns throughout the event. At one point, 35 minutes in to the event, 4 of the 8 users present at that time were waiting a turn to speak. As the figure clearly shows, some users were prepared to wait for over 3 minutes for their turn to interact via audio and video. Indeed, the average wait to speak whilst queuing was 42 seconds, but only half the broadcasts were initiated by queuing – in the other half students spoke after someone had finished and no one else wanted to. But users clearly also used text chat all the time. There were 176 individual audiovisual 'broadcasts' making an average audiovisual broadcast 37 seconds long, but there were 486 text chat messages sent, with 16,900 characters typed.

3   Students' experience of these online video peer-events

The questionnaire and in-depth interview data provide a little more highlighted detail on the users experience. The following is a typical description of an interviewed user asked to describe a typical session:

> "… in FlashMeeting, so we have files that we look at on-line and we get together and just look at these things from movies and say, you know like, "what's interesting about this, what makes it good animation, what makes it bad animation?" And again it's a way for everybody to get together and look and learn from something that they're passionate about in a way that they wouldn't be able to in their own neighbourhoods. […] if you're working on an assignment and you've posted a video up to a website, you can say, like, 'hey, you know, I see there's four people in the room here, I'm working on this assignment, would you please all check this out and tell me what you think?' And so that's how the meetings pretty much stay focused." (ES interview, male)

This student paints a scene of opportunistic learning sessions driven by self-directed learning needs, and self-managed in order to extend their learning interactions out into a wider on-line community.

To pick up on some of the key features with a large sample, the questionnaire asked 7 closed-questions designed to probe users experience with this environment over this extended period with

respect to their learning and working goals. These questions were 5-point Likert-scale statements (ranging from strongly agree to strongly disagree) with a not-applicable option. The first 4 were to explore the nature of the work conducted; the last 3 were about specific features of the system and its use.

The 'work' probe statements were:

Q.9. FlashMeeting Helps me stay in touch with fellow students.

Q.10. FlashMeeting allows me to discuss work with students I would not meet otherwise.

Q.11. Discussions during FlashMeeting have improved my understanding of my work.

Q.12. Discussions during FlashMeeting have NOT been useful for my work.

Figure 4 – Work in AS-FM events

As can be seen from figure 4 students were very positive about their work during FlashMeetings. Statements 9 and 10 aimed to probe the social versus work balance in the AS-FM community. With only 2 exceptions the respondents overwhelmingly agreed that the meetings helped them to both stay in touch with fellow students and even more strongly to discuss work with students they would not meet otherwise. Statements 11 and 12 are mirrors of the issue of how useful the AS-FM meetings have been. Item 12 was presented in the questionnaire as inverted, to ensure that respondents are not just being automatically agreeable. Again, with 2 exceptions all respondents affirm the usefulness of the peer meetings to helping their understanding and work. The next three probes were more with respect to aspects of the system itself.

Q.13. Most FlashMeetings I have participated in have been focused on the planned topic.

Q.14. FlashMeeting allows people to 'ramble inappropriately'.

Q.15. FlashMeeting's strict timing is helpful in keeping the meeting focussed.

