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Digital Dialogue Games and InterLoc: A Deep Learning Design for Collaborative Argumentation on the Web

Andrew Ravenscroft, Simon McAlister and Musbah Sagar

Learning Technology Research Institute (LTRI)

London Metropolitan University, London, UK

a.ravenscroft@londonmet.ac.uk

http://staffweb.londonmet.ac.uk/~ravensca/

Abstract

Educational practice and research both readily acknowledge the challenge of getting students, in online contexts, to argue in order to think together in reasoned and intelligent, or 'scholarly', ways. In addressing this significant concern we will describe the pedagogical design and rationale, implementation and evaluation of InterLoc - a web-based tool supporting collaborative argumentation and other forms of real-time learning dialogue. InterLoc operationalises a well-attested paradigm of Digital Dialogue Games (DDGs) and provides re-usable learner generated content – that is a textual representation of players' collaborative thinking (or Collaborative Thinking Text) that can be incorporated into related learning activities and used in various ways. Five case studies, along with a synthesis of the findings, are reported, that were performed in a rich and varied range of learning contexts with over 350 students and 10 tutors. Inspired by positive findings from these, we are currently exploring more widespread exploitation through incorporating the approach and technology with near-future semantic and mobile technologies, so this ongoing work will also be briefly discussed.

INTRODUCTION: WHY GOOD ARGUMENTATION IS MORE IMPORTANT THAN EVER

Presently there are deep concerns within the education community about the lack of criticality on the web and the 'dumbing down' of observed intellect through increased plagiarism, distracting communication and the general prevalence of a 'cut and paste' literacy amongst students. Basically there is the fear that, in cyberspace, many students tend to 'originate less and think less'. This is combined with a relatively older and ongoing challenge of getting students, through dialogue, to think and think together in reasoned and intelligent, or 'scholarly', ways in online contexts, and research and practice have shown that achieving this has been a significant problem with the gamut of relatively recent communicative media - including conferencing, chat and social software (e.g. [1], [2] and [3]). It's arguably a truism that all stakeholders in the education process want to raise the level of intellectual debate and criticality on the web, but find it very difficult to do so. The challenge of moving from superficial discourses to deeper and more meaningful 'learning dialogues' is accepted as a key problem in every sector of education. Similarly, linking these learning dialogues, where they do occur, to related pedagogical practices, such as academic writing, is another significant problem. These are the problems that the development of our Digital Dialogue Game (hereafter DDG) software – InterLoc – addresses.

There are various approaches and definitions to argument and argumentation in the Technology Enhanced Learning (hereafter TEL) field (e.g. see [4]).

The one we follow and the DDGs embody is one of 'collaborative argumentation for education', or:

'A collaborative dialogue process for educational purposes that advances reasoned discussion and understanding, which has a level of interpersonal engagement that drives it forward.'

This stance is also similar to that of 'transactive discussion' [6], which holds that:

"Transactive discussion is a form of discussion originally identified in adolescent peer moral dilemma discussions. It is defined as speech acts in which the speaker re-presents (e.g., paraphrases) or actively operates on (e.g., analyzes, extends, logically critiques) the reasoning of a co-discussant."

[7] Berkowitz & Grych, (1998), p 10.

In following this definition, and essentially, through scaffolding real-time collaborative argumentation, InterLoc stimulates and supports 'reasoned' learning and thinking on the net. And provides re-usable learner generated content (called Collaborative Thinking Texts) – that are textual representations of collaborative thinking and argument that can be incorporated into related learning and activities and used in various ways. So in this Chapter we will describe InterLoc (version 5) and show how it stimulates and supports scholarly thinking and reasoning through argument and links this to pedagogical problems, activities and opportunities.

Theoretically, the approach is driven by Vygotskyan [8] notions of conceptual development and contemporary articulations of *dialogic* and *dialectic* dimensions of learning dialogue [9]. These are complemented and realised through applying original principles of 'ambient pedagogy' and 'experience design' [10]. In succinct terms: ambient pedagogy holds that the structure or scaffolding supportingthe learning interaction is 'behind the scenes' and also implicit in the digital practice that is supported; and, 'experience design' emphasises that the learning occurs through the production of an experiential context, or 'space', in contrast to foregrounding the management of instruction and pedagogical design. This perspective on Technology Enhanced Learning, which emphasises the interweaving of theory (Vygotsky and notions of dialogic and dialectic), design (of dialogue games) and evaluation (see later Sections) within a design based research methodology (see Design Based Research Collective, 2002) is what we have called Deep Learning Design (DLD). This new paradigm is justified and described in detail in [11], and concisely presented below, before we show how it is articulated through our DDG approach.

DEEP LEARNING DESIGN (DLD) AND DIALOGUE

Why are we interested in, and what is, 'deep learning design' (hereafter DLD)? There are several points which address this question, that we will articulate and deliberately avoid recent notions of 'Learning Design' (e.g. [12, 13]) as technology inspired pedagogical modelling in the Technology Enhanced Learning (TEL) field, which has typically been an alias for instructional or curriculum design.

Firstly, given the pace of change of the technological possibilities that support learning, we need to focus on a more future-proof concept that abstracts from the technologies themselves and that will assist us in both better understanding and realising learning. We argue, that 'design' is a suitably rich, flexible and yet formal enough concept to help us to engineer, or at least favour, better learning whilst also supporting better understanding of the processes at play. This stance is partly a reaction to research in the TEL area that has been predicated on just the application of technologies, and where often there are Journals dedicated to this emphasis. These have included technological paradigms such as Artificial Intelligence (e.g. Intelligent Tutoring Systems), Multimedia (e.g. Immersive Simulations), Communicative software and the internet (e.g. Computer Supported Collaborative Learning) and more recently Mobile Learning, Serious Games and Augmented Reality. It is interesting and important to note that, for each technological wave, often researchers and research centres have advocated these as being imbued with transformative powers that will address the fundamental problems with learning. But as yet, none of these revolutions has occurred, and worse, our collective memory is so poor, that we quickly jump onto the next technological bandwagon without learning lessons from the one we were previously riding. This is what could be called – a 'magic elixir syndrome'. A metaphor which captures the way in which both the politicians who drive policy and researchers attempting to satisfy their ambitions are constantly looking for that paradigmatic 'quick fix' that will make education and learning cheaper, better and more accessible to all. But, judging from the history of our field, learning is too poorly understood and yet also so inherently complex and varying across people and contexts that technological determinism by itself will never improve learning or easily address societal

challenges in this respect. However this stance is not 'anti technology', instead it is arguing for designs that operationalise technologies rather than being dictated by them.

A second reason for focussing on design is that it is more permeable at its boundaries than technologies, and more naturally lends itself to theoretical foundation and empirical testing, exploration and verification. We also have methodologies, of Design Based Research (or DBR, see Design Based Research Collective, 2002; [14]) that allow us to fully articulate both: this holistic picture, of designs linked to theories, technologies and contexts of use, that can be empirically evaluated according to sound pedagogical frameworks; and, the prescriptive imperative that we want to change learning for the better. So, we can have theories of design that inform practical approaches that both investigate and uncover principles of design, e.g. [15]. DLD however is deliberately narrower than DBR, in that it is aimed at designing for learning in contemporary TEL contexts (e.g. Web 2.0), whereas DBR is a broader and arguably more diffuse paradigm that is applicable to educational research in general.

Thirdly, a lot of TEL research that is technology led promotes debate around false dichotomies because technologies can predicate particular stances, so we have: student-centred or tutor-centred, personalised or institutional, individual or collaborative, informal or formal, mobile or location based, etc. All these dichotomies are captured, for example, by the Personal Learning Environment (PLE) versus the organisationally focussed Virtual Learning Environment (VLE) debate. But in reality learning will occur through an orchestration of practices within a mixed economy of these dimensions. For example, we will always learn through both being alone and together, and may use a combination of personal and organisational technologies to learn through informal and formal activities. Again, 'design' is a useful concept for representing optimal orchestrations of practices across technologies, compared to a more purely technological emphasis that typically prejudices one stance over another.

Fourthly, deep learning design recognises that design will benefit from psychologically informed models of learning, ideally linking cognition, communication and context [16], and goes beyond simply stating that performing some activity will lead to learning. This means that we need to link notions of cognitive change, in terms of improved knowledge or reasoning, to competencies that lead to practices in contexts, where improvements that correspond to learning are measurable through evaluations. For example, linking Vygotskian notions of internalisation of social practices within the zone of proximal development to identifiable changes, such as improvements in critical thinking and related writing skills in education or work-based settings.

Finally, a corollary of these points in contemporary learning contexts, is that deep learning design emphasises: the richness of learners' psychology and experience (and not just pedagogical procedures); interaction and social processes; and, the role of increasingly prevalent digitally-mediated practices that are interwoven with our everyday behaviour.

