Formative e-assessment: practitioner cases

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Abstract

This paper reports on one aspect of the Joint Information Systems Committee (JISC)-funded project 'Scoping a vision of formative e-assessment', namely on cases of formative e-assessment developed iteratively with the UK education practitioner community. The project, which took place from June 2008 – January 2009, aimed to identify current theories and practices relating to formative assessment of learning where technologies play a key role. The project aimed to scope the 'domain' of formative e-assessment, by developing cases of practice and identifying key formative processes within them, which are affected by the use of technologies. From this analysis, patterns were extracted to inform future software design. A discussion of the key issues emerging from the review of the literature on formative e-assessment, a full account of the project methodology – the design pattern methodology – as well as a critical discussion of the findings – namely the patterns and the role of technology – are the focus of a separate paper (see Daly et al (forthcoming). This paper documents how cases of formative e-assessment were developed during the project by a collaborative methodology involving practitioners from a range of post-16 education contexts. The cases were analysed with reference to key theoretical perspectives on formative assessment, particularly the work of Black and Wiliam (2009). In addition, Laurillard's Conversational Framework (2002, 2007) was used to locate practices of formative assessment within a wider concept of learning and teaching involving technologies, although a detailed discussion of the latter is not within the scope of this paper[1].

Introduction and literature review

This paper focuses on the cases which were developed as part of the JISC-funded project 'Scoping a vision of formative e-assessment' which aimed to identify current theories and practices relating to formative assessment where technologies play a key role. The project aimed to scope the 'domain' of formative e-assessment within post-16 contexts including Higher Education (HE), Further Education (FE) and Work-Based Learning (WBL), by developing cases of practice and identifying key formative processes within them which are affected by the use of technologies. A further aim, not explored in this paper, was then to derive patterns by analysing the cases, and capture the essential features of a range of formative e-assessment practices in patterns which would inform future software development. This paper presents two representative cases, and discusses the contribution they make to understanding the features of formative assessment where technologies have a range of roles in learning and teaching.

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[1] For a comprehensive project report see Pachler et al (2009).

The literature presents a diverse set of perspectives on the nature and value of formative e-assessment. It is sometimes presented principally as a relatively easy way of introducing e-assessment within an institution, arguing that as 'low stakes' assessment it presents less of a threat to institutions. Formative assessment is often presented as being simply serial (or repeated) summative assessment, and it is even referred to as 'practice' assessment. However, many authors question the value of such an approach and argue for a view of formative assessment that places much more emphasis on the role of feedback in the learning process (e.g. Maughan, Peet, and Willmott 2001).

For others, formative e-assessment is seen as having the potential to support significant changes in the way in which learning occurs in HE. Whitelock (2007), for example, argues for formative e-assessment as a means of promoting self-reflection and students taking control of their own learning, a view which echoes the ideas of Nichol (2006), who proposes a series of design principles for using formative e-assessment to support learner self regulation.

Writing in 1998 and looking to the future of e-assessment, Bennet (1998) describes three generations of e-assessment: First Generation tests using designs based closely on existing paper-based tests, Next-Generation tests which would use new formats including multimedia, constructed response, automatic item generation and automatic scoring, and Generation "R" (Reinvention) tests which would use complex simulations and intelligent tutors. Simulations such as the those now used in medical licensing examinations (see http://www.usmle.org/Orientation/2009/menu.html) enable detailed formative feedback on the execution of complex tasks, whilst intelligent tutoring systems (see for example http://www.carnegielearning.com/ and http://www.aleks.com/) use cognitive science and statistical techniques to generate detailed models of the student's understanding and use this to provide formative feedback and to modify the instructional sequence. A rather different approach to forming the future of formative assessment is seen in the call by Elliott (2008) for the incorporation of perspectives based on Web 2.0 technologies and approaches, and the blurring of boundaries between formative and summative assessment.