We have had informal feedback, from users in other communities, that events without a clear agenda (as these peer driven meetings invariably were) had a tendency to lose focus on the planned topic of the meeting. Strict time-keeping can help mitigate this tendency, and the FlashMeeting interface has constant 'timing' reminders. It displays a 'countdown clock' to remind participants of time running out, and it beeps and flashes as the event runs down to the last few minutes. However, there is a significant argument in the literature (see above) that lack of formal moderation in a meeting could mean that some users can be hard to manage, and could therefore damage the whole event.
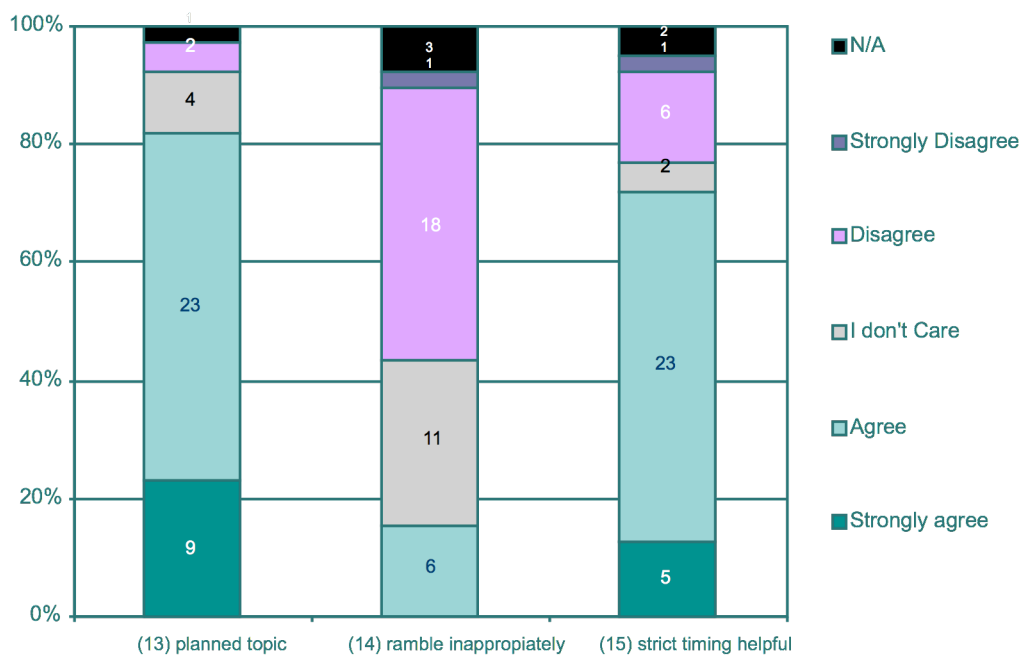

Figure 5 – Features of AS-FM events

The results of the survey clearly support the informal feedback, (see below). The AS-FM community felt that the meetings had kept a working 'focus' very well (with over 80% agreement). In the same way, users liked the strict timekeeping enforced in the events. Statement 14 was in an inverted form so most respondents felt that FlashMeeting did not encourage participants to 'ramble inappropriately'. A significant minority (6 out of 39) however clearly felt that there were participants who had themselves lost focus on the work.

Some 35 of the sample 39 respondents provided further optional comments in the free input parts of the questionnaire which related to their reason for using this, and the best and worst aspects of the their events. Comments with respect to the event empowering 'desire for interaction' of some sort was cited by over 80% of these respondents (29/35) in considering their reasons for using the system. The most common, was the role of the video meetings in community maintenance and a sense of 'connectedness':

"Real time audio/video exchange with a large group greatly helps the exchange of information and ideas. It also helps build a sense of community." (Anon survey response)

"The discussions, the students, the ability to connect with motivated people who share the same passion as I do." (Anon survey response)

"Side education projects in conjunction with my main school … as well as setting up collaborative creative meetings with fellow students". (Anon survey response)

Many respondents also noted that the international aspect of the interaction was particularly valuable to them.

"Listening to people you would never meet/listen to otherwise." (Anon survey response)

"Ability to converse with students from around the world." (Anon survey response)

"Interacting and getting feedback from my fellow classmates around the world." (Anon survey response)

Students were also very enthusiastic about the value of video meeting events and the natural interactions the events engendered. The power of real time conversation, as a replacement for large group physical face-to-face was also an issue for this group:

"It feels like you're all in the same room". (Anon survey response)

"Having the input of many people all at once, like a genuine conversation, often opens up more ideas and understanding of a topic. Immediate video response makes conversation easier than using a chat program or e-mail. Especially with topics that are difficult to articulate in well thought-out sentences." (Anon survey response)

"Peer to peer discussion, give/receive feedback on school projects." (Anon survey response)

It may also be that animation is a particularly well-suited subject for this sort of peer-critique learning model. Certainly, animation lends itself to a 'performance' aspect that may be well suited to on-line and distant criticism. Students could easily download samples of each other's work and assignments from their virtual learning environment, and peer-critique it. Certainly, the students described these meetings as very powerful, and fitting into the visual aspect of their work very well:

"One thing I really like, again this really the virtue of video, is the ability to take the camera and actually point it at the screen or I'm kind of known for drawing out a little pattern and holding it up and you know you can draw little examples and those are really useful for me to see anybody do and point out where, you know where you might be able to do a certain technique better or try this or try that. So it's not just talking, but the video really helps with being able to demonstrate things. So that's really effective by working that way." (ES interview, male)

As we have already noted, students felt that their meetings were quite strongly focused upon their work for the most part, even though there are no staff or teachers present. The students tend to be happy with the 'focus' maintained in events and stress that they have quite acceptable informal rules that have arisen to keep the community functioning well over a long time:

"You know, we're all aware that we're students, we're all aware that we only have so much time and so there's, you know, there's just a general sense of politeness and it's unspoken and we talk. We keep things on topic". (ES, male, interview)

When asked if any students tend to act as formal moderators in these sessions, most students highlighted the role of the "meeting-booker" student (labelled SP in all figures and quotes here), but noted that he did not have any real formal role, as they all tended to share out 'community maintenance' issues.

"That would be SP. He has been facilitator for all the FlashMeetings that I've been to. He's the one who sets all the meetings up… […] We have very light moderators, I guess you could say. We really try to stay away from moderating. We kind of wanted to let people be professional on their own. Usually… well the group is very good about, you know if somebody goes off track, we just point it out and you know it usually comes back on track and we get back on task. We really haven't had to have a problem where there's a moderator who has to, you know, monitor what's being said." (JN interview, female)

Indeed, the concept of sharing the moderation role and evenly taking turns so that everyone has a chance to contribute is a common theme in the students' description of these events.

"… we all contribute. I mean whenever we watch a clip, we all take turns talking about things that we noticed, things that we thought were interesting, things that were well done. You know, things to watch out for … so in the FlashMeeting we don't actually have anyone who takes that role as mentor. It's just like, you know if you imagine a classroom where you have the teacher who will go over your work and really, you know tells you what needs to be done. And then you have all the students who are with you and you know, like looking over your shoulder, "oh that looks cool, you know, I think that would look better"… the FlashMeeting for us is where the students you know get together and help each other out." (BS interview, female)

4 Comparing learner perceptions with actual-use log data

Students are positive about the work they have done in this time and uniformly describe it as peer-driven and peer-supportive. Looking back at figure 3, it seems clear from the pattern of interaction that students seem to share the use of the video channel to speak fairly evenly. In figure 3, no user appears to be 'over-dominant' of the use of broadcast "air-time". However, we need a much stronger measure before we can be confident that such patterns are stable and present though out this large data set. Sampling 99 events over sixth months of constant activity is very challenging. The range is understandably wide. For this analysis, we have selected one event from each month, which matches the most typical, or 'modal' meeting. The modal meeting is part of the series that the students have tended to refer to as "Dailies", which is a professional animation term for regular meeting to show work. This 'most typical event' is timed to start between 23:00 and 05:00 (UT/GMT) on a Friday. Its length is between 1.5 to 2 hours, and is attended by around 10 participants. The users in these meetings rarely use features of the interface such as URL launching, emoticons or voting.

Having selected the one meeting from each month that most closely matched these modal characteristics, we can look in a little more detail at user participation. Figures 6a-11a provide a visualization of each user's use of 'broadcast' or 'air-time' per modal event over 6 months. The polar area diagram's 360-degree angle represents 100% of the audiovisual broadcast (i.e. the circumference of the circle is up to 1 hour speaking in a 1 hour-long event). The radius of the circle represents the number of times that a speaker takes a speaking-turn. This means that speakers who take more turns will have a proportionally larger segment radius, whilst those who speak longer will have a proportionally larger segment angle. We can therefore view each segment's area as a simple indication of their "broadcast audiovisual dominance". In contrast figures 6b-11b provide the alternative view of "text chat dominance" for each modal event. The circumference of the 'b' figures correspond to 100% of the characters typed in each meeting, whist the radius of each segment indicates the number of 'utterances', ie. Being a reflection of how often the user sent each message (as a proportion of the maximum number of 'utterances' of the most loquacious participant).