To summarise, and present this argument in another way, shallow learning design is typically predicated on technologies and practical pedagogical modeling (e.g. course design). In contrast deep learning design is a stance and approach that incorporates DBR methods to orchestrates technology development and use according to theoretically informed frameworks and models. So shallow learning design typically focuses on (often untested) propositions about learning (that this or that technology will revolutionalise learning for the better), whereas deep learning design is informed by pedagogical models and typically refines its designs and underpinning models through evaluations. Our DDG projects are examples of how this approach has been applied to tackle a significant TEL problem, namely of supporting collaborative and critical thinking and learning on the web.

In conceptualising TEL design in this way, the role and importance of designs related to learning dialogue should be relatively straightforward to justify. Dialogue is arguably the primary mechanism for thinking and learning in collaborative contexts [8], [9], [17] and although its form and means of realisation are changing through the increased prevalence of highly participative and discourse intensive social software, or web 2.0, technologies, the underpinning pragmatic level, or deep and social, discourse processes that are more stable are also still at play. For example, we will always use dialogue, as our most intuitive semiotic system, to articulate and express what we think, share our thoughts and ideas with others, and collaboratively create meaning and understanding to make joint inquiries or solve common problems. We may be doing these things in a more immediate, participative or multimodal way, but the deep psycho-social imperatives are more impervious to change. This position is exemplified by our work with Digital Dialogue Games and InterLoc that are described below.

DIGITAL DIALOGUE GAMES AND INTERLOC: A DLD EMPHASISING COLLABORATIVE THINKING THROUGH ARGUMENT

Our Dialogue Game approach has proven efficacy for a range of learning problems and contexts, as documented in a range of research projects over the past ten years that are summarised in [2]. It is currently realised through the Open Source tool, called InterLoc [18] that realises the dialogue games through creating and organising a suitable learning activity, or learning ecosystem [19], and mediating learning processes through supporting a structured practice and a unique method of collaborative text production. This approach has been supported through three successive multi-partner projects over the past four years (see www.interloc.org). The recent project that is reported here was supported by the UK JISC (Joint Information Systems Committee) and had partners at London Metropolitan University, UK Open University, Universities of Exeter and Teesside and, Queen Mary (University of London).

Attractive, inclusive and reusable learning dialogues

As Ravenscroft et al [18] point out, InterLoc embodies the need to reconcile learners developing digital literacies with the well-established requirements for reasoned and purposeful dialogue. Specifically, through incorporating the notions of 'ambient pedagogy' and 'experience design' we have provided a managed, attractive and inclusive learning context and experience that provides a structured, collaborative and engaging learning practice. This practice, in turn, allows learners to incorporate media and generate text and content that are relevant and valuable through linking their digital dialogue to their thinking and the production of collaborative and personalised texts or knowledge assets. So this practice links learners interest-driven, and typically media-centric behaviours, to more learning-driven dialogue and textual practices. There is also the incorporation of multimodal and multimedia aspects into learning interactions to further enrich the learning experience. In achieving these we have also 'made the complex look and feel simple', through rendering a relatively complex learning design [20] into a more attractive 'experience design', that is similar to popular dialogue and social software technologies that are familiar to students. *This rendering of a validated pedagogical framework (e.g [21]) and similarly validated learning design (e.g. [19]) into a digital experience (see Figure 1) that is familiar to users and links with related teaching and learning practices, and is subsequently evaluated, is the essence of deep learning design.*

The methodology of Investigation by Design (IBD) which produced the Dialogue Game tool is described in detail in [23] and recent modifications to this are described in [27]. Below we summarise this methodology and the resulting deep learning design before describing the current InterLoc tool.

The DDG development methodology

Through adopting a DBR approach and building on their discourse analysis work [22], Ravenscroft and Pilkington [23] developed the methodology of "investigation by design" (hereafter IBD) to investigate educational dialogue and design models that support reasoned discourse leading to conceptual change and development. Where the most common dialogues that are modelled in this respect tend to be what can be characterised as real-time collaborative argumentation (i.e. in contrast to more conflictual and oppositional argument). The methodology has been successfully used to design a number of digital dialogue game tools (e.g. DIALAB, CoLLeGE, CLARISSA, AcademicTalk and InterLoc) that, along with a more detailed explanation of the IBD and dialogue game approach, are given in [2]. This educationally and socially derived definition and articulation of games is justified in some detail and contrasted with 'video-game' approaches (e.g. [24]; [25]) in [26], and our conception of dialogue games is illustrated in some detail later in this Chapter, in the sections that demonstrate how our InterLoc tool realises them.

Recently the IBD approach has been extended to support the design of contemporary learning practices that are suitable for social, inclusive and participative approaches within the social software and Web 2.0 landscape [27]. In essence, this has represented an elaboration of pedagogical process design into a more experiential pedagogical practice and activity design. This 'serious gaming' approach is inclusive, social and collaborative, and yet focussed on the fundamental need to structure and scaffold learning dialogues that support types of thinking and meaning making that are relevant within the digital landscape and conveyed through the production of a collaborative text.

The locution openers and resulting texts

The latest tools also make extensive use of sets of semi-natural Locution Openers (e.g. *"I think…", "Let me explain…", "I disagree because…", "Is there another way of looking at it…*") to realise each permissible Move type (e.g. *Assert, Challenge*) to scaffold the expression of contributions. This approach has a strong pedigree in terms of previous and related work. An early implementation of learning dialogues used 'note' starters in the CSILE study [28], aimed at younger schoolchildren, which contained about eight simple starters designed to get the children focused on desired aspects of discussion. Asecond study [29] compared the use of structuring interactions using sentence openers to unstructured text with older schoolchildren, and while there was no difference in task success, there was more on-task communication with the Openers. Robertson, Good & Pain [30] provided a synchronous interface with twenty-eight openers designed to stimulate collaborative discussion skills with younger children, and showed that a discursive discussion was possible for children with well-selected sentence openers, though there was occasional mismatch in terms of message content and the openers. The openers in this study had been originally implemented in an ITS program by McManus & Aiken [31], and were derived from the Collaborative Skills Network [32]. Soller & Lesgold [33] then successfully used a similar set of openers in a collaborative discussion program for adult students learning object-oriented data structures. Other studies [34], [35], have used sentence openers at tertiary level - the latter study finding that students scoring low on extraversion tests were predisposed to use of the interface compared with verbal discussion.

Building on this work a default set of openers used in InterLoc (Critical Discussion & Reasoning set) draws from the facilitating sets used in the Robertson [30] and Soller [33] studies, but develops many more openers related to the specific purpose of tertiary-level discussions – critical argument. However, InterLoc does more than simply provide a choice of well-selected openers, it also crucially structures the sequencing of openers. The InterLoc interface affords 'preferred' sequences of openers that both interlock and develop or guide the interlocutors towards well understood argumentation patterns that provoke direct questioning, prompts for evidence, justifications of reasoning etc. It is this subtle imposition of an argumentation framework on the discussion that encourages students and participants to have to (as one respondent pointed out) "think carefully about your answer or you will surely be challenged later", and evaluations of early versions of InterLoc showed that contributions were (very significantly) more direct, challenging and argumentative than discussions in comparable unstructured control groups [36]. Rules are introduced which describe sequences of 'moves' to foster legitimate responding and coherent argumentation (e.g. in the simplest case a procedure to reply to a Question will list the Assertion openers), where these may be used as flexible guidance or overridden where this is felt necessary. More detail of how these features work is given in later sections, but Figure 1 and 2 convey a key feature, where we can see how the player chooses from a list of suggested Openers ("*Is there another way of looking at it?", Why do you think that?"* etc.) in replying to a Challenge expressed using *"I disagree because"*.

So the texts that result (see Figure 1 for a sample that is also extracted and explained later in Table 1) are more formal than records of unstructured Chat or dialogue that is typical in conferencing software, and yet are less formal – in terms of textual representation - than a typical wiki or blog.

