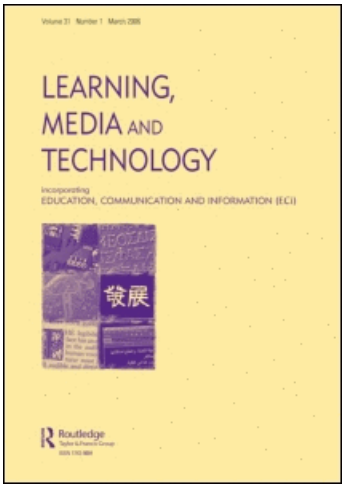

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Student reflections on formative e-assessment: expectations and perceptions

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Research into student experiences of e-assessment has been neglected. Students' expectations and perceptions of e-assessment have been under-researched and their learning strategies are often unclear. This paper reports a qualitative study which investigated student expectations and perceptions of formative e-assessment. Screen-capture software was utilised to record students' on-task actions during completion of a formative e-assessment. The captured interaction was subsequently used to stimulate recall in post-assessment interviews. Participants discussed the thinking underpinning their approach to different question types, reflected on strategies employed during completion of their assessments and described in detail any difficulties encountered. Interpretative phenomenological analysis identified seven major themes. These provided an insight into the way students approach formative e-assessment tasks, the techniques they employ, issues associated with assessment design, and the provision and quality of feedback. Implications for future research and professional action to enhance the effectiveness of formative assessment were outlined.

Keywords: e-assessment; formative; anxiety; feedback; student perceptions

Introduction

The use of e-assessment in higher education is increasing rapidly, yet research into student experiences of e-assessment is limited. Students' expectations and perceptions of e-assessment are under-researched and their learning strategies are often unclear. Research focusing on the relationship between assessment and student approaches to learning has been identified as an area demanding further investigation (Hofer and Pintrich 1997), with effect, experiences and expectations of e-assessment pinpointed as areas prime for exploration (Northcote 2003). Furthermore, the influence of web-based assessment methods on student perceptions of assessment and their anxieties requires more extensive examination (Cassady and Gridley 2005).

E-assessment represents an attractive option for institutions looking to address the logistical problems associated with the increase in student numbers entering higher education. The potential of e-assessment to motivate student learning, increase the provision of feedback to learners and remove concerns associated with marking by ensuring consistency is driving the use of e-assessment in courses (Bull and McKenna 2004). In terms of learning benefits, e-assessments are seen as a means by which to help students reinforce their understanding

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of core concepts (McCausland 2003) and close the gap between actual and desired performance levels through the provision of timely feedback (Nicol 2007). Studies into the use of e-assessment in higher education have however highlighted concerns surrounding the credibility of e-assessment practice (Conole and Warburton 2005), with particular concerns relating to the capacity of e-assessment to test higher-order learning and the time required to develop valid test items (Hepplestone and Helm 2003).

Although research in the area of e-assessment has intensified in recent years and research into the student experience of e-learning is emerging (Creanor et al. 2006), little research has been conducted into the effect of e-assessment strategies and the impact on the student learning experience. Numerous case studies exist describing how to deploy e-assessment institutionally (Zakrzewski and Bull 1998) alongside articles examining security issues and the risks surrounding e-assessment (Zakrzewski and Steven 2000; Ricketts and Zakrzewski 2004; Harwood and Warburton 2004). In contrast, few studies have focussed on the appropriateness and effectiveness of e-assessment as an assessment method and the influence it has on student learning approaches and study behaviour. This paper reports a qualitative study conducted at the University of Dundee which investigated student expectations and perceptions of formative e-assessment. The methodological approach adopted facilitated in-depth exploration of student experiences of formative e-assessment tasks and addresses the identified gap in the literature in this area.

Methodology

Aim

The study aimed to understand more fully the students' experiences of formative e-assessment, specifically exploring their expectations and perceptions and the on-task difficulties they face.