As only one speaker can speak at a time in this simplex audiovisual environment, and the events are constrained in time, it is highly likely that one or more students will dominate the 'air time' and that (especially in a larger group) some will hardly 'broadcast' at all. However, for text chat all users can type at the same time, so we would naturally expect more even contributions for all participants. We might even expect to find some trends that align with user preferences for video against text interactions.

In four of the six modal months, text chat was very evenly distributed amongst participants, as we would expect. However, broadcast 'air-time' dominance was also remarkably evenly shared amongst a number of participants. If we just focus on audiovisual interaction first, the October event, in figure 6, is heavily dominated by two users (TR and SP) who take up one third each of the available 'air time', equal in both time and turns taken. The remaining 11 others shared the remaining time amongst them. This is an early meeting for this group, and not necessarily characteristic.

In figure 7, the November event is not attended by user TR and is evenly shared amongst 5 different users, with 7 further users taking a very small audiovisual role. User JL is one of the 5 most dominant audiovisual users and also the most dominant text chat user. When not talking, this user is typing.

In figure 8, the December event sees 3 evenly dominant users, (TR and SP again, but joined this time by user ER). Figure 8 is the same meeting as the one depicted in the linear diagram of figure 3. However, 3 further users take a significant, share of the audiovisual 'air time'. For example, even though user SN appears in figure 8 to be only the 5th most dominant student with respect to audiovisual contribution and 8th most dominant with respect to text chat it should be noted that this is relative. In absolute terms, having joined the meeting late, we can see from figure 3 that this user still takes some 18 turns fairly evenly distributed over the remaining time, (and we can also see that this user is 7th to join the event, arriving at 15 minutes after the start). This actually accounts for some 14 minutes of the student audiovisual interaction. This is not a small contribution. Furthermore, we have already noted that the text chat for this specific meeting is some 16,900 characters. User SN is only responsible for 600 characters over 28 individual message, and as user MF types nearly 4000 characters in this same time, this appears as a relatively small amount, but it is still a significant contribution to the event. One interesting user in this meeting is the last to join, user VF who comes for only the last 50 minutes. This user does not use the audiovisual channel at all, but instead contributes with text chat, typing some 3000 characters over 47 different messages.

In figure 9, the January event is quite like the October event in that students TR and SP take half of the available 'air time', however the remaining half of the event is quite evenly shared amongst 8 further students. In figure 10, the February event, with only 4 of the 5 users using audiovisual interaction, we find that the event is almost equally shared amongst these 4. Interestingly, it is clear from this diagram that whilst user SP took as much 'air time' as the others, he took about a quarter less turns in this time, meaning that his individual utterances were comparatively much longer. In figure 11, the March event and last in this sequence we see that user TR takes over a third of the 'air time' with 3 students equally sharing the rest.
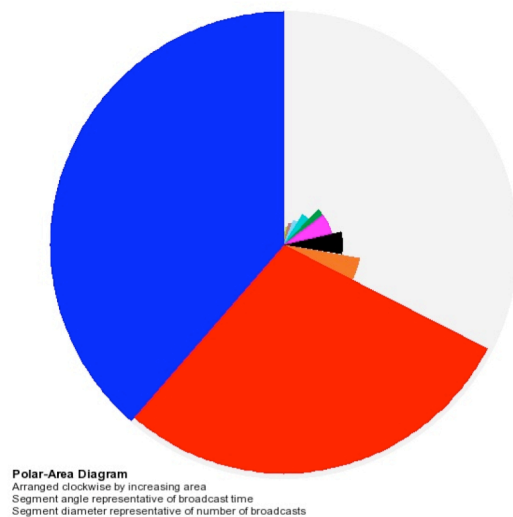
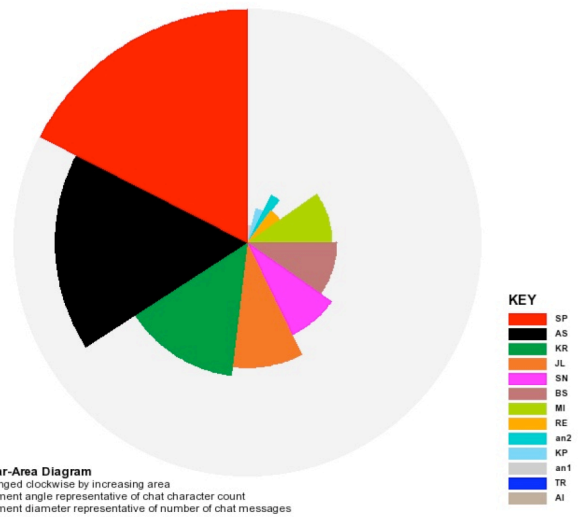*Figure 6a – Broadcast Dominance, October 2005 Modal*