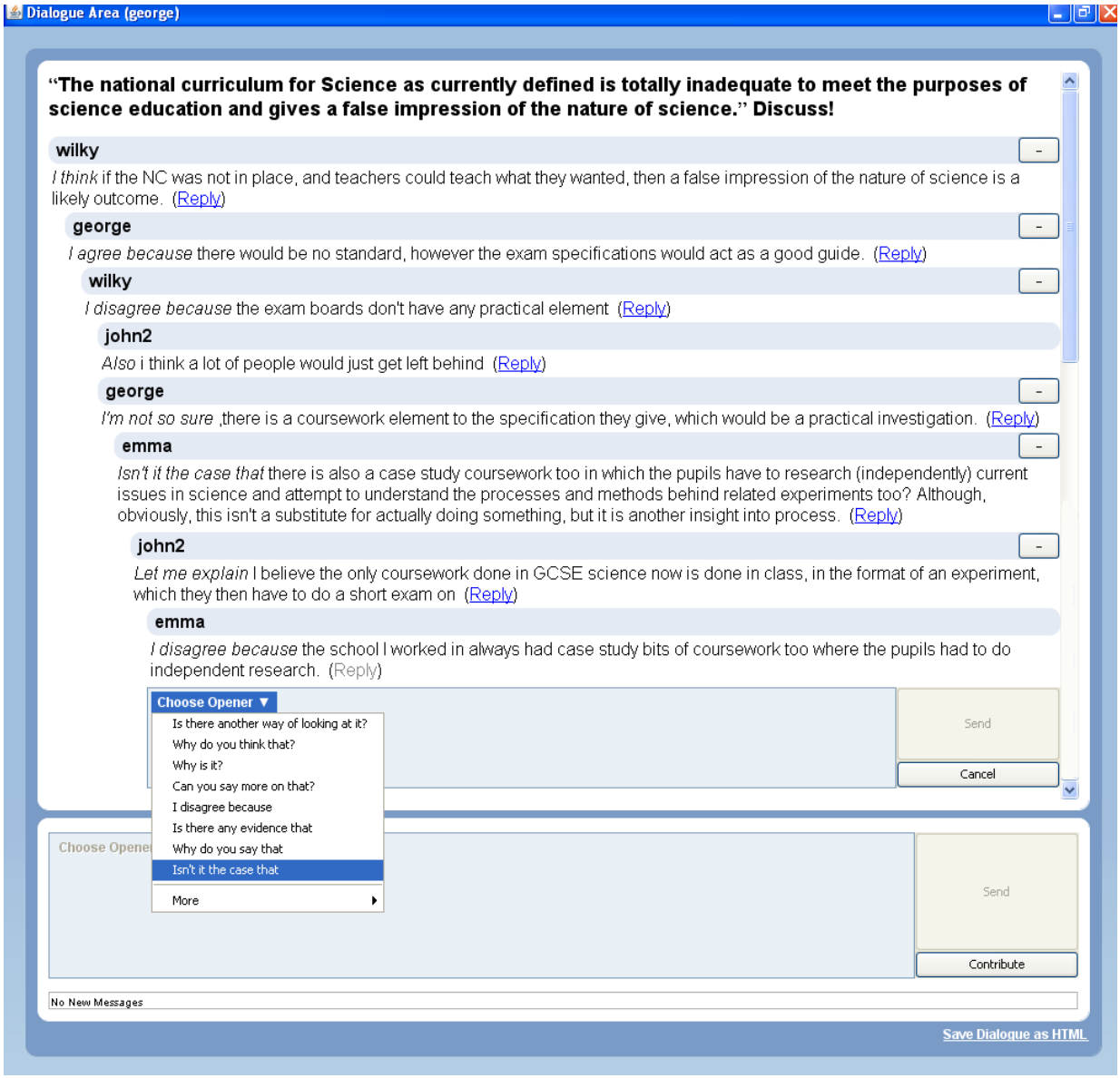

Figure 1: InterLoc (version 5) Screenshot demonstrating the Critical Discussion and Reasoning (CDR) game

They are significant in that they capture 'live thinking'. So these can provide unique intermediary representations between collaborative thinking and thoughtful writing. In a sense, the current dialogue game approach is a way of generating and capturing thinking on the web in ways that realise and satisfy accepted ambitions for learning that also 'sits with' more informal and media driven digital practices with social software.

Technical model and realisation

To address the design requirements (that emerged predominantly from user feedback during a range of evaluations) in the context of a distributed and collaborative application, required a methodology of development in three related layers:

1. Client-server architecture based on a flexible XML-based messaging protocol (XMPP) and Open Source XMPP server (OpenFire) with plug-in archival tool;
2. JAVA application programming (for learning and interaction design) together with the client deployed through Web-start technology (for flexible and robust deployment, and from within institutional infrastructures);
3. HTML-based interface (for a familiar and attractive user-experience).

Adopting this development approach and methodology allowed us to develop a sophisticated and structured Instant Messaging (IM) technology that is Web-enabled, easily deployed and feels like a typical 'Web experience'. The design was derived, ostensibly, from two different and yet typical

Internet experiences; the first being the use of the World Wide Web - such as Web browsing, social networking etc., and the second based on the use of IM applications. The way in which the interface design has taken into account the experience most Web users have with IM applications is shown in Figures 1 and 2.

Users who are familiar with applications like MSN, Yahoo and Skype find using InterLoc extremely easy since the interaction builds on these experiences. As an example, IM users expect to be presented with a simple login page which requires the input of usernames and passwords before gaining access and being presented with activities and content. While logged in, users expect to view the status (online/offline) of their friends (other users) and to be able to communicate informally with them (InterLoc provides an informal chat feature to support this aspect). Also, the layout of the dialogue window (the main venue where the communication between participants is taking place) has typical layout where an upper part is used to present the communication that's taking place (the actual contributions) and a lower part allows the player to enter their contributions to the discussion. InterLoc(v5) was designed to take into account this layout and design familiarity with 'similar' applications to accommodate the realisation of its design. This allows new users to quickly learn the 'interaction basics' that allow them to increase the sophistication of their dialogue game practices in a cumulative way.

Roles and Setting the Learning Activity

Users of InterLoc are assigned one of three roles, namely Learning Manager, Facilitator or Player. The Learning Manager, who is usually a tutor, takes the initiative to set the activity for the dialogue games through assigning the roles, selecting any preparatory materials, deciding on a specific dialogue game and setting a question, or questions, that seed the game. Once the users log in - using the username and password that has been assigned to them - they are presented with the interfaces that reflect the rights for their role and the functionality that is specific to their role. So, for the players, logging in takes them to a realisation of the learning design that has been set up for them. This is typically a number of preparation materials and media along with the particular dialogue game that has been selected or configured for them. This demonstrates how InterLoc provides the means to realise flexible, open and yet configurable learning experiences.

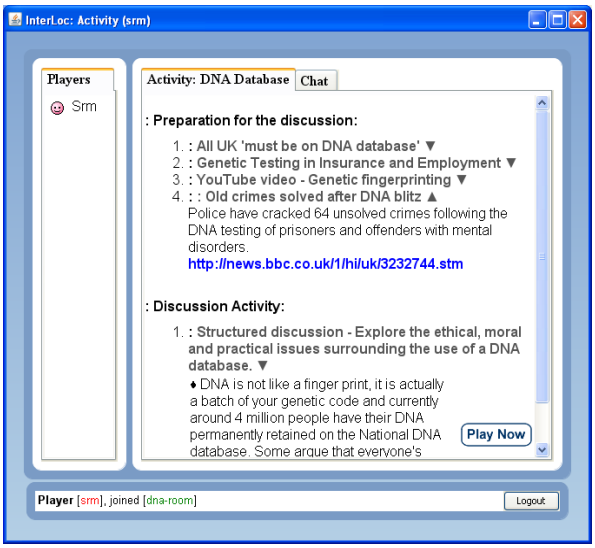

Figure 2: Player on the Activity page

A Player will see a screen like Figure 2 once they have logged in. This shows the Player Srm looking at the Activity page of a discussion activity about setting up a National DNA database. Each of the triangles will 'unfold' more information to display. Once the Player has read the materials and followed the online links they can start the Dialogue Game through the 'Play Now' button. There is also a Chat tab which allows them to communicate informally with other Players before and after the game. A user with a Facilitator role sees the same interfaces presented to players in addition to being able to broadcast a message to all players to manage the real-time game. These roles can be flexibly realized. For example the learning manager could also be the facilitator and play an active role, as a player, in the game. Alternatively, the learning manager can set-up the activity and assign a student as the facilitator, or have no facilitator, and simply let the students perform as players.

The above example shows how the contextual aspects of the ambient pedagogy are set through linking the preparation tasks to a suitable dialogue game. This activity uses four preparation tasks associated with the topic of DNA testing, but the Learning Manager could use more or less depending on the preparation requirements. Most dialogue games require such preparation, to give the learners sufficient prior knowledge and understanding, or grounding, to perform an engaging and meaningful dialogue game. The second part of the screen displays the actual question, which seeds this dialogue game. This 'seeding question' is important, as combined with the preparation materials, they play an important role in grounding the students

knowledge, setting the context and framing the activity. So all players typically share the initial goal, of simply critically discussing a topic, but the players or facilitators, through their participation, can steer the conversation towards conclusions or summaries etc.