In the *Roadmap for e-assessment* developed for JISC by Whitelock and Brashar (2006) the authors consulted widely with the UK e-assessment community considering the divergent views of the ways forward for e-assessment in HE. They concluded that the future roles of e-assessment in the medium term lie in the areas of on-demand testing, e-portfolios, student modelling, formative assessment supporting learner autonomy, and diagnostic assessment, and they stress the need for improved forms of feedback informed by pedagogical (or rather androgogical) principles.

Within this context JISC funded a range of projects (see http://www.jisc.ac.uk/assessment.html) as part of its e-Learning programme in order to examine various aspects of e-assessment. The project described here is one of several that dealt with formative e-assessment. The more advanced techniques belonging to Bennett's Generation "R", such as the use of simulations, were addressed in the Review of Advanced e-Assessment Techniques project (Ripley et al 2009). The use of e-portfolios was addressed in a number of projects and the work of these is summarised in the JISC report 'Effective Practice with e-Portfolios' (JISC 2008). Therefore, positioning itself with respect to other ongoing work, the project

reported in this present study concentrated on examples of formative e-assessment where the pedagogy was relatively well developed, but excluded both the use of e-portfolios and the use of 'advanced' techniques.

The work of Black and Wiliam (1998) is widely quoted in the literature in developing an argument for the effectiveness and value of formative e-assessment, though the argument is often made without regard for the nature of the feedback and interaction in teaching and learning contexts. Our own interest in formative e-assessment also starts from Black and Wiliam's (1998) work and in particular their recent theorisation of formative assessment (Black and Wiliam 2009), which proposes five key strategies:
1   engineering effective classroom discussion, questions, and learning tasks that elicit evidence of learning;
2   providing feedback that moves learners forward;
3   clarifying and sharing learning intentions and criteria for success;
4   activating students as owners of their own learning; and
5   activating students as instructional resources for one another.

Core to Black and Wiliam's developing theory of formative assessment is the concept of 'moments of contingency' (Leahy et al, 2005) which they argue to be 'hinge' points in the teaching and learning process where the flow of instruction will depend on how students respond and cannot be predetermined (Black and Wiliam, 2009). Moments of contingency contain within them the scope for learners' understanding to be 'otherwise'. Contingency is constituted by a multiplicity of factors which are present in the learning context, and which may be social, cognitive and psychological. A learner's response to a potential learning opportunity (provided for example by teacher questioning, stimulus material, automated scoring of performance or peer comment) is part of their unique engagement in the learning process and is autobiographical. Responsiveness (on the part of the learner, teacher and/or peers) is key to contingency, and is necessary to 'moments', which have formative effects on learning. The role of technologies in contributing to the potential for responsiveness within moments of contingency became a focus for analysing the cases, and identifying 'hinge' points in the learning process.

Our perspective on the use of technology to support formative assessmenthas also been strongly influenced by Lauruillard's Conversational Framework (Laurillard, 2002, 2007). We view learning as 'conversational', consisting of a series of iterative cycles of interaction between teacher/learner/peers in a variety of combinations which may make use of technologies to greater or lesser degrees.

Drawing on these perspectives, and for the purposes of developing cases of practice for this study, we defined formative e-assessment as the use of ICT to support the iterative process of gathering and analysing information about student learning by teachers as well as learners and of evaluating it in relation to prior achievement and attainment of intended, as well as unintended learning outcomes. We did so also with a view to allowing the teacher or student to adjust the learning trajectory by becoming activated in a variety of ways. Within this definition, technologies of e-assessment are not seen as in themselves being inherently either summative or formative, but rather what is of interest is whether e-assessment is being used summatively or formatively.