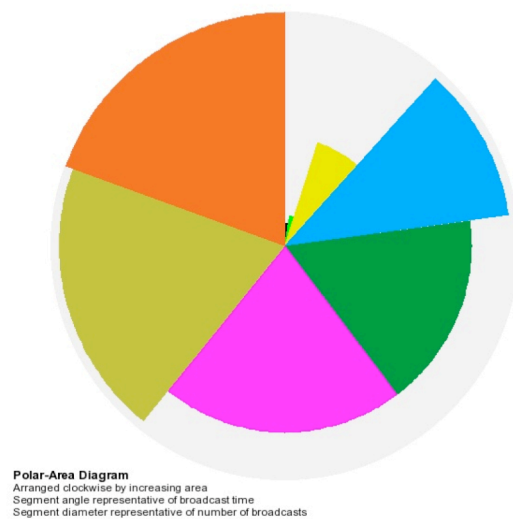*Figure 6b – Text Chat Dominance, October 2005*

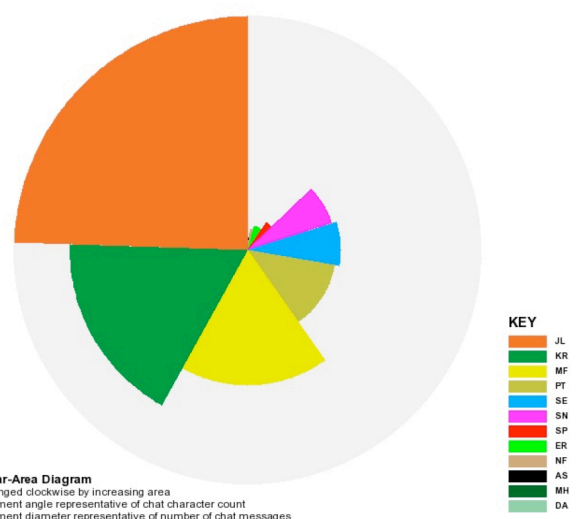*Figure 7a – Broadcast Dominance, November 2005*