Typically players will perform the preparation asynchronously, in advance of the scheduled game activity, in their own time. The bottom windowpane displays the participant's role and status.

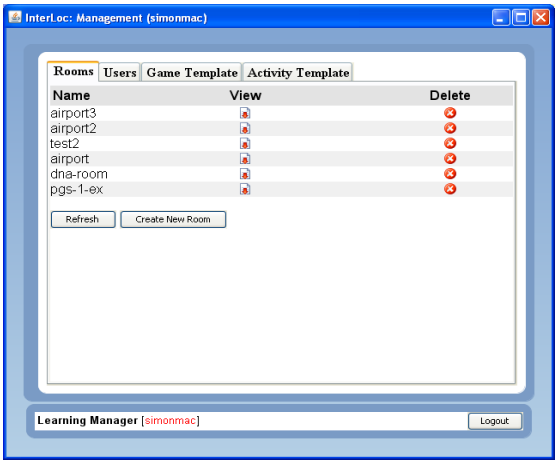

Figure 3: A Learning Manager viewing a Management screen

Figure 3 shows a Learning Manager (simonmac) viewing the Management screen after login. With this screen and tabs the Learning Manager can: create and delete rooms; create, delete and edit user properties; create and edit activities; create and edit Dialogue Games.

Turn-taking and 'Listening'

To ensure the dialogues remain coherent a turn-taking model is employed, (shown in Figure 4) which allows each player to 'hold the floor' whilst making a response, which is automatically signalled to the other players (via a 'typing man' next to the player icon and the contribution being responded to), and 'locks out' other responses to the same contribution. This allows the dialogue to be logically and coherently displayed and appear more linear. This also means that players don't 'rush' to make their contributions, and instead observe and 'listen' to the developing dialogue. If any player holds the turn for too long they are prompted to Contribute or Cancel, and of course players can always attend to another contribution if the specific one they wanted to reply to is in the process of being responded to by another player.

So these turn-taking and awareness features ensure logically (i.e. reasoned) and sequentially coherent dialogue is performed, and that sequential incoherence (which is experienced with Chat-style dialogues) is avoided. This leads to a more considered, reflective and thoughtful dialogue. Note that *problems of sequential and semantic incoherence that are addressed by the InterLoc design are significant problems in virtually all other tools that support synchronous communication*. In contrast this mechanism realises a balance between fairly managed dialogue and a 'pace of interaction' that leads to thoughtful and yet 'forward moving' dialogue. In Figure 4 we can see what george and the other players observe when emma is making the response referred to in Figure 2 which 'locks' the Contribution input field for the selected reply for all players of the game until he has finished.

Playing the Dialogue Games

The interface in Figures 1 and 4 shows how each player performs the dialogue game, which was taken from an exercise performed by PGCE students at the UK University of Exeter, who were critically discussing the National Curriculum for Science. They can either contribute to the current state of the developing dialogue through selecting "Contribute" or "Reply" to a specific previous contribution. 'Contributing' to the dialogue places a message at the bottom of the display while 'Reply' indents responses below the specific contribution that is replied to - preserving a thread. This model contains affordances that achieve a balance of 'keeping the dialogue moving forward' whilst allowing reflective asides and specific responses to previous contributions. So players need to distinguish whether they are "Contributing" to the developing dialogue (using the large reply bar at the bottom), typically responding to the latest 'state of the dialogue', or replying to a specific previous contribution (by selecting "Reply" next to each contribution). Also, all contributions or replies are made using the pre-defined Move categories (Inform, Question, Challenge etc.) and the specific locution openers (*"I think…"*, *"I disagree because…"*, *"Let me elaborate…"* etc.) that have to be used to perform the dialogue. Similarly, rules about the legitimate and logical responding openers, based on the specific Openers that are replied to, are offered selectively. So in this example (in Figure 1) the responding player (george) is presented with logically legitimate responses to *"I disagree because…"*, such as *"Is there another way of looking at it?"*, *"Why do you think that?"* etc.

Although he is not restricted to this preferred response set, and can instead select “More” to see the full range of Openers. So a structured and yet flexible form of scaffolding is provided.

The player interface (Figure 1 and 4) shows how the adoption of html, Cascading Style Sheets (CSS) and common design colours and idioms (e.g. threading, menu operation and expansion boxes) ensures the dialogue game experience is attractive and ‘feels like’ a typical and intuitive web experience.

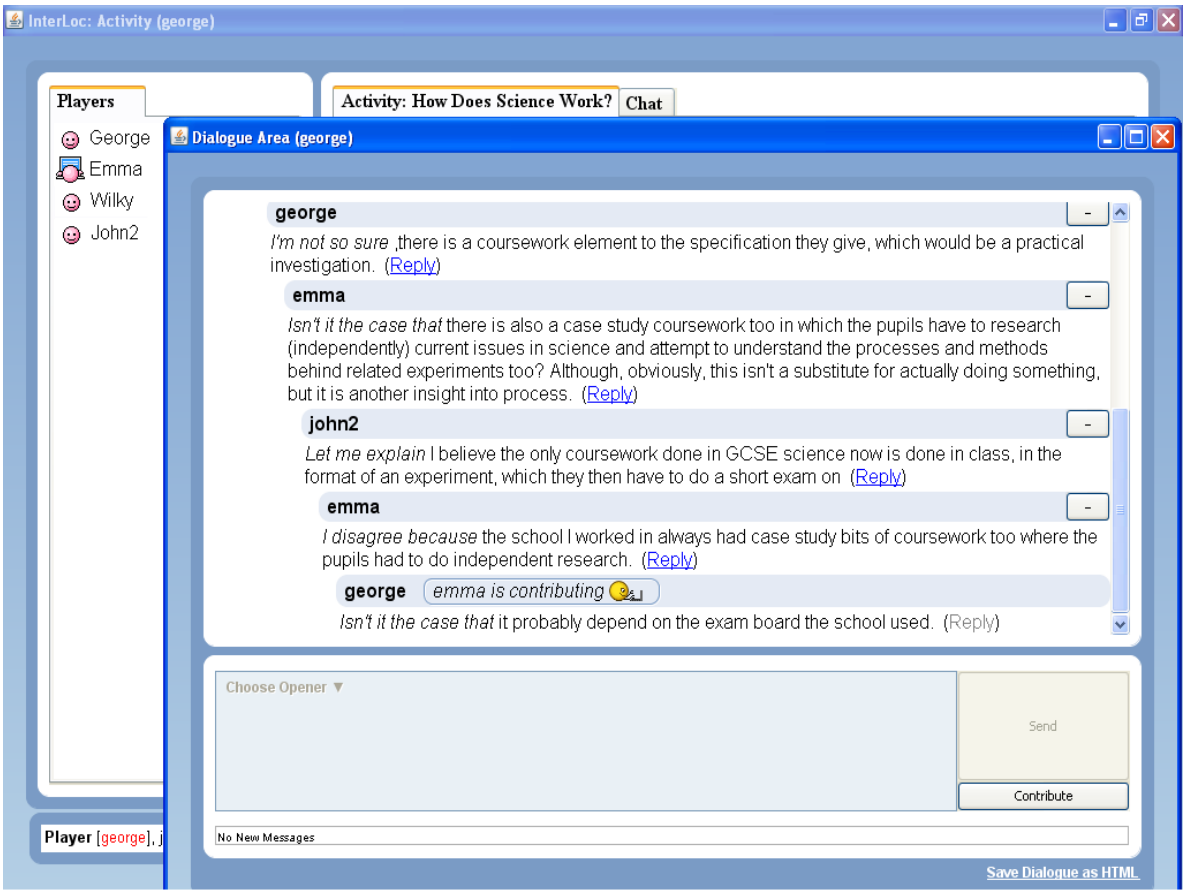

Figure 4. Turn-taking and Listening

wilky

I think if the NC was not in place, and teachers could teach what they wanted, then a false impression of the nature of science is a likely outcome.

george

I agree because there would be no standard, however the exam specifications would act as a good guide.

wilky

I disagree because the exam boards don't have any practical element

john2

Also i think a lot of people would just get left behind

george

I'm not so sure , there is a coursework element to the specification they give, which would be a practical investigation.

emma

Isn't it the case that there is also a case study coursework too in which the pupils have to research (independently) current issues in science and attempt to understand the processes and methods behind related experiments too? Although, obviously, this isn't a substitute for actually doing something, but it is another insight into process.

john2

Let me explain I believe the only coursework done in GCSE science now is done in class, in the format of an experiment, which they then have to do a short exam on

emma

I disagree because the school I worked in always had case study bits of coursework too where the pupils had to do independent research.

george

Isn't it the case that that it probably depend on the exam board the school uses.