Methodology

Formative assessment is continuously embedded in the teaching and learning process; its interaction with the multiple dimensions of this process create a highly complex domain. The project worked with a methodology that is capable of taking in the complexity and fluidity of this domain. We identified the potential of the pattern-based methodology of the JISC-funded Planet project (see http://purl.org/planet/Outcomes/Methodology for details). The methodology centres on identifying ensembles of context, problem and solution in a domain of practice. These form the core of design patterns; a term coined by Christopher Alexander in the theory of architecture (Alexander et al., 1977), and since then adopted widely in domains such as software engineering, interaction and interface design, and organizational change (cf. Mor and Winters, 2007 for a review).
Our initial review of the literature confirmed the domain of formative e-assessment as extremely complex (for details see http://patternlanguagenetwork.myxwiki.org/xwiki/bin/view/Groups.FormativeEAssessment/Literature+Review). This complexity arises from the inherent nature of formative assessment. It is continuously embedded in the process of teaching and learning, and interacts with the multitude of factors, both social and cognitive, which constitute this process. This complexity is compounded by the "e" dimensions; technology introduces new opportunities along with new challenges and reshuffles the context of teacher-student interaction. A methodology was required which addressed the complex interaction of social, pedagogical and technical factors at play in a variety of learning contexts,.
In addition, a research approach was required which allowed us to capture the practical expertise of those engaged in formative assessment practices, together with opportunities for critical reflection on those practices. In exploring the practice dimensions, the project engaged participant informants in thinking through their professional practice in the field of formative e-assessment. We identified the design-pattern based methodology, as developed by the JISC-funded Planet project (Finlay et al, 2009), as a suitable framework for user engagement, analysis, and modelling. We see this approach as supporting enquiry processes in relation to practice in the field of formative e-assessment, be they professional practice- or tool-design related.
The process of case development discussed here was participatory and iterative. The project brought together education practitioners from a range of contexts to meet on 'Practical Enquiry Days' (PEDs), in order to collaboratively reflect on the aspects of their practice they considered to constitute formative e-assessment. Practitioners were prompted to recount their experiences of using formative e-assessment as case stories, discuss them with their peers and document them on the project wiki using a template designed by the project team. The construction and discussion of these narratives was scaffolded by asking small groups of participants to consider the key features of their practice, concerning context, problem, task, results and lessons learned. These cases then constituted the data from which design patterns for formative e-assessment were developed. In contrast to other projects in the e-Learning programme, the cases were, therefore, not authored by members of the project team on the basis of data collected about practice through interviews, desk-based research etc. but by practitioners themselves.

The cases
Through participation in PEDs as well as (telephone) interviews, a number of cases

were developed by participants and the project team and captured on the project wiki. Criteria were developed in order to identify the features of a range of cases from which processes could be identified and patterns relevant to formative e-assessment were to be mainly derived. The following criteria were used:

Assessment focus	what types of knowledge, skills or attributes does the case involve as a focus for increased achievement?
Technology used	what technologies are involved in bringing about formative effects?
Role played by technology	what is it that the technology does to achieve formative effects?
Socio-pedagogical setting	what actors (teacher/individual student/peers) are involved in learning and teaching, and what is the relationship between them?
Institutional setting	where is the case situated in terms of education providers?

Table 1 Criteria for identifying cases of formative e-assessment

The PEDs generated a large number of 'seed' cases describing practices in a variety of educational settings where elements of formative assessment were present. Within the scale of the project it was not possible to develop all of them into full cases from which patterns can be derived and five key examples were selected to develop detailed cases. There exists a variety of reasons for not developing some very interesting cases of practice. Some reasons were rooted in the challenges which are intrinsic to the collaborative participatory approach to case-building in the project. This needs to be considered in future development of the methodology, as practitioner engagement over time is an important feature in developing authentic cases from which patterns can be derived. Other reasons were rooted in the content focus of the practices which were captured. The reasons for excluding cases can be summarised:

- it was not practical for some practitioners to attend all the PEDs where the cases were developed over time, so practitioners could not take part in ongoing group review and refinement of the cases they owned;
- formative assessment was not a major aspect of some of the practices described;
- there were a number of cases based on similar pedagogical practices, and we tried to avoid duplication to present a broader range of contexts/ technologies/practices;
- some cases were not sufficiently developed for inclusion because it was difficult to engage some practitioners in developing their cases on the wiki outside of the PEDs, due to pressures of time and workload;
- some cases did not fall within the main focus of post-16 sectors;
- some cases were already well-documented elsewhere.

We collected material to develop five cases, selecting these to ensure a range according to the criteria outlined in Table 1. Table 2 provides a summary overview of the cases.