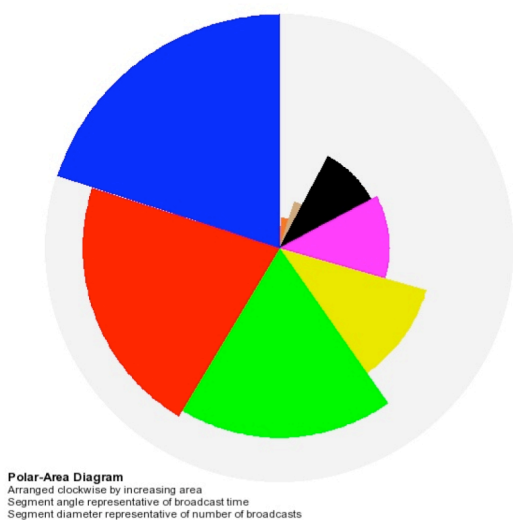*Figure 7b – Text Chat Dominance, November 2005*
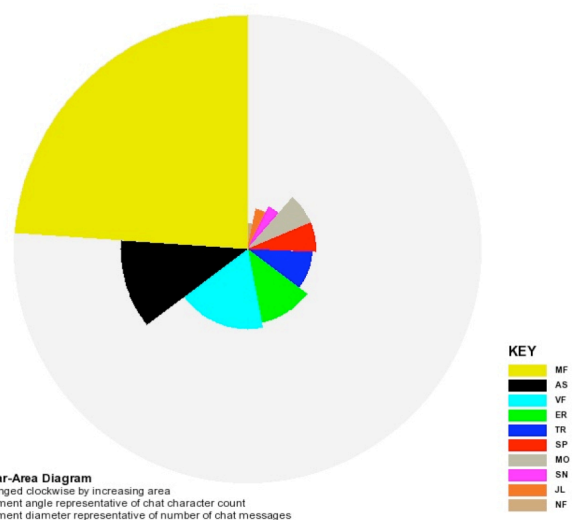

Figure 8a – Broadcast Dominance, December 2005

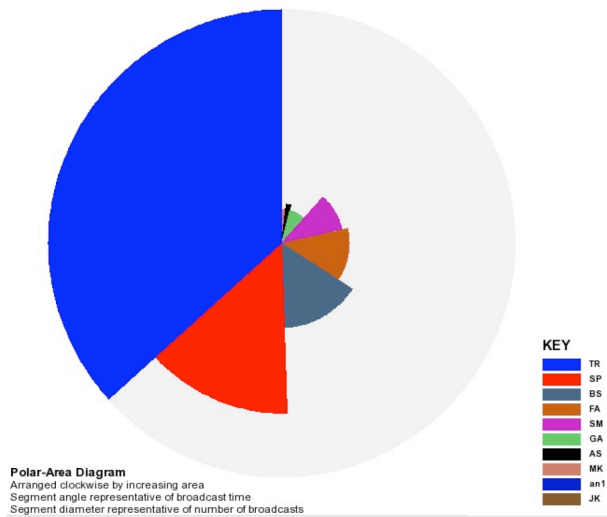*Figure 8b – Text Chat Dominance, December 2005*

14

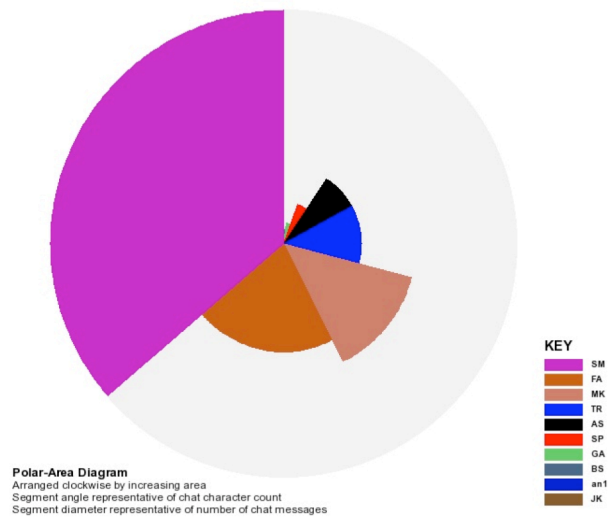*Figure 9a - Broadcast Dominance, January 2006*

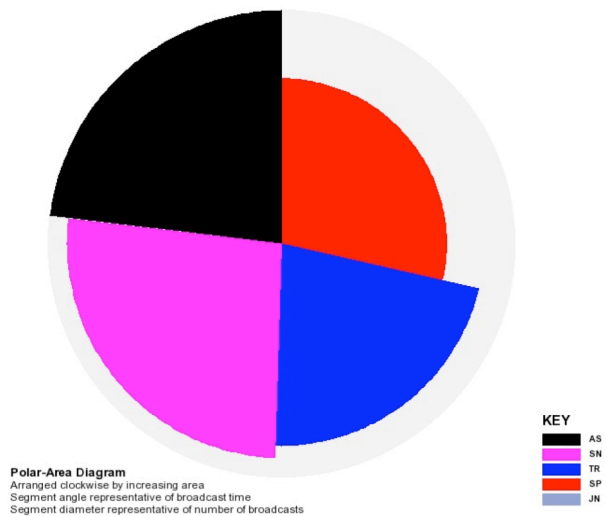*Figure 9b – Text Chat Dominance, January 2006*