Sample

Fifteen student volunteers studying on four science-based modules that used e-assessment for both formative and summative purposes formed the basis of a purposive sample during semester two of academic year 2006–07. Participants were drawn from the School of Life Sciences ($n = 8$), School of Nursing and Midwifery ($n = 3$) and School of Medicine ($n = 4$). Twelve of the students were in their first year of study while the three Nursing students were in their second year. Participants were predominantly female ($n = 12$) with males ($n = 3$) constituting only 20% of the sample. The median age of the participants was 25. The decision to select only those modules from science-based subjects was based on previous research findings that indicated that e-assessment activity is predominantly located within these disciplines (Bull and McKenna 2000; Warburton and Conole 2003), therefore allowing exploration of the implications of any findings against existing literature. Table 1 provides details of the four modules within the sample and indicates the percentage of the overall module assessment (conducted online) that carried a summative weighting.

Data collection

In order to explore the expectations and perceptions underpinning student interaction with e-assessment software, it was necessary to capture and examine the meanings that students themselves assigned to these interactions. This experiential data was obtained through

Table 1. Modules included in sample and percentage of overall module grade assessed online.

Module	Year	Programme of study	Overall module assessment online (%)
Biology	1	Life Science*	90.00
Chemistry	1	Life Science*	95.00
Medicine	1	MBChB Medicine	67.00
Nursing	2	BA Nursing (Mental Health)	33.33

*Life Science is a multi-course structure with numerous degree pathways following completion of first year.

individual semi-structured interviews, conducted immediately following each student's completion of a formative e-assessment. Each assessment was presented in Questionmark Perception™ and accessed by the students through their modules on the university's virtual learning environment, Blackboard™. To facilitate exploration of specific actions and issues encountered, each assessment was screen-captured using Camtasia Studio™ with the video subsequently used to guide discussion. Table 2 presents details of the four assessments completed including number of questions, range of question types and assigned summative value. Participants were encouraged to explain their underlying motivation and feelings in as much detail as possible. The use of stimulated recall has been reported by Clarke (2001) as a means of looking at the negotiation of meaning in mathematics classrooms. Though the findings may appear to be of a higher grain size, they are, as Clarke suggests, a way of exploring feelings and strategic approaches to particular questions.

Data analysis

Interpretative phenomenological analysis (IPA) underpinned the research methodology. IPA focuses on individual's experiences and accounts of an event or topic as lived by that individual and, through a rigorous and explicit process of interpretative activity, seeks to make sense of and inferences from those experiences (Reid, Flowers, and Larkin 2005). Each interview, of approximately 15–20 minutes duration, was audio-taped and transcribed verbatim. Interviews were coded with each transcript treated as a single unit of analysis. Themes emerging from analysis of the first transcript were used to identify similar thematic instances within subsequent transcripts with the addition of any new themes to emerge. Further rounds of comparison were conducted to refine the list of themes to ensure that they were both accurate and sufficiently rich in evidence. A final round of comparison tested the master list of themes against each transcript. As an interpretative process, IPA is inherently

Table 2. Formative assessment question types and assigned summative value.

Module	Number of questions	Type of questions	Assigned summative value (%)
Biology	15	MCQ; PULL; MR; FILL;DRAG	3.00
Chemistry	10	MCQ; NUM; MR; T/F; FILL; PULL; Y/N	3.00
Medicine	20	MCQ; MR; PULL; DRAG; FILL	0.00
Nursing	20	MCQ	0.00

Note: Question types coded as follows: DRAG = drag and drop; FILL = fill in the blank; MCQ = multiple choice; MR = multiple response; NUM = numeric; PULL= pull-down list; T/F = true/false and Y/N = yes/no.

subjective, relying on the researcher's interpretations of interviewee's accounts. Given the subjective nature of the analysis and the lack of cross-validation, the findings should be considered as tentative; with generalisations limited to only those who participated in the study.

Results

A total of seven themes were identified. The main themes were as follows: (1) personal aims and drivers; (2) the role of formative e-assessment within learning; (3) approaches to answering questions; (4) learning approaches and styles; (5) implications of assessment design; (6) use of feedback; and (7) perceptions of e-assessment.

Personal aims and drivers

A range of factors emerged relating to students' personal objectives and motives underpinning their use of e-assessment within their learning. The capacity to assess personal progress and identify learning needs figured strongly in the accounts given by the majority of students, as the following comments from a Nursing and Life Science student illustrate:

> Just really to check how much I've taken in. Just … because it gives you the feedback straightaway you can sort of get an idea of how much you've taken in. By practicing I guess it's just a way of checking how you're getting on.

> To see how much I've already learned without revision and see what areas I need to work on. I write down what areas I'm failing on and then I'll go back and read through my work and then do it again.