Table 1. Dialogue from Critical Discussion Game

In this relatively brief interchange we can see how InterLoc supported reasoned agreement, reasoned disagreement and then the further elaboration and clarification of concepts (related to the role or practical work in the National Curriculum). Summarising the conversation, where note that the individuals have been anonymised through being given 'dummy' names, wilky initiates its using an Assertion Move, "*I think*", to offer a position for the role of the NC, to guide (or deliberately restrict) what can be taught about the Nature of Science. A position that george agrees with, using "*I agree because*". However wilky then Challenges george, using "*I disagree because*" to point out that examination boards don't actually have a 'practical element', and john2 points out, using "*Also*" to make a related point that otherwise people would get left behind. This introduction of the notion of a 'practical element' stimulates george, using "*I'm not sure*" to point out that maybe there is a practical element in the form of coursework. This then stimulates emma to offer a qualifying question in the form of "*Isn't it the case that*" to offer a more sophisticated position that includes notions of independent study and how this relates to experimental work. This in turn, stimulates john2 to clarify his position using "*Let me explain*". But emma then Challenges john2's clarified position, using "*I disagree because*" to offer a different relationship between coursework and independent study. And finally, this excerpt ends with george about to offer a further qualifying question through selecting "*Isn't is the case that*". So even this brief excerpt, taken from one of the implementations, demonstrates:-

- The sort of question (that is bolded at the top of screen in Figure 1) that seeds the dialogue games;
- How four participants all contribute to the dialogue, to co-construct a well-balanced critical account;
- A good range of Moves and Openers, including Assertions (*I think*, *I agree because*, *Also*, *Let me explain*), Challenges (*I disagree because*) and a Question (*Isn't it the case that*) being used to perform the dialogue;
- How the dialogue game allows the players to quite quickly identify, consider the importance of, and then elaborate their understanding of a key concept – the role of practical or experimental work; and,
- How each participant, at this stage of the game, is articulating their own and different understanding of how this concept (of practical or experimental work) relates to other aspects of coursework and independent research.

This conversation then goes on to appreciate how the NC is actually open to interpretation in these respects, and that coursework now has to consider issues such as plagiarism.

The DDG project Evaluation Report (at www.interloc.org) and a number of previous papers [3], [20] and [26] give a considerable number of longer and more varied dialogue game interactions along with their analysis and evaluation, including comparisons with equivalent Chat exercises. The extract used here is deliberately straightforward and illustrative for the purposes of this Chapter. But it still provides insights about what the Dialogue Game approach gives us, as without InterLoc these sort of dialogues are likely to be: less well balanced (with some individuals dominating); less deep and detailed; open to more misunderstandings; and, generally more poorly reasoned and involve the simple 'trading of opinions' instead of reasoned engagement. Note also, that the way in which the openers and interaction design afford participation means that we rarely experience some participants been overly 'silent' during the games [18].

Saving, Replaying and Reusing the Dialogues: Dialogue as knowledge

As the content of the dialogue games can be saved as an html file – they form a valuable learning resource that contains a collaborative, structured and semi-formal textual argument, or a Collaborative Thinking Text (CTT) as we call it. This may be used as: personal notes; the pre-cursor to an essay or assessment exercise; content that could be posted to another forum, a blog or a wiki; a form of assessment; and, a representation used by tutors to diagnose students understanding. Also the html format can be replayed using a standard text to speech translator, such as the one freely available with the Opera browser (http://www.opera.com/). This provides an accessible 'replay' facility that can be performed after the dialogue games so that players can decide whether to further manipulate or edit the generated content. Of course, this replay facility could be performed via a web-enabled mobile phone. This flexibility, across platform, device and modality also makes the current approach more powerful.

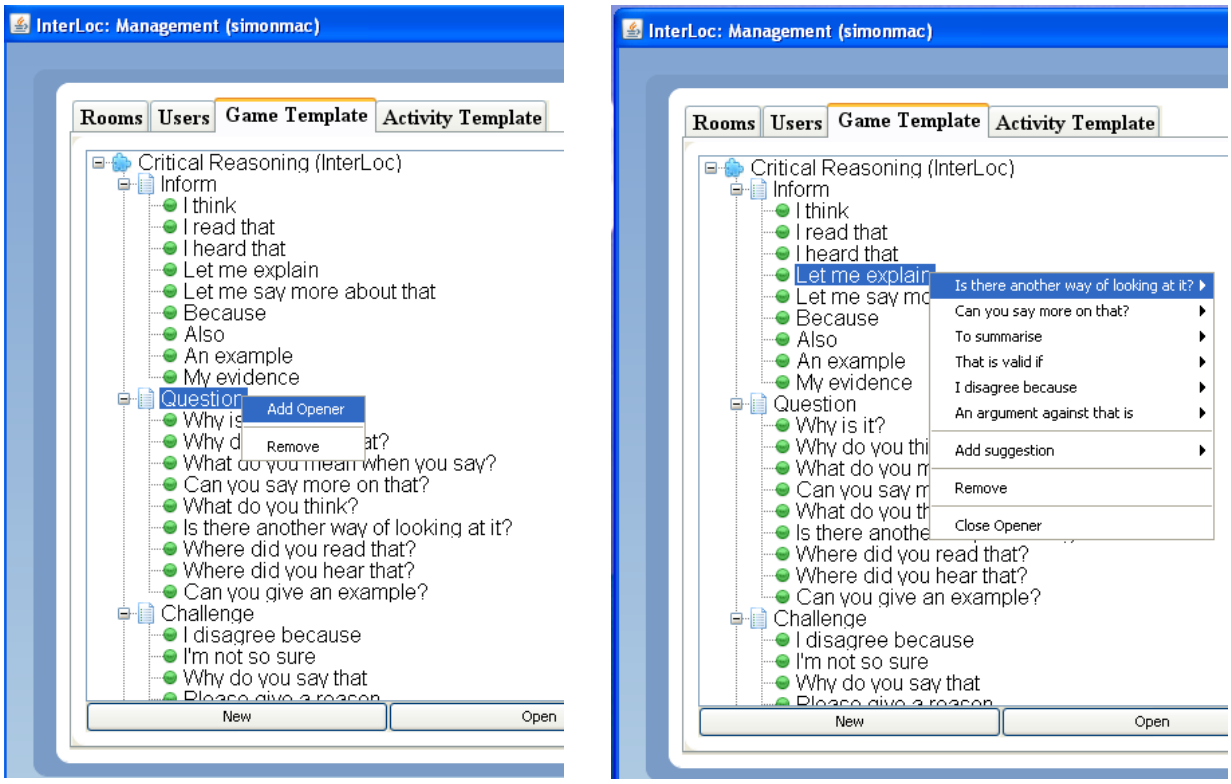

Figure 5. Modifying a Dialogue Game – 1) adding/removing openers 2) adding/removing Opener suggestions

Editing the Dialogue Games: Modifying games and creating new ones

An important feature of InterLoc(v5) is the inclusion of a Dialogue Game Editing tool (Figure 5). This was specially designed to allow for easy editing of the Dialogue Games, i.e.: the Move Categories; the specific Locution Openers; and, the rules about suggested next Openers. Note that, to support this editing and amending all the textual contents contained in the Menus that realise the dialogue games are stored and read in from xml files. So the Learning Manager can choose to modify particular Move categories, alter the wording of the Openers or alter some of the rules of the interaction in ways they think will fit their pedagogical purposes. Figure 5 shows how a user can add/remove Openers and add/remove Suggested Openers.

The project Final Report [18], available at www.interloc.org provides considerable detail about: the learning design that is implemented; the technical realisation of this design; the related pedagogical framework within which InterLoc is deployed; and, an evaluation with over 350 users (students and work-based learners) and 10 tutors who have performed these dialogue game activities on courses and work-related settings. Below we summarise the considerable Evaluation, which consisted of 5 Case Studies covering a rich and varied range of contexts.

SUMMARY OF FIVE CASE STUDIES: THE REALITY OF INTRODUCING NEW DIGITAL PRACTICES FOR THINKING AND LEARNING

Five participating institutions performed exemplary implementations following an action research approach. This involved using InterLoc through either incorporating activities into courses or by holding additional activities for volunteer students on course related topics. These were a rich and varied set of implementations that covered: a range of types of learners (e.g. campus-based, distance learners and adult learners); learning contexts (traditional Universities, 'new' Universities and The Open University); and specific pedagogical problems addressed (e.g. from practicing the use of English by non-native speakers to stimulating conceptual change through dialogue). These implementations are reported as Case Studies for each site in Ravenscroft et al, [18]. Below, we review and summarise the findings from the five institutions which performed these studies, that all used questionnaires (with open questions) and focus groups along with often other methods appropriate to their particular contexts.