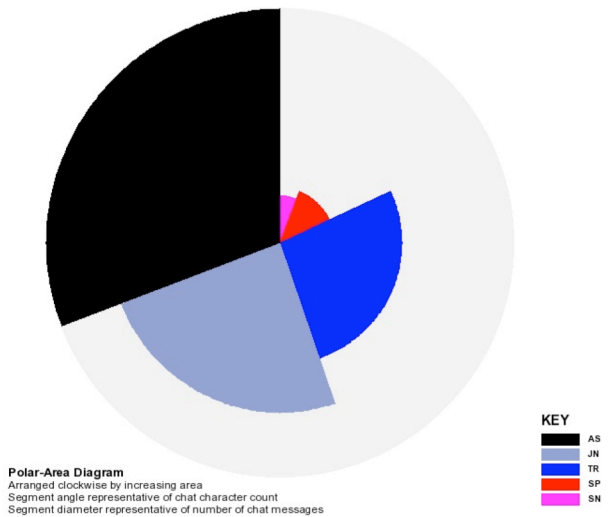*Figure 10a – Broadcast Dominance, February 2006*

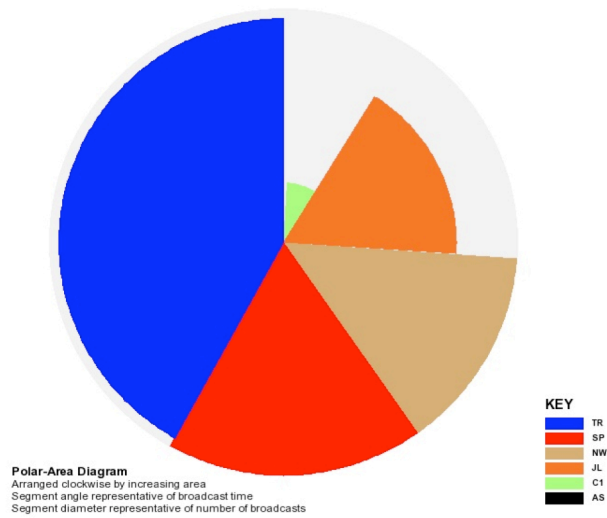*Figure 10b – Text Chat Dominance, February 2006*

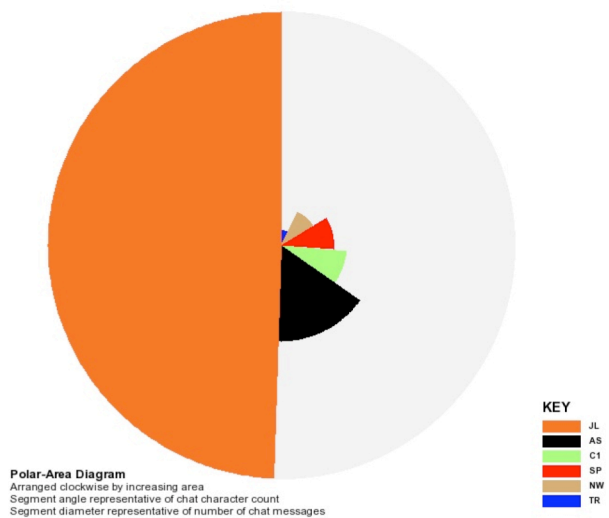
Figure 11a – Broadcast Dominance, March 2006

Figure 11b – Text Chat Dominance, March 2006

The text chat dominance for each meeting is less surprising, but shows a fairly even share of the amount of textual activity amongst users. The one unusual figure is 11b, which shows user JL, who was the 4th most dominant audio visual user (with a good share of 'air time') taking up half of the text chat. This March 2006 event had 5000 characters of text chat over 161 individual messages, and this individual typed over 2,500 characters in 75 individual text utterances. Whilst we would not expect the audiovisual broadcasting to be evenly balanced, we would expect the chat usage to be more balanced. Not all users can speak at the same time, but all can type at the same time. However it is important to note that the "text dominant" users are typically using this channel in parallel with the audiovisual speaker, and seem to prefer its use instead of audiovisual interaction.