In these extracts it is apparent that, for these students, e-assessment performs a valuable diagnostic role to gauge the knowledge they have retained and to identify areas where further revision is required. Progress however appears to be judged against retention and not necessarily whether the topic has been understood or can be applied more widely.

The achievement of outcome emerged as the primary driver for students from the School of Life Sciences where formative e-assessments also carried a small summative weighting. Extracts from two students illustrate the goals driving their approach:

> To get an A1, that is what I always try to maintain for every assessment that we do online because we're told that we can try them as many times until we achieve an A1, so I always make sure I have an A1 if possible.

> … some weeks it's just literally been I just want an A1 and it would be a case that I would sit there until I got it and didn't necessarily pay very much attention to what the actual questions were saying.

In these extracts the experience of formative e-assessment is represented as a mechanical process. Rather than a method of self-diagnosing learning needs, the formative assessments described in this context are fundamentally about grades and learning is secondary ('didn't pay very much attention to what the actual questions were saying'). Although the narrowness of this learning approach appears to be recognised by the students, the sense of personal liability is diminished due to the influence of significant others ('we're told that we can try them as many time until we achieve an A1').

Role of formative e-assessment within learning

The students' description of their use of formative e-assessment provided an insight into the role of e-assessment in their studies. The diagnostic function of formative e-assessment was again strongly apparent and reflected in their patterns of use. The following comment from a Medical student illustrates the place of e-assessment within their learning:

> I normally do a formative before I do any revision to see how much, how much I've actually learned during the class time and then I normally wouldn't attempt one until I feel I've covered the subject to my best abilities the first time and then use it to try and minimise my errors.

The above extract portrays a very structured approach to the use of formative e-assessments, representing both the start and end point of the students' revision process. Comments indicated that in these cases the e-assessments encouraged students to engage with their learning materials.

The influence of outcome was again apparent in a minority of cases. In those cases the influence on frequency and pattern of use was telling, as the following comment from a Life Science student illustrates:

> … when I attempt the CSAs [Computer Supported Assessments] in my own time I like to try and view all the questions so I like to try and access them on numerous occasions to try and see what every single question is.

In this extract use of the assessments is compulsive and less about identifying weaknesses via a diagnostic approach with a view to directing revision, and more about rote-learning and recall.

Approaches to answering questions

Exploration of the thought processes underpinning approaches to different question types revealed: a common technique employed and examples where use of such techniques had proven ineffective; differences in approach to prompted and unprompted question types; and a number of factors that influenced the approach students adopted during formative e-assessments. A deductive approach to question solution was common across all three disciplines:

> Multiple choice ones again I'm just trying to remember but obviously but anything that's clearly true or clearly false I spot quite quickly and then I sort of consider the other options.

> This I just went down the list and I thought is it this one, no, is it this one, yes.

The process represented in these extracts demonstrates that the students are applying a method which involves an element of analysis and not simply guessing. However, further analysis revealed that problems arise when application of such techniques fail. In these cases uncertainty increases and the student resorts to guessing the answer:

> I was unsure of the question and although I was trying to do the process of elimination I was finding it hard to eliminate any of them.

> I just guessed based on what it was asking for in the question and picked the one that was relevant to a few of the words that they'd used, a few of the terms.

The second quote is revealing in that it highlights the way the student attempted to adapt their approach to answering the question by seeking a clue to the answer from within the question wording rather than from their own knowledgebase.

Unprompted question types, such as fill in the blank questions, where options are not provided to select from, require that a different approach be adopted as elimination techniques are not viable. Notably, it emerged that several students (excluding Nursing students whose tests comprised entirely of multiple-choice questions) found these question types challenging:

> … I wanted to have a think whether I could actually recall what goes in the gaps but then decided that I couldn't and then there was little attempt to even try and do so because those particular questions look for very specific answers and so if you haven't got the answers or if you haven't got the correct phrase there is little point in attempting them.

In the extract above, there is a sense of helplessness ('if you haven't got the correct phrase there is little point') and frustration experienced by the student as they attempted to answer what might be regarded as a more authentic question type. In contrast, the dominant student view that emerged regarded these question types as unjust, requiring too great a degree of precision:

> Oh, and I changed the case because often if you spell something slightly wrong or its, god I don't know got a bit of punctuation in it or something like that, that's not supposed to be there it gets marked wrong. Again I don't know how beneficial that is because it's not really assessing knowledge and understanding it's assessing whether you can type properly.