Note that previous evaluations (e.g. see [19] for a summary and review) had used experimental and quasi-experimental methods to establish the educational efficacy of the DDG approach. So these Case Studies followed an Action research approach that was deliberately more qualitative and contextualized, aimed at establishing the acceptability, usability and appropriateness in authentic contexts, in addition to their effectiveness for learning. This necessitated a deliberately less formal empirical approach that was sensitive to the contexts of use and incorporated questionaires with open questions etc.

Computing students at London Metropolitan University

InterLoc was implemented across a number of courses at London Met. with undergraduate Software Engineering students, MSc Software Project Management students, Multimedia Technology and Applications students, final year undergraduate students on Interaction Design and first year Computer Games students. The latter two of these will be summarised below where students on the Interaction Design module played a game about the topic of whether 'computer gaming by very young children would help or hinder their development' and the Computer Games students critically discussed 'plot and character integration in computer games'. These sessions took place within one or two computer rooms and usually lasted about one hour.

Feedback was obtained from 30 students covering both of the latter cohorts via a short questionnaire on their experience, asking about: ease of use; usefulness; aspects liked; aspects not liked; and other comments. On both ease of use and usefulness, 27 (90%) students found it easy to use and, 23 (77%) useful to them. The following reasons were cited for InterLoc being useful: developing ideas collaboratively; it helped draw out and clarify ideas; and provided insight or shed light on the topic area. Some verbatim comments by students were:

> *'Very useful, helped me understand the thoughts of my group much better.'*
>
> *'It was useful because you get to know other peoples opinions on subjects that you wouldn't normally talk about.'*
>
> *'It was a good experience as everyone could get there point across without any interruptions.'*
>
> *'It was very useful to me because I got to see other people's point of views….'*
>
> *'It feels that you are having a real conversation because it shows when the other person is interacting, so you have to wait in order to type,.. in other words it is not a messy conversation.'*

Afterwards, ten students took part in two focus groups. Four students felt it was good to organize the dialogues around the reading materials and to be given time to do the research as it appeared to help everyone think together about the topic. They felt the InterLoc discussion was very focused on the topic and the 'openers' also helped in this respect. It was felt that everyone took the activity seriously because the transcripts formed part of the students' marked logbooks. When asked how the discussions might be different from the students sitting face to face in a group activity it was suggested '*…in group discussions it's quite easy for someone just to say, "Well I'm just going to sit back and let everybody else talk!"'* .

Feedback from the tutor who covered the Interaction Design and Computer Games courses was that some thought needed to be given to contextualize that activity, so that the students are aware of the benefits. Another, Software Engineering tutor said:

> *'The main thing is that they are thinking while they are within Interloc. The thinking that they are doing is slightly different from their normal thinking, in as much as they are thinking about other people within the group; everybody's thinking about what each other's thinking; about what's going on, which is very, very important.'*

Education students at Exeter University

At Exeter University 63 students on two ICT courses discussed whether 'ICT was a good or bad thing for the quality of modern childhood'. At the same time 12 PGCE (ICT) students discussed whether 'summative assessment is the key factor in securing improvements in educational standards'.

Later 69 students on a (PGCE) secondary science programme at Exeter University evaluated InterLoc as part of a three day discussion exercise on the topic of 'the Nature of Science' and the way in which science is characterised in the National Curriculum. The students were put into nine groups of six to eight (note that this exceeded the recommended group sizes, of four to six, so this implementation actually tested this dimension). Each discussion was supported by a facilitator, so each of the three lecturers was responsible for facilitating three groups' discussions. Seventeen students from this cohort provided open feedback with respect to questions on e-discussion and critical thinking, and said that using InterLoc: was an '*effective way of sharing knowledge*'; '*(students can) get together and discuss*'; '*enabled everyone to write their thoughts*'. Some felt that '*ideas were brainstormed*' and that '*everyone made good points*'. Two students said that e-discussion '*allowed critical thinking – (and to) reflect and respond at later date*' along with '*multiple threads*' of conversation, which provided both breadth and depth to discussion. They felt that using InterLoc '*allowed (them) to fully explore the subject*', it would '*get you thinking in more depth*', and '*developed a good discussion*'. Most students said that it gave them a '*broader and better understanding of (the) subject*' with seven being specific that InterLoc discussion '*challenged you to think critically / differently*'. Unsurprisingly, some students complained that they '*could not keep up with discussion*' as they '*spent more time getting to grips with conversation*', because of '*too many thread(s) of conversations'* and that the number of participants in the discussion should be smaller than eight students. So, this confirmed that our recommendations on this dimension, of small groups of four to six, should not be altered.

Five students thought the prior reading task combined with the game contributed to new learning – '*reading before the discussion allowed new learning*'. Three students expanded on this saying that the depth of discussion and learning '*depended on prior knowledge*'. There were also more indifferent comments made by some students. Four students decided that they '*have not learnt new things because of this discussion*'. Five students opined that it did '*not really challenge my views*'.

Eighteen students from the latter cohort also provided feedback on the advantages or disadvantages of InterLoc over face to face discussion and other tools like WebCT and MSN.

They felt the '*format (was) appropriate to challenging ideas and debate*'. It was '*effective for talking over problems and getting ideas from others, verbal reasoning and rational responses*', and that '*anonymity helps to confidently express opinions'*. It supports '*multiple discussions*' as well as '*allows opinions to be expressed without someone dominating'*, leading to '*scaffolding*' of learning. Four compared the ease of carrying on a discussion with shortfalls of MSN, stating that '*keeping to threads maintains flow of discussion (over MSN)*'. Seven students compared the use to that in WebCT stating InterLoc '*helps to keep time and contribute in real time, keeps focused (over slow webct)*' and so is '*motivating'*. Seven students clearly valued the tool's facility to '*keep record of discussion, to reflect later and use as reference point*'. Three students welcomed '*a good alternative to travelling to participate in face to face discussions*'.

The disadvantages of InterLoc were varied, for example, eight comments were regarding the lack of non-verbal communication – '*can get personal, and emoticons are not visible; no non-verbals to observe; prefer face to face; easier to follow face to face (as in video conferencing)*'. Only two students stated that using openers was a disadvantage of the tool.

Pre-Sessional students and Physics students at Queen Mary (UL)

Two implementations took place at Queen Mary, University of London, involving 48 students. They comprised various Non-Native Speaker (NNS) pre-sessional courses (provided for the International students by the Language and Learning Unit at QM) and a first year Physics course (collaborating with the Thinking and Writing Unit). The various sessions were undertaken with the group in the same room over a period of 45 minutes to one hour. A number of activities were undertaken with several groups of NNS students on topics such as the 'abolition of the British monarchy' and 'gun-control'. Also, four postgraduate NNS students discussed the issue of a 'National DNA Database'. A group of nine volunteer students on a first year Physics course were asked to read preparatory materials and discuss a deceptively difficult problem of rotational forces, and to predict and explain the outcome using theory and formulae. This was a very non-typical and daring application of the DDG approach that is not designed for learning mathematical problems. But the tutor felt it useful to try this out given the problems students experienced with this topic.

Feedback from the NNS students' tutor was that '*it was obvious that the students were engaged and enthusiastic to participate in the discussion*', and the transcripts were useful in that the learners could extend their arguments further in later sessions, linking them with the given texts. It also proved an invaluable medium in which to highlight language errors, given as a homework task. The students were later asked to write essays on the topics discussed and students were able to provide reasoned analysis in their responses, demonstrating critical evaluation. The tutor found that the results appeared to be better than students who had attended face to face seminars and then written essays on the same topics.

Feedback from the Physics tutor was in the form of a 'Think-aloud' interview while he read the transcripts of the student discussions. He was disappointed in the direction of the student discussion and their inability to apply the correct formulae. He did not feel that playing the game had moved them forward in their understanding, as their reasoning didn't appear much different from that used by students in orally discussing coursework, and they were unable to use diagrams. However, what he took of value from the experience was having the means, through the CTTs, to gain greater insight into students' level of understanding and their ability to reason/or not on the basis of this understanding. So, these findings confirmed our recommendations, about using InterLoc for critical domains rather than those characterised by 'correct' science.

