Institution: The Open University

Unit of Assessment: B11 Computer Science and Informatics

Title of case study: Supporting effective live, visual, virtual collaboration

1. Summary of the impact

Our research has created a framework that sustains new forms of effective collaboration for distributed workers and learners in 'live environments'. The framework has resulted in a software toolkit and online guidelines designed for the new collaborative spaces: from avatar and embodied worlds to live video meetings. One part of the framework has transformed the work of international universities and multi-disciplinary research institutes, improving their 3D, avatar-based work and 'embodied' learning spaces, while another aspect has created our FlashMeeting (FM) video-meeting tool. Released in 2003 (predating multi-party Skype™ by seven years), this research brought multi-party, in-browser, video meetings to thousands worldwide, including recording and analytic features that have only now started to emerge commercially.

2. Underpinning research

Underpinning our work is research on the new affordances of work and learning live in online spaces with rich communication channels, combined with social presence through innovative live event design technologies. We started thinking about these affordances in response to the needs of learners who could not collaborate face to face, but our work quickly expanded beyond a student-learning context. We have focused in this case study on just two components of our framework: live visual, virtual collaboration in 'video social spaces' and in 'embodied avatar-based virtual worlds'.

Initially, our work focused on how these new technologies changed the 'live' and 'reuse' experience of users online. Subsequent research looked into the new structures of live events, with a particular thread on using technological and structural insights to support effective working and learning event models. This research, supported by grant [3.a], has evolved into a widely deployed set of systems and services.

Subsequent experimental work (2009-present, supported by grant [3.b]) has improved the concept to allow users to build effective communities, and to syndicate and share the results of their work in these live spaces [3.1]. One research theme investigated the different roles of participants and how innovative computing technologies can support them. For instance, the work allows participants to visualise what happens in the meeting event, and over a series of events, by mapping each participant's contribution (av talk; text chat, voting, smileys, etc) in the meeting as an automatically generated meeting map. Other analytic views in the associated web page also examine speaking and typing 'dominance', and provide a typed topic map [3.2].

Our research explores the interplay of social interactions between people and the technological affordances of the online medium. Our multi-dimensional paradigm has provided insights into:

- the affordances of the technologies and their match with the shape of new events [3.3];
- the social interactions that these online environments facilitate, and their impact on socialisation, learning, teaching and research dialogues;
- combining technologies in complementary ways for knowledge creation and management, e.g. team meetings in a 3D virtual environment and live working video discussions;
- technical support requirements, and considerations for institutions and policy makers in terms of technology adoption and staff training;
- environments 'without teachers' [3.4].

Our research in 3D learning environments has focused on:

- **Investigating the role of 3D learning environments** in overcoming student isolation in distance education, for gaining team working and communication skills, and for learning by doing, such as by practising real-life scenarios through **role-play simulations** [3.5];

- Developing a state-of-the-art '**knowledge construction model**', which guides the integration of 2D environments, such as blogs and wikis, with a 3D learning space in blended e-learning environments [3.5]; see also the Skiddaw 3D lab environment, supported by grant [3.c];
- **Developing an empirically-grounded tool kit of guidelines for designing 3D learning spaces**, which includes guidance for navigation and way finding [3.6], and draws out the relationships between pedagogical designs (design of learning activities) and the design of 3D learning spaces, supported by grant [3.d].

Our empirical research leading to the live, visual, virtual collaboration framework has been inherently interdisciplinary: its strength and success derives from the synergies of the multiple intellectual cultures we have incorporated. Starting from the empirically grounded, human-centred design principles of human–computer interaction (HCI) and human factors, we have adapted theory and methods from management, services quality, psychology and sociology. The research outcomes have included checklist-driven strategies, evidence-based methodologies, design guidelines and toolkits that inform the design and encompass the overall user experience with 'live environments'.

Research team: current appointment and OU dates: Scott, P. (Professor, 1995-); Minocha, S. (Reader, 1999-); Quick K. (Project Officer, 1996-); Linney, J. (Project Officer, 1994-), Tomadaki, E. (RA, 2006-8).

3. References to the research (key references in bold)

[3.1] Scott, P.J., Castañeda, L., Quick, K.A. and Linney, J.W. (2007) 'Trialogical learning in public: FlashMeeting recording and reuse in a peer-learning context', *International Journal of Knowledge and Learning*, vol. 3, no. 4, pp. 529–41. http://oro.open.ac.uk/38070/.