Cases	Assessment focus	Technology used	Role played by technology	Socio-pedagogical setting	Institutional setting
Academic writing	students' critical understanding of the features of academic writing	wiki	aid communication between learner, teacher and peers, through the presentation & organization of student thinking	peer-to-peer, teacher-student, teacher-group	university masters level initial teacher education programme
Audiofiles	students' knowledge and understanding of key concepts in sociology	Audacity© software; digital audio recording on dictaphones	deliver tutor feedback and affect content of that feedback	teacher-student	university undergraduate
Como: mobiles + flickr/= co-reflective practice	recording and reflecting on clinical experiences	mobile devices with camera function; social networking tools	encourage individual reflection and feedback between peers & feedback from tutors to students and student groups	self, peer-to-peer, teacher-student, teacher-group	Higher Education veterinary training, Work-Based Learning
Open Mentor	achieve adequate levels of socio-emotive feedback from teachers	web-based tool	provide graphical feedback to tutors on the adequacy or frequency of comments provided to students	teacher self assessment	distance Higher Education
String comparison	accuracy in written language in complex sentences in language learning	string comparator (bespoke software design)	deliver immediate feedback on written accuracy in multiple language items	self (student self-directed independent interaction with software)	university undergraduate and post-16 foreign language courses

Table 2   Cases of formative e-assessment – summary overview

For reasons of space, two of the five are presented below in summary form It is important to note that the cases are presented here mainly in a descriptive form – as developed by the practitioners – with only some reference to supporting evidence from the literature and with some analysis around the notion of contingency. This is done deliberately in order to demonstrate the nature of the data the project collected, on which the design patterns of the project, discussed in Pachler et al. (2009) and Daly et al. (forthcoming) were derived. It is also important to stress that the project did not test the efficacy of the interventions described by practitioners in their cases;

whilst this can be seen as a limitation, testing the effectiveness of each case would have gone far beyond the scope of this project. The cases are not intended as examples of 'good' practice, but as representative examples of current practice in the field of formative e-assessment in relation to which a 'vision' – the project team always preferred to think of it as a possible future – could be delineated with reference also to what is known from the literature.

Case 1: Audiofiles

Practice
Audiofiles have been piloted with twenty-five undergraduate university students in years 1, 2 and 3 in a school of sociology and social policy. They form part of ongoing research and development to improve strategies for tutors to give feedback to students on traditional written essays to help deal with a contemporary challenge – increasing class sizes and less time for staff to spend on feedback on written coursework, leading to inconsistency in feedback even where it is done well. The intervention sought to explore the value of replacing text-based feedback with audio feedback, and to find out 'Does the feedback change?' Tutors used both handheld dictaphones and audio software to record their feedback directly onto a PC. There were no rules about the length of the file. Feedback was recorded in a single audiofile at the conclusion to reading the whole piece of writing and lasted between ninety seconds and twenty-one minutes. Audiofiles were then returned to the students via the course Virtual Learning Environment (VLE). In the audiofiles, tutors tended to comment more freely than in their equivalent written feedback which conformed more closely to the content guidelines of a feedback template sheet. It took tutors longer to produce however, and it was considered that further development may help the staff with managing this. The student work was also being formally assessed, so the students were getting formative outcomes from a summative piece of work, and it was felt that the approach may be more effective in a purely formative context. Planned next steps in this institution were to:
•   explore audiofiles with other disciplines
•   explore the possibilities of inserting feedback at intervals into the body of the documents like 'comment' inserts on word files
•   enable tutors to easily edit the word files as they make them.