Computing and Placement students at Teesside University

Three implementations were undertaken at Teesside University involving 40 (mainly NNS) students. Five computing postgraduate research students (of the Accessibility Research Centre), from various European countries, discussed the topic of a 'National DNA Database'. Eleven French students, visiting on placement, discussed 'Middlesbrough as a place to study', and eleven final-year Learning Technology students (CLT) discussed 'How learning takes place'. Finally, thirteen Computing and Multimedia Masters students (MMC), with varying nationalities, discussed the topic of 'mobile technology for older and disabled users'. These sessions lasted about 45 minutes to an hour, and were conducted with students in the same room,

The student feedback from all the groups was similar, that InterLoc was easy to use and was a useful platform for group discussion. Interestingly, these mentioned some frustrations with turn-taking

and having to use openers that are features which have been praised in the main by other student groups. However, the students' personal reflection of the InterLoc experience was that it was a useful and practical platform with which to initiate and summarise a group discussion or enhance communication between team members. The visiting students particularly appreciated the ability to save the transcripts of the discussions for later use.

Educational Technology students at the Open University and Family Support Workers

There were 25 volunteers in this study, mainly postgraduate students of Educational Technology and a group of five family-support workers of a charity in Hackney Borough of London. There were four discussions involving five students in each group on topics such as 'The barriers to peer assessment', 'Is e-learning 2.0 happening?' and a 'National DNA database' (twice). The five family workers discussed 'When should Social Services intervene?' Obviously, the ODLs could not perform any 'live' introductions as part of a co-present exercise and worked remotely in discussion.

The feedback from 15 of the students and workers was that, in spite of having no group practice sessions, usability was not a problem as most of the participants said they found InterLoc easy to use. Some students said the openers could be restrictive, but at the same time understood the necessity for using them. The majority of the participants, particularly the workers, thought that interactions of the sort provided by InterLoc were very valuable and they welcomed more experiences in their learning and training. When asked if they think it would be useful for them to participate regularly in dialogues like they just had, many participants answered positively, particularly if it was a new experience to them.

Discussion of the Case Studies

The section above describes how the InterLoc tool and Dialogue Games have been used in a wide variety of contexts. These ranged from first year undergraduates to research postgraduates; and from non-native speakers of English to post-graduate educators. They have been used with computing and multimedia students, science students, physics students and educational technology students, totaling some 350 participants. The different implementation contexts led to a range of different outcomes from the activities, including:

- the generation of well thought-out ideas (LMet);
- more engaging and higher quality interaction than had been previously possible (LMet);
- writing and reasoning correctly in English (Queen Mary, NNS);
- diagnosis of misunderstandings of a Physic problem (Queen Mary, physics);
- understanding and articulating the ways learning takes place (Teesside, CLT);
- integrating NNS into a wider group (Teesside, ARC);
- a critical discussion, with signs of conceptual change, on the science National Curriculum (Exeter);
- critical discussion on e-learning and assessment (OU);
- weighing evidence and judgements in Social Work (OU).

In all these contexts, according to student and tutor appraisals (that are covered in detail in [18]), InterLoc performed well or very well, as it stimulated the sort critical practice and deeper argument that is notoriously illusive without such an intervention.

One focus in the Exeter study was on developing critical discussion around the Science National Curriculum and the transcripts showed that this was successful. The students responded with positive comments about sharing knowledge, fully exploring the subject, and thinking in more depth. A number were specific that using InterLoc challenged them to think critically and to think before contributing. Most felt they had learned something from their discussions. The tutors at Queen Mary judged that Dialogue Games promoted critical thinking and reasoning. The transcripts of the gun-control discussions were used on the course as notes for an extended essay on gun-control, which students were able to refer to and went on to write reasonably well balanced discursive essays, compared to more disappointing results with students who had only face to face discussion. In a follow up interview with an Exeter student, critical event recall, in conjunction with the transcript, was used to trace how the student had come to change his mind on his stance with regard to the priority of content over process in learning. This powerfully attests to the possibility of argument and critical reasoning to create new learning.

Feedback on using sentence openers was interesting. Most students appreciated their value in stimulating and supporting thinking and reasonable dialogue. Nevertheless some students felt that they were 'restrictive', which ironically, is an aspect that promotes thinking, which has been strongly supported in a range of empirical studies [see 2, 19]. It is not unexpected that the hurdle of the transition from habitual interactions – of the type typical in most Chat tools – to a more academic discourse in which definite positions are considered and taken, can be demanding initially. And often students found that using the openers became easier with practice, even within an initial session. The difficulties associated with moving from informal and superficial interactions to deeper and more meaningful formal 'learning dialogues' are well accepted in education. To do this InterLoc is necessarily structured, in that it guides, and to some extent constrains, students away from informal common usages of language which don't make any real contribution to the interaction and instead moves them towards questions, assertions, reasoning and challenges that stimulate thinking and encourage critical debate. It is worth emphasising the way in which InterLoc is actually a social game, where 'getting students thinking and thinking together' is a higher priority than the exact details and semantics of individual contributions. Frequent players have no problem understanding this, as the value of the engaging interaction nearly always outweighs the constraints associated with using the openers. The issue of some students being initially uncomfortable with the openers is also easily improved, by adapting them to meet the preferences of particular student groups. This is very easy to do. But perhaps, even this is missing the point at play here. Without the use of the openers, as much research has shown (e.g. see [2] for a review), the dialogue and interaction as a whole is more superficial and less engaging. If you play by the rules of the game you engage in a stimulating interaction and produce a valuable product as a result, and most players appreciate this and find the experiences as a whole valuable and motivating. But, some will always want the 'gain' without the 'pain', which simply isn't possible. Also, simply becoming familiar with the DDG approach usually ameliorates any initial reservations.

Most students appreciated the value of the turn-taking feature in InterLoc, adding time for reflection, with only a few suggesting it was de-motivating. Its rationale is to reduce the clustering of replies saying similar things, which helps linearise the discussion threads and at the same time encourage reflection. Students also appreciated threading and the Reply feature to link their contributions directly to previous ones. Some feedback from the Exeter students on 'too many threads' occurred with large group sizes of eight, whereas the usual (and recommended) group size is 4-6.

There was a range of other outcomes and advantages to using InterLoc. Feedback from students and tutors commonly reported the enhanced focus of the groups on the discussion, engaging them for longer and more intensely. At Exeter students noted that the tool was easy to use as it '*allows for well structured discussions, is more controlled and keeps you on track*'. Some students reported that the relative anonymity gave them confidence to express themselves, and that everybody got to contribute and no one person dominated the discussion, as in face to face discussions. Inclusivity was a particular aim for the discussions involving NNS students at both Queen Mary and Teesside, and to make it easy for those less fluent students to participate in a discussion without putting pressure on them.

Another significant issue in education is linking learners' thinking to their academic writing and related learning activities. The relatively simple DDG transcript, in an easily readable form, has been surprisingly well received among the many groups who used it – in particular the NNS students at Queen Mary and Teesside. Further work is needed to prove the usefulness when students undertake work using the transcripts as an input, but initial findings at London Met. (for presentations) and Queen Mary (for essays) are promising. These could be particularly helpful to students as an aide memoire, in the case of a delay of a week or more between the occurrence of these discussions and 'writing up', or, as in the Queen Mary study, for NNS students to work on language skills.

In the London Met. study the tutor found that the transcripts were useful in another way – students tend to worry about 'ownership' of their ideas (in brainstorming activities) and InterLoc changes this notion of 'ownership' as the transcripts provide evidence of their contribution to the group. An additional value of the transcript is that it can be reviewed by the tutor to see the type of reasoning and level of understanding by the group. The Queen Mary Physics tutor was able to gain some insight and reassess his students' abilities by working through the transcript. The London Met. tutor went so far as to suggest that InterLoc could be used by students as a talking shop to discuss the previous week's lecture '*to see if they have captured the salient points*' and the tutor could review the results later to assess their understanding.

Summary of the Case Studies

These implementations of the Digital Dialogue Game (DDG) approach, and InterLoc software, were performed with over 350 users, in a rich and varied range of learning contexts. The evaluations showed that InterLoc: was easy and intuitive to use; was popular with, and valued by, tutors and students; and most importantly, succeeded in providing a unique way to stimulate critical and collaborative thinking amongst students – as evidenced through student and tutor appraisals, and some initial analyses of the dialogues. The generated content, or Collaborative Thinking Texts, were used in varied and sometimes unanticipated ways by students and tutors. In brief, the DDGs stimulated and supported learners to think critically online and linked this to learning and pedagogical practices. Inspired by these positive findings, we are further integrating the DDG technology with existing learning platforms in addition to exploring exploitations in concert with near-future semantic and mobile technologies, so this ongoing work will also be briefly discussed.

DISCUSSION AND ONGOING WORK

This Section will consider the wider implications of this work in terms of what has been learned that is relevant to the HE and TEL community. It will consider four issues, namely: an 'innovation paradox'; changes in (digital) literacies and learning dialogue; treating dialogue as re-usable knowledge; technical improvements; and, integrating with mobile technologies.