What these diagrams reveal is a surprisingly 'symmetrical' pattern of balanced peer-support in a very large longitudinal sample of learning events. With the exception of the first event in the sample, as the students were starting to explore this learning model, whilst one student is talking, others are typing comments and critiques. In three of the figures (7, 8 and 10) the symmetry is very striking. Most students tend to engage in both text and video interactions. In all these events, the less video-dominant users tend to be the more text-dominant users. User TR is an interesting exception to this rule as he is personally more audiovisually dominant in 3 of the 6 sample events, strongly dominant with SP in the first (figure 6) and then with some dominance in 2 further events (see figures 9 and 11).

However, it is important to note that even with the 'overall' TR dominance in a few of these events, the meetings are sufficiently long that most event participants seem to make a very good and symmetric contribution to the event. Indeed, the picture is still quite complex and worthy of much deeper further study. As figure 3 shows, not all users remain for the whole event. SP and TR tend to stay with these events for the whole 2 hours, whilst many other participants only stay for a shorter time, so get a higher proportional share of the time that each could reasonably have, given their attendance. Finally, it is worth noting that the 3 events which we had earlier noted were excluded from our final month sample (i.e. March 2006, being only 2 person and not advertised to the whole community), were actually "management" events in which the user TR's perceived dominant role in the events was discussed with him. He chose to spend his time henceforth, in other communities. Indeed, over the sample period quite a few students in this group were similarly forming multiple new live online communities, keen to explore new models of working, playing and learning.

5   Conclusion

The fact that this community made so much use of this system over such an extended time is prima facie evidence of its impact and evident value to them. No external incentives, positive or negative, were provided to the students for the use of this system, and yet over the 6 months sample period something like 100 different students spoke online to each other for 120 hours, with 27 of them attending more than 10 different events. The level of commitment, and epistemic agency within this group is very striking (Paavola & Hakkarainen, 2005). However, it is also clear that these students did not require a formal 'scaffold' provided by teachers or professional mentors to derive this significant value from the help of their peers. They managed this substantial community themselves, taking on appropriate roles within meetings as required and supporting each other's work. Overall, the surprisingly 'symmetrical' patterns in the log data clearly support the users subjective experience that

the events are remarkably peer-to-peer, and shared very evenly within this large community. Even without formal external drivers the students formed and managed a powerful learning model.

How singular this finding is, remains to be seen. Intelligent adults working in a distance context might be expected to be capable of such epistemic agency in managing and critically reflecting upon their own work (King & Kitchener, 1994), however the impact of 'peer' critical-reflection in this synchronous context is surprising. It may well be that the subject, animation is particularly well suited to peer-critique learning, and indeed it does seem that this substantial community have made a strikingly good use of it. The significance of peer reflection in the context of artefacts and documents has also been noted, (Brooks & Scott, 2006; Gay, Sturgill, Martin, & Huttenlocher, 1999). Extending from this research we expect to examine further the 'roles' taken by individual peers in such sophisticated communities, as it is clear that the individuals perform different functions within even this small group. Indeed, these students say, and demonstrate through each event, that live online meetings are extremely powerful in helping them with their work in this non-formal, at-a-distance learning context. The analysis of the log data also clearly illustrates a substantial and longitudinal mutual support and shared use of each others' time and effort.

This sort of naturalistic study is unusual, but increasingly viable in an online, non-formal context. Whilst many research studies tend to focus on artificial scenarios to observe users, this sort of naturalistic data is the most valuable as it represents users whose focus is not on the system, nor the experimenter standing behind with a camera, but on real work in a real working context.

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