Analysis
A key feature of developing audiofiles to construct feedback is the dual contingency that is evident in the account. The technological intervention was designed to impact on both students and tutors, increasing the potential for responsiveness in both. For tutors, increased contingency can be interpreted in the changed nature of their feedback comments. The practice of audio-recording appears to develop heightened focus on the potential impact of what they say. This relates to Laurillard's (2002) Conversational Framework, by which both teachers' and learners' conceptions go through a process of adaptation as a result of 'feedback on action'. The transmission of the audiofile itself takes place at the level of 'practice' within the framework. It is linked to conceptual adaptation by both teacher and learner by the reflective processes which are linked to engaging with feedback by both parties. In this case, the level of conceptual adaptation by the tutor was the most significant feature to emerge, and possibly greater levels of conceptual adaptation take place for the tutor

than the learner in many instances. Comments were 'richer' and more emphatic. In comparing the audio transcripts with written feedback from the same tutors, the feedback tended to be richer, longer, personalised, more immediate and 'authentic'. The process appeared to make tutors reflect more on their own feedback, leading to the desire to amend it. This is consistent with Black and Wiliam's view (1998) that pedagogical change in itself is a core aim of formative assessment, and that effects on learners may only become apparent over long feedback cycles.

In relation to the learners' responsiveness, the audiofiles case addresses somewhat Nicol and Macfarlane-Dick's (2006) criticisms of transmission-focused feedback, that 'feedback messages are invariably complex and difficult to decipher' in transmission contexts, because students find it hard to take appropriate actions to improve. The heightened tutor focus on providing emphasis and detail may counter these concerns, and certainly suggests that technology can enhance the capacity for transmission-focussed feedback to prompt 'moments of contingency' for learners as well as tutors. It is interesting to note the seemingly positive impact of oral feedback in this case given Shute's (2008) classification of orally delivered feedback as a 'thing to avoid'. It might well be that in the audiofiles case the oral feedback is in the form of a disembodied voice, recorded digitally and 'delivered' by the computer that mitigates against the potential negative effects suggested by some of the literature. Most importantly, the impact on the tutor is highlighted, and contingency is located firstly in the tutor's capacity to reflect more deeply on the nature of the feedback they will give, prompted by the technological intervention. The tutor's adaptation is the key to the second 'moment of contingency', which involves the learner's potentially enlarged range of responses to the enhanced feedback.

The full case can be found at:
http://patternlanguagenetwork.myxwiki.org/xwiki/bin/view/Cases/Audiofiles.

Case 2: Como: mobiles + flickr = co-reflective practice

Practice
At the Royal Veterinary College, a group of students were engaged in practical work in a vet training hospital. As part of their training, the students were required to capture instances of practice on a mobile phone and the photos collected were automatically uploaded to flickr. The students worked in groups of four or five and each was provided with a mobile phone and given a short familiarisation session. In one scenario, during morning rounds students would be directed to monitor the progress of an animal being treated. Their task would be to document case progress over time. They took pictures throughout the day, uploaded them to a blog, tagged them with caseID and key features e.g. type of animal, the injury, condition. The students then used quiet moments to add details to the 'case' using blog postings. During the evening rounds, the students presented their cases in group discussion sessions with their tutor, using the images, blog posts and a projector. The group reviewed the diagnosis and the actions which were taken, and reviewed these in the light of revisiting the images and postings which acted as catalysts for evaluation of practice. Co-reflection was enhanced because of the availability of images which bring the medical case into the seminar room. It affected the students' tutorial conversation, providing ongoing formative contributions to the case in the form of postings. The discussion moved from abstract "textbook theory" to what tutors called "case presentation": how the particular condition presents itself in a particular case,

how to analyse symptoms in real-world conditions and how to assess treatment. These are key skills which are often neglected due to the inability to have a concrete presence of the case in the seminar room as a focus for reflective and analytical discussion. The process of using images to capture cases also provided feedback to tutors on the students' learning. Tutors reported that observing students' pictures gave them a window on their thinking: what they noticed, where their attention was and where they assigned importance. This was the basis for modifying tutor input and the focus of the tutorial discussion.