[3.2] Scott, P.J., Tomadaki, E. and Quick, K. (2007) 'The shape of online meetings', *The International Journal of Technology, Knowledge and Society*, vol. 3, no. 4, pp. 1–16. ISSN: 1832-3669 http://oro.open.ac.uk/8641/.

[3.3] **Minocha, S. and Reeves, A.J. (2010) 'Design of learning spaces in 3D virtual worlds: an empirical investigation of Second Life', special issue on learning and researching in virtual worlds, *Learning, Media and Technology*, vol. 35, no. 2, pp. 111–37.** http://oro.open.ac.uk/21538/. Editors' Choice, Educational Media and Technology stream in the Taylor and Francis group of journals, 2011.

[3.4] **Scott, P.J., Castañeda, L., Quick, K. and Linney, J. (2008) 'Synchronous symmetrical support: a naturalistic study of live online peer-to-peer learning via software videoconferencing', *Interactive Learning Environments*, vol. 16, no. 5.** http://oro.open.ac.uk/25147/ .

[3.5] Minocha, S. and Roberts, D. (2008) 'Laying the groundwork for socialisation and knowledge construction within 3D virtual worlds', *ALT-J: Research in Learning Technology*, vol. 16, no. 3, pp. 181–196, http://oro.open.ac.uk/16142.

[3.6] **Minocha, S. and Hardy, C.L. (2011) 'Designing navigation and wayfinding in 3D virtual learning spaces' in OzCHI 2011 Design, Culture and Interaction, 29 November–2 December, Australian National University, Canberra, Australia** (http://oro.open.ac.uk/29864/). This paper received the Gitte Lindgaard Award for the best paper at the OZCHI 2011 conference.

Key **grants** supporting this research:

[3.a] PROLEARN, EU Framework 6 (2004 – 2007) £330,144.
[3.b] STELLAR, EU Framework 7 (2009 – 2012) £707,651.
[3.c] OpenScience, Wolfson Foundation (2012 – 2013) £975,657.
[3.d] 3D Learning Spaces, JISC (2008–09) £75,000.

4. Details of the impact

This case study focuses on two components of our live, visual, virtual collaboration framework: the first is a 3D Tool Kit helps which helps builders of 'embodied worlds' to use an existing technology

effectively; the second, FlashMeeting, is a new technology tool. The unifying theme is the design of social and learning spaces, live environments and live events that facilitate new forms of social and collaborative work and learning.

Beneficiaries of our live, virtual collaboration programme have included a wide range of groups at all levels, from local organisations in the field (e.g. schools and non-government organisations) through to international schools, universities, research institutes (e.g. in the UK, Japan and the USA) and international associations (e.g. the European Association of Technology Enhanced Learning).

As a result of our 'embodied social spaces' research, the live, virtual collaboration toolkit has been adopted (or adapted for local context) in many ways. For example, the Japan Agency for Marine–Earth Science and Technology used our event design toolkit guidelines when re-designing the information architecture, navigation and way finding in its virtual museum concept in Second Life, a 3D virtual world (http://www.secondlife.com/). Public themed-tours supported by staff and educators, and self-directed tours, have been designed to support marine science learning in collaborative 3D spaces for schools and higher education institutions. The improved user experience has made this museum into a world-leading showcase for effective scientific curation for STEM disciplines [5.1].

Texas Wesleyan University used our guidelines in a genetics learning and collaboration model for K12 schools, which enabled it to re-design its 3D learning spaces to support self-directed learning [5.2]. Vassar College focused on the navigation and way-finding elements of the toolkit to improve the designs of its Arts and Humanities 3D immersive learning spaces [5.3].

Much research in this area is dominated by Second Life installations, but our work is also deployed in other embodied worlds. For example, in OpenSim, Liverpool University has used all elements of our kit to support the design and implementation of a bio-informatics learning space [5.4].

Our research in the design of 3D learning spaces and the pedagogical implications, such as student learning, engagement, sense of immersion and collaboration, has created a new research direction. It has led to initiatives by other researchers that involve investigating the impact of spaces and spatial practice in 3D virtual worlds on teaching and collaborative learning in higher education.

The Wolfson Trust provided funding to design and develop a 3D virtual Geology field trip as part of the OpenScience Laboratory project (http://www.open.ac.uk/researchprojects/open-science/). The experience can be used to prepare students for a real field trip, for reflection after a real field trip, or as a replacement for a real field trip to address mobility or other constraints on participation in a real field trip [5.5].