Confidence and the ability to manage uncertainty were identified as important factors which influenced the way students approached their assessment. In the majority of cases the ability to successfully answer questions bred confidence and eased tension. Conversely when unsuccessful, a heightened level of anxiety and self-doubt was apparent. The following quotes from a Nursing and Medical student illustrate both dimensions of this behaviour:

> I'm glad when I know the answers, you know when you read the question and think oh yes that's what it is, that's good you know.

> Annoyed with myself slightly that I couldn't recall some things and I was taking confidence from the fact that I could answer most of the questions without being doubtful about my answers.

In the first extract the student's heightened sense of anxiety is evident by their relief at being able to answer the question. Similarly, anxiety and its effect on ability to answer questions is suggested in the second extract; however in this case the failure to recall certain answers is a source of frustration rather than worry. Further examination of the approaches students adopted during their e-assessments highlighted the efforts they made in order to maximise their success. Students from across all three disciplines described the precision with which they attempted to answer questions and the majority of students reviewed some or all of their answers prior to submission. The following extracts from a Life Science and Medical student illustrate the methods adopted and reasons underpinning these methods:

> Just to go back through and check that I'd answered everything and that I hadn't missed anything out and every answer that I actually ended up ticking has been the one that I had intended to tick.

> I go through all the questions after every assessment so once I've completed all of them I will go back, I will check them. If it's the main exam then I will go through it two or three times until I'm reasonably happy.

The process of reviewing answers is a source of reassurance that the question has been interpreted correctly and that the answer they have selected is, as far as they can be certain, the correct one. The latter quote revealed that a different approach is taken in summative exams and indicates that the degree of precision and attention to detail is greater during completion of these tasks.

Learning approaches and learning styles

A pattern of surface and strategic learning behaviour emerged from the accounts given by a significant minority of students. While prominent, these learning approaches were not found to be common across the group as a whole. In a small number of cases evidence of deep learning processes, such as reflection, were evident:

> So this one here, this question that I'd flagged, I went back and I changed it to the right answer because in thinking about it, it had been in my head for the whole time that I was doing it and I was a bit more confident that what I had changed it to was then the right answer.

Although the subject of criticism by some participants, free text question were cast in a more positive light by one Medical student who described the way a fill in the blank question had made her think more broadly about a particular issue rather than restricting her thoughts to a set of options available:

> It certainly makes you think, it makes you think more about … for that one it's melanoma so I maybe spent a couple of minutes thinking more about melanoma as a whole as opposed to just what is specifically in front of me but they are a bit, it's more problems solving-ish than recall.

The importance of careful question construction was highlighted in the comment of one Life Science student who described how a specific question had forced her to deviate from deductive question techniques and deploy a more active learning approach:

> … that involved me actually having to go to the textbook and look it up and find out for myself which was a lot more beneficial than using some strategy of whether it is going to be true or false or fill in the gaps strategy because it was more of a research type situation.

In the extract above we get a sense of the student's appreciation at being challenged by a question type which she regarded as appropriate for her learning needs and suited to her preferred learning style. We also get a sense of her refreshment at not having to apply a technique she does not regard as being of benefit to her learning.

The capacity to include images within items and the more engaging nature of question types like drag and drop questions was highlighted by three students who described how these more visual formats suited their method of learning, aiding their capacity to remember and recall information. A comment from one Life Science student illustrates how the drag and drop question format equated with her revision methods:

> I like putting the arrows places. It's a good way of teaching you to remember as well. Like drawing, I like drawing pictures to revise so it reminds me of that.

Implications of assessment design

All of the participants related to a certain degree their own views on aspects of assessment design and how this shaped their experience of e-assessments. Clarity, in terms of both assessment instructions and question wording, emerged strongly as an important aspect of assessment design in the accounts given. One Nursing student expressed how the interpretation of assessment instructions was an important first step before proceeding to tackle the questions:

> Just really trying to work out what it is, what the instruction is … reading it through and trying to work out what to do next.

More commonly across the transcripts concern relating to the clarity of question wording was apparent with ambiguous question text and distracters the source of frustration and anxiety. An example of such ambiguity is presented below in a comment from a Life Science student who reflected on a multiple-choice question she had just completed:

> I find these questions quite hard because you have to spot the differences in the sentences before you can really work out what they're trying to say.