Analysis
A key to the role of technology in formative assessment in this case is the 'window on their thinking', which is opened up for the tutors in relation to learners' knowledge and understanding. Shute (2008), based on her survey of relevant literature on feedback, highlights the potential of multimedia to contribute to feedback practices, and recommends alternative modes of presentation. The project identified 'construction and representation' as one of six main affordances of digital technology in relation to formative e-assessment (see Pachler et al 2009, pp. 20-21). By this, the ability to represent ideas in a variety of ways and to make meaning with a variety of symbols and modes enhances opportunities for teachers and learners to engage in iterative exchanges, which support adaptation of thinking. The use of photographs in this case was core to the tutors' understanding of how the students were thinking in their work-based learning contexts. The process required the students to select, prioritise and synthesise in order to be able to articulate their cases using the images collected.

Again, dual contingency is at work here. Firstly, the learner is prompted to engage with the digital images they have made to decide how to use them to present a case. This does not require tutor intervention, but requires critical reflection at the level of the task via self-evaluation of the choices already made in taking the photographs. The affordances of the mobile technology mean that material can be re-purposed as a result of review, and speed and adaptability enable the process of case presentation to be enhanced. Laurillard (2002) presents such practices in her Conversational Framework as a feedback cycle in which the learner is able to develop conceptually by reflecting on their task and the actions they have undertaken to achieve a goal. There are potentials to engage with 'other learners' conceptions' (e.g. students could share their photographs and seek peer-advice on how to work with them) but self-evaluation is a valid iterative practice leading to enhanced understanding.

In a further stage, the tutor is able to respond to what the images reveal about a student's current state of understanding, and conduct the teaching session in the light of that knowledge. Further 'moments of contingency' are made possible here, by the tutor bringing their pedagogical and subject knowledge to inform their responses to the student presentations, based on what the images reveal about their thinking.

The full case can be found at:
http://patternlanguagenetwork.myxwiki.org/xwiki/bin/view/Cases/CoMo.

Discussion

As part of our developing conceptualisation of formative e-assessment, we see key processes which have formative effects taking place within broader frameworks of learning. Such processes are based on the roles of key players (teachers, individual learners, peers) and a range of practical and discursive actions in which they participate.

As can be seen from the cases presented here, technology does not in itself bring about formative effects. 'Formative e-assessment', we argue, is better understood as multiple processes involving technologies to greater or lesser degrees, where evidence is generated about a learner's state of understanding relative to desirable goals, and where individuals are enabled to take actions which bring about changes in learners' skills, knowledge and understanding, or in teachers' pedagogical practice. What is key is not how we assess but what we do with the data we generate as a result of interventions which can be supported by technologies.

The cases suggest that there are key technological attributes or 'resources' which appear to make a difference to the learners' potential for improvement, because of the way the technology contributed to creating moments of contingency. The technology does not in and of itself create these moments of contingency, however. These depend on the set of human responses, motivational factors and socio-interactive contexts which create opportunities for the choices learners make and actions taken in conjunction with feedback and interaction offered by electronic tools. The tools do have particular shaping effects on the types of choices and actions which can emerge. The technologies we describe in the cases and patterns help to constitute the learning environment and contribute to shaping the contingent possibilities which are part of it.

Black and Wiliam (2009) outline 'key aspects' of formative assessment around three core learning scenarios (Table 3):

- where the learner is going
- where the learner is
- how to get there.

	Where the learner is going	Where the learner is	How to get there
Teacher	Clarify and share learning intentions	Engineering effective discussions, tasks and activities that elicit evidence of learning	Providing feedback that moves learners forward
Peer	Understand and share learning intentions	Activating learners as learning resources for one another	
Learner	Understand learning intentions	Activating learners as owners of their own learning	

Table 3: Key aspects of formative assessment (Black and Wiliam, 2009)

The cases, both the examples summarised in this paper and the complete collection from the project, include few examples of 'where the learner is going' with most of them providing examples of 'where the learner is' and 'how to get there'. There was little focus on understanding learning intentions as involving mutual review between

teachers and learners. The study was small-scale and we can only make some cautious observations about this, but in these cases the majority of formative practice in post-16 formal education settings is geared towards achieving pre-determined learning outcomes with relatively little time devoted to sharing and understanding learning goals. This is an area in need of further investigation.