The innovation paradox

This project has clearly alerted us to the tensions arising through what we will call 'the innovation paradox in higher education' (which probably also applies to schools and other well organised forms of human activity, e.g. working practices). This holds that there will always be a tension between the potential value of the innovation and the amount of organisational change that is required to accommodate it, where these are typically in opposition and yet can be directly proportional. So, the more exciting and ground breaking the innovation the more change is required to adopt it. So it's easier to adopt a marginal innovation and challenging to adopt more major innovations. Related to this paradox, although develpment and use is assisted through involving users in the design process, and interweaving this with implementation and use, end-users under the common pressures in HE settings also want a finished and robust product. So, another related tension is about users wanting to influence the design process whilst also wanting a finished product. One way of addressing this problem, that was developed at Queen Mary in particular, was to see these sorts of pedagogical innovations as internal action research that necessitated the 'buy in' of a specialised staff-action researcher role to embed and promote the innovation.

Changes in (digital) literacies and learning dialogue

This project was performed during arguably a revolution in the context of Web 2.0, and the changes this has induced in learners: expectations of software; their digital literacies; the nature of collaborative dialogue; and new forms of legitimate learning content. This technology aimed quite deliberately to bridge the social software world and the academic world – and did this successfully [27], but it should not be underestimated how 'conceptually demanding' this was at the design level. The main point is that we successfully reconfigured some learning activities within relatively 'change resistant' pedagogical contexts, which explains why this project was arguably more successful than many recent attempts to simply use Web 2.0 technologies for learning that have demonstrated very mixed findings in terms of their adoption and value [1]. Our current design of InterLoc(v5) exemplifies the need to conceptualise reasoned learning dialogues within a broader learning and interaction design, within an ecosystem of related digital practices and various forms of media and representation. Within these contexts, the attractiveness and flexibility of InterLoc could be further improved by introducing more graphical design idioms and making it more directly interoperable with other devices, such as mobile phones. A scenario illustrating the practice and digital ecosystem that would result from such improvements is presented and discussed more fully in [19]. These elaborations are important to consider, because these sorts of personalised and multimodal activities that link online processes to new forms of representation are becoming increasingly important within education.

DDGs and Continuous Social Learning in Knowledge Networks

The current InterLoc(v5) is being developed in various ways, and particularly through the FP7 MATURE Project, which focuses on 'Continuous Social Learning in Knowledge Networks' in work-based settings. The current foci within these developments is: investigating the role of dialogue as re-usable knowledge; examining semi-natural dialogue as an interface between people and the semantic web; and, wider exploitation and adoption of dialogue games more generally.

The first of these is investigating the re-use of the CTTs generated from DDGs, as re-usable knowledge. As mentioned earlier, these capture the thinking of co-interlocutors in a textual form that contains implicit semantic structure that: is a valuable representation of semi-formal argument, in a register between spoken dialogue and written discourse; and, a representation that can be easily searched and semantically processed in argumentative ways. This means that these texts can scaffold 'thinking writing' and provide a permanent and semantically rich trace of social learning processes across a community. So they can support innovative semantic processing, such as searching across dialogues for common disagreements or challenges related to particular topics and how these were addressed, or not, etc. So we could automatically diagnose misunderstandings, conflicts and disagreements within a community to guide further interactions towards resolutions. The latter is particularly valuable and important in the context of collaborative ontology development, gardening[1] and exploitation. Along these lines, within the MATURE project (www.mature-ip.eu), we are currently integrating InterLoc with a Social Bookmarking technology called SOBOLEO [37] and a Semantic Media Wiki.

There are several key benefits in 'mashing up' the ontology development and InterLoc to investigate learning as knowledge maturing that have been reported in [27]. Also as evaluation results have shown [37], more specifically, we propose a useful and alternative way, through dialogue games, to populate, clarify and refine the ontologies that are produced. Additionally, important dimensions of collaborative ontology development [38] such as Appropriateness, Social Agreement and Formality can be negotiated, and therefore also better understood through suitably designed dialogue games.

Practically, this is being achieved through replacing or supplementing the Chat component of SOBOLEO with specially designed dialogue game for Ontology maturing, where we stimulate users to have a dialogue with, and about, the developing ontologies to specify, clarify and refine the semantic features or degrees of certainty about their classification. This is achieved through specifying the pre-defined Moves and Openers of the dialogue game in terms of the semantic relations and classifications that are implicit in SOBOLEO and supplementing these with attested and more argumentative, or critical, ones from existing dialogue games. This allows both individual users and the community to have dialogues with and about the ontology, and to construct more understandable and meaningful representations. Allowing the community to engage in collaborative dialogues about the ontologies in this sort of way will catalyse and crystallise knowledge maturing and social learning in relation to the domain and the users who are continuously developing their understanding of it. In other words, having a structured dialogue about the development and use of the ontology will actually help to 'bring it to life' and make it more useful. *This is an exciting and non-trivial exercise, because at a more general level, we are developing the means, through a dialogue game interlingua, to better align human understanding and communication with machine understanding and communication in the context of the semantic web*. This is a big problem, that to our knowledge, no other research is addressing in a way that so directly links authentic users, who are not ontology or even technical experts, with powerful semantic and knowledge structures that support their behaviour.

Specifically this approach is being applied in a Demonstrator supporting a CoP in Classic Roman Civil Engineering where we are incorporating dialogue games to: stimulate knowledge maturing through critical dialogues about selected assets; provide 'thinking texts' as a new type of asset linked to the resources that were the dialogue topics; promote ontology maturing through specifying a specialised game linked to the semantics of the Ontology; and, introducing community dialogue driven semantics, e.g. tagging concepts as being agreed, in a state of conflict or as requiring discussion. *In brief, the aim is to have a continuous and automatic connection between resources, ontologies and dialogue processes in a CoP*.

[1] 'gardening' is a technical term used by the Ontology community to refer to how ontologies are revised and maintained.

From web-enabled to web-based

When this version of InterLoc was developed it was not possible to engineer it as a pure web-based application because HTTP protocols could not support the sophisticated interaction design linked to the requirements for quite nuanced and controllable screen layout and refreshing, etc. So we adopted this hybrid rich-internet solution, linking the client server technology to a html interface within a JAVA client. Although this solution works on most platforms, there can be problems if the client does not have a recent or latest version of JAVA or where the port (5222) over which XMPP runs is restricted. Although such restrictions are easily lifted where they are in place, as in our Case Studies, it would clearly be preferable to make the deployment slicker and impervious to network restrictions as much as possible. A solution is to re-engineer InterLoc as a more pure web-based application. Ongoing work is exploring using AJAX implementations to make InterLoc an exploitable and intelligent application that also easily integrates with other web-applications. Alternatively, InterLoc could be re-engineered as Social Gadget for Google Wave. This latter approach is particularly promising. Because the way in which Wave emphasises functionality based around the notion of a 'hosted conversation' that is both a shared conversation and document, and operates in real-time, shares a significant overlap with the key conceptual dimensions of our DDGs. The key difference is, that the DDGs add an extra layer of management, structure and organisation to potentially direct these hosted conversations for particular purposes [11].

Integrating with mobile technologies

Another important advantage of moving to a 'purer' web-based application is the possibilities that this opens up for mobile applications. Along these lines we are developing 'lite' dialogue games that are incorporated within a WOMBLE (Work Oriented Mobile Learning Environment). The design of these games is adapted to the requirements of 'on the spot' work-based learning and problem solving. So in these cases, an emergent problem, such as medical diagnosis or understanding a technical document, seeds the games which then include available members of a CoP with known competencies to engage in a collaborative problem solving dialogue game. So this application, will additionally incorporate additional, but already well modeled, intelligent and semantic processing to identify suitable dialogue participants based on the communities own interpretation and tagging of each others competencies and qualifications.

CONCLUSIONS

In this large-scale pedagogical action research project the DDGs and InterLoc were deployed and evaluated in a rich and varied set of contexts. The technology worked well in supporting scholarly thinking processes and related practices, and it was clearly valued by tutors and students. However, the approach was also questioning on occasions. For example some tutors, whilst recognising the fundamental value of getting their students to think more and think together, sometimes had to consider how this should be directly linked within more instructional and assessment-oriented procedures. Or, these collaborative thinking and learning practices questioned other more standard and individualized practices, such as the assumption that individual research without these sorts of critical dialogues is somehow sufficient. On the other hand, in some situations, such as the 'thinking writing' initiative at Queen Mary and the Interaction and Game Design courses at London Met, the approach suggested a step-change in improving the established pedagogy. We accept that these somewhat sophisticated findings are inevitable with an innovation that changes thinking patterns and practices that are fundamental to learning. And the questions that are raised about 'accepted' pedagogy can be as valuable as the positive experiences of learning that are produced.

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