Another student, again from the School of Life Sciences, revealed a similar concern when trying to tackle negatively phrased questions, explaining the way she adapts her approach when she encounters these question types:

> I normally read the question twice because this particular one says which are untrue so for a start I read it as true which is a little bit confusing and had to remove one of my options so I just double-check these sorts of questions so they don't catch you out like that.

The comment above highlights the increased margin for error and indicates a perception that these are trick questions designed to catch the respondent out. The student, having initially misinterpreted the question, corrects her initial error and consciously takes steps to check her answer fits the question.

Transparency in relation to marking was an issue highlighted by several students. Primarily, concerns were found to relate to fill in the blank questions and the lack of clarity surrounding factors such as case sensitivity or misspelling. When asked whether they regarded these to be fair questions, views were found to be divided:

> Not really, to be honest I think unless you've got the exact phrase there, like for example with this one at the end with the PFU I put plaque forming units and I got it wrong because I hadn't put the hyphen between the plaque and the forming.

> I think they're a fair question type, I mean I think they, they actually to be honest with you these assessments do kind of help you because I know my spelling is not good but I do have a reasonable vocabulary with it and I find it does actually help me reinforce my spelling quite a lot doing these assessments.

These two very different extracts reveal alternative perspectives on the same point of controversy. In the first account the question of the fairness of the question format is discounted immediately ('Not really'). The student related that she felt the expectation to reproduce the correct answer ('the exact phrase') was too high and insufficiently flexible. In the second account, the student viewed this inflexibility more positively as reason to improve his spelling and enhance his grasp of the language of science.

Continued analysis revealed further issues relating to assessment availability and its implication for the approach adopted during and prior to formative e-assessments. Restrictions on the number of attempts possible within formative assessments were expressed as desirable by two students from the School of Life Sciences who felt that the current format which allowed multiple attempts discouraged deep learning approaches. The following comment was indicative of this view:

> Well sometimes I think that the assessments would be much better if they were limited attempts because then it stops people from just simply guessing or working it out through a process of elimination … and people don't learn anything like that because it's quicker to do it that way than to go and research it and find out the answer usually. If they were limited attempt I think people would research it as they went along.

The extract reveals the student's frustration that others are achieving success through the use of what she regards as strategic methods that are unbeneficial for learning. The student's closing remark indicates that she believes that restricting access to the assessments would act as a spur to encourage students to study more actively and progressively.

Use of feedback

Three applications for the information obtained through question feedback were identified. Perceptions of the quality of the feedback provided however were found to vary, while the absence of feedback was found to have implications for the learning approach adopted. The majority of students were found to use feedback to reinforce their learning and gain a deeper insight into specific topics/concepts. The following comment from a Life Science student illustrates this approach and provides an indication of the value attributed to detailed explanatory feedback:

> I'm just trying to get what I can from it, learn more about the topic because sometimes it expands on the question even if you do get it right it gives you a little bit more information about why that was the case which is useful.

A significant minority of students were found to use the feedback provided to identify errors and clarify any misunderstanding they may have in relation to a specific topic:

> … for the ones that I've got wrong usually I write down what I've got wrong so I can take it away and then go and study it up or figure out where I've gone wrong.

A further application to emerge from analysis, though apparent among only a small group of Life Science students, was the use of feedback to enhance the achievement of outcome. In these cases feedback was either written down or printed and used to aid subsequent attempts as the following quote illustrates:

> Generally I go on to Student Tools on My Grades and print them off from there so that I have them in front of me when I do them next.

A consistent theme relating to the quality of feedback provided within the formative assessments emerged. The presence of explanatory feedback was viewed in the majority of cases positively and seen as a key resource with which to further learning. While a small number of students simply wanted to be informed of the right answer, many wanted to gain an insight into why their answer was right or wrong:

> I prefer the explanations because sometimes even if they give you the answer you still don't understand why your answer was wrong. You're like well yeah sometimes you can see why the answer they gave is right but sometimes the longer explanations tend to tell you why an answer is wrong as well as the ones that are right and that's more useful.

Exploration of the use of feedback in the interviews with participants revealed significant frustration when questions did not provide any feedback. In one case a Life Science student explained how this had forced her to adopt a trial and error approach to establish the right answer:

> It's quite … well it's quite difficult to know which ones, for example the ones that are two out of four, and you don't know which one … you've got right, and which one you've got wrong. You just have to try and use different … look it up in books or online or otherwise you just do it again and see which one is right because there's no other way to do it really.