Towards a vision of formative e-assessment

Two key points stand out from the theoretical work and case development within the project. Firstly, no technology-based assessment is in itself formative, but almost any technology can be used in a formative way – if the right conditions are set in place. This observation is in line with a socio-technical view of educational systems, which sees the technological dimensions (e.g. speed, storage capacity, processing, communication, construction and representation and mutability) as inseparable from the pedagogical conditions (e.g. verbal/electronic/ synchronous/asynchronous interaction between key players which brings about changes in concepts or skills). It is consistent with a view of learning as 'conversational' (Laurillard, 2002, 2007), consisting of a series of iterative cycles of interaction between teacher/learner/peers in a variety of combinations which may make use of technologies to greater or lesser degrees. This range of combined technological and pedagogical resources impacts not only on how students act but also informs what teachers do to enhance learning. From our analysis of the cases, 'moments of contingency' (Leahy et al, 2005) are identified in terms of how they act as 'hinge' points in the teaching and learning process. The technology itself does not create these moments; they are dependent on teachers' and learners' actions. But for technology to perform formatively, it needs to acknowledge and support these moments.

The second key point is that formative e-assessment is incredibly complex, since it requires the delicate orchestration of social, pedagogical and technological systems. Any framework of design and development attempting to address this domain needs to identify methodological tools which allow it to deal with such complexities. Such tools need to balance the need for a crisp directive for action with a rich repre-sentation of context, intentions and possible solutions. In our study, we found the Planet methodology – which develops cases, design patterns and future scenarios via collaborative structured groups conversations – to be a valuable asset. It enabled discussion between all stakeholders in an iterative, user-centric development process.

On the basis of our engagement with practice and the literature in the field of formative e-assessment a set of parameters emerged which, if they can be validated by further work, we consider to offer a potentially exciting way forward in analyzing and planning for formative e-assessment. They are:

- nature (extrinsic/intrinsic), frequency, role and functions (monitoring, diagnosing, instructionally tractable) of feedback;
- affordance of moments of contingency;
- potential for learner self-regulation;
- iteration;
- scope for sharing outputs and ideas with peers;
- focus on where the learner is going;
- length of cycle;
- potential for pedagogical modification;

- scope for closing the gap;
- contribution to future learning trajectories;
- measurable attributes.

We offer them here as possible focal points for discussion in the design of instructional episodes and/or the development of future e-assessment tools but wish to stress that they are neither systematic nor have they been empirically tested and verified as part of our project.

Conclusion

Formative e-assessment can be understood as a set of processes involving both technological and social resources by which individuals (both learners and teachers) are enabled to engage agentively with evidence of learning, in order to effect changes in understanding. Such engagement we see as crucial to 'moments of contingency'. Part of understanding formative assessment has to be the recognition that students may not improve despite engaging with technological and social resources; also, technology cannot guarantee moments of contingency. It is the learners and teachers as human actors who ultimately determine the formative effects of engaging with technologies, but technologies can shape the potential for this to happen. It is only when it is located in wider understandings of effective learning that the potentials of electronic tools to contribute to formative assessment can be understood and optimised.

Our discussion of cases of formative e-assessment in this paper also clearly points to the conclusion that – on their own – cases are insufficient to move the sector forward. Whilst in themselves they may offer a useful stimulus for reflection on one's professional practice, in order to become an effective basis for the planning of intervention at a system level as well as for the design and development of software tools, a process of abstraction is necessary, which extracts the essential 'messages' contained in the cases, which lend themselves for generalisation and transfer across context. And, this distillation needs to be mapped tested against relevant literature and mapped against a domain map in order to ensure validity, reliability and comprehensiveness of coverage. The project discussed here affirms the view that patterns are a valuable extension of an inductive, case-based approach to improving pedagogical practice and better understanding the domain of formative e-assessment. They can serve as meditational tools by providing a stimulus for practitioners to critically review and innovate their practice and by providing a basis for an understanding of key pedagogical issues for software developers. Patterns derived from cases can also form a useful set of criteria against which to assess the effectiveness of individual interventions – a process also outside the scope of the project discussed here.

Acknowledgements

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