From the collaborative video spaces research, the largest technical deployment is 'FlashMeeting', one of our toolkit products (note it was being widely used in 2003 whereas the basic 1:1 version of Skype™ was not in wide use until 2004 and not multi-party until 2010). This tool is still extensively used today; indeed our user community tell us that it still has research features that are highly valued, e.g. its group, social, secure, trust, analytic and syndication features. For example, one FM server has been operated under license to the European Association of Technology Enhanced Learning (http://fm.ea-tel.eu) since 2007. It currently serves an active FM user community of over 60,000 worldwide, [5.6]. The FM toolkit is primarily used by this association to frame new forms of business meeting, e.g. driven by an agenda, calendar and count-down timer.

The East of England Broadband Consortium (since 2008) has deployed FM into schools under license, where it has supported more than 20,000 unique users in schools or classes to facilitate pan-classroom and outreach from school through live-video events:

> 'FlashMeeting is a powerful way for enabling teachers and students to rethink classroom and out-of-classroom events, connecting with schools in the region and all over the world. Pupils have had the unique experience of live virtual interviews with Charles Darwin, Charles Dickens and even Father Christmas.' [5.7]

UNISUL, a Brazilian University, used FM to create an event model that allowed them to 'scale up' virtual viva-voce exams for some courses, as face-to-face vivas are very expensive for them.

Between 2008 and 2011, UNISUL conducted 3462 FM viva-voces for masters-level business studies in the remotest corners of Brazil. They have used this experience to transform how they think about effective quality assurance of remote students' assignments today.

In all these examples, the toolkit enables innovative 're-use' of event recordings and innovative analytic tools for reflection, syndication and sharing. This is cited by many users as transforming their working practices:

> 'My work is helping people care for their historic buildings […] On a typical day I might be using a wooden plane to smooth a board by hand in the workshop and then in the afternoon connecting with a crew of tradespeople halfway across the country via FlashMeeting, helping them restore historic windows. With FlashMeeting live video conference I can attract and help a handful of people, however I feel the greater impact is the thousands of people who find and view the replays.' [5.7]

For other user groups, designing new 'event types' in challenging social spaces has been the key. For example, the Adult Cystic Fibrosis Centre at Papworth Hospital NHS Foundation Trust has used FM to successfully create social and medical online events with sufferers in isolation wards, [5.8].

FlashMeeting also encourages environmental awareness, as each meeting (or meeting series) calculates the carbon saving associated with a virtual rather than a physical event. Our oldest single server alone has saved a minimum estimated 32m kilos of CO_2 since 2003 (calculated from 'replaced physical events' with the most carbon efficient travel), [5.9].

This environmental feature led Sunderland City Council to include FM technologies in its successful 2008 'Digital City Challenge' to enable the transparent engagement of citizens with council and community services. In 2009 Sunderland City Council deployed three FM-based servers under a commercial license for their region to deliver awareness and collaboration between local community support groups as diverse as Age Concern, ex-miners support groups and the Rape Crisis Centre [5.10].

5. Sources to corroborate the impact

[5.1] Executive Assistant for Director General, Japan Agency for Marine–Earth Science and Technology.

[5.2] Professor, Texas Wesleyan University, USA.

[5.3] Vice-President, Information Technology, Tallahassee Community College; earlier Chief Technology Officer, Vassar College, USA.

[5.4] Researcher, Institute of Integrative Biology, University of Liverpool, UK.

[5.5] Wolfson Open Science Skiddaw 3D: https://learn5.open.ac.uk/course/format/sciencelab/section.php?name=skiddaw_1

[5.6] A hosted FlashMeeting Server: http://fm.ea-tel.eu/impact shows selected live and reuse 'impact maps' for one FM server (evidencing the claimed scale).

[5.7] FlashMeeting website: http://flashmeeting.com/feedback contains recent user testimonials, cited here and many more (evidencing the different uses claimed impact).

[5.8] Clinical Specialist Dietitian, Papworth Hospital NHS Foundation Trust, UK.

[5.9] eWell-being award from The Sustainit Foundation in 2008: see http://www3.open.ac.uk/media/fullstory.aspx?id=13628 or http://web.archive.org/web/20080509064644/http://www.sustainit.org/ewell-being-awards/2007-8-awards.php

[5.10] Sunderland Council Use of FM technology is cited in numerous Council reports, eg. The Sunderland Way: Digital Inclusion (2009-10) http://www.sunderland.gov.uk/CHttpHandler.ashx?id=9601&p=0