Perceptions of e-assessment

A range of positive features of e-assessment were identified by interviewees, the majority of whom broadly accepted that e-assessments can be a useful learning aid. E-assessments were highlighted as being less stressful than alternative formats which was seen as advantageous as this allowed more scope for thinking:

> So it's a bit more relaxed sitting on a computer because you can, you can sit back and just click through whereas you've got all this going on in your mind but it's not as, you don't have the added thing of writing down.

In the above extract the Medical student makes clear that while there are clear differences in the physical effort demanded by the respective formats (online versus paper), there are no differences at the cognitive level. The ability to focus and arrange this thought process is facilitated, it is suggested, by not having the pressure of having to construct an answer.

The potential for formative e-assessment to reinforce learning and test higher-level skills was acknowledged by a number of students who recognised that when designed and embedded appropriately, the assessments represented a valuable learning aid. However, as the following quotation from a Life Science student illustrates, it was perceived in a small number of cases that they could also be exploited by strategic learners and may also be used by academics merely to achieve efficiency gains:

> I think that on the whole this type of assessment it can work, and it can consolidate learning, and it can enable you to apply knowledge and understanding to situations and problem solving but I think on the other hand it can be a means to an end and I think it can be manipulated by students.

Concerns emerged relating to the potential for over-reliance on the assessment format within courses and its suitability for specific disciplines. A comment from one Life Science student indicated her concern that e-assessment was too prominent in her particular course and expressed a desire for more face-to-face learning opportunities:

> … I find CSAs really helpful as part of the whole learning package but sometimes I think they're relied on too much. I mean I think it's great you can build up your course mark over the term by doing them each week and by getting a 100% but it would be really helpful if there was still small group tutorials.

Due to this over-reliance, the same student also expressed concerns about being under-prepared to cope with alternative formats when she entered subsequent years of study where e-assessment was not employed:

> … suddenly you get to second or third year and you have to write an essay and a lot of people will never have written an essay before whereas I think first year should be a time where you learn those kind of skills.

Discussion

This paper reports a study which investigated the student experience of formative e-assessment. Specifically, the study examined the way students approached such tasks in order to: identify techniques they employed; gain an insight into the learning approaches adopted; and explore their perceptions of the assessment mode. E-assessments were primarily found to be used diagnostically to identify areas of strength and weakness and determine proficiency in answering questions within specific topics. A second function related to the achievement of outcome. This function was most commonly associated with participants from the School of Life Sciences who described their compulsive approach to trying to achieve high marks in their assessments which also carried a small summative weighting. This blurring of formative and summative assessments, similarly identified in previous research (Thelwall 2000), appears to encourage learning approaches which are contradictory to the task's formative goals. Instead of directing learning, students are found to be adopting trial and error approaches, paying little attention to the content. The findings suggest that the students appear to feel that this narrow learning approach is legitimised by the format of the assessment and the endorsement of academic staff that they should use as many attempts as necessary to achieve the required standard. The higher level of personal significance attributed to summative assessment tasks was apparent, with several students indicating that their preparation for such tasks was more intense and exam strategies more precise.

Exploration of the different approaches students adopted to answering questions highlighted issues relating to learning approach, assessment design and test anxiety. The students interviewed were all found to make use of deductive techniques to answer questions in their assessments in order to establish the correct answer. The application of this technique suggests a higher level of analytical skill than pure recall. Students were however found to be forced to resort to lower level answering strategies, such as guessing or looking for clues within the question, when this process of elimination was found to be ineffective or in question types where options were not provided to select from. Significant concerns were identified relating to the challenges facing students when asked to complete fill in the blank questions. A number of students highlighted the difficulty in identifying the specific answer required due to the range of possible alternatives available. The fairness and validity of these questions were questioned by the students who, in some cases, did not view these question types to be beneficial to learning. The need for transparency of marking and clarity of question wording is evident, as is an apparent need for flexibility (where appropriate) in answer acceptance.

While surface learning strategies were evident in the approaches described by a section of interviewees, a causal link can tentatively be established between adoption of this approach and the format of the assessment (low stakes summative allowing multiple attempts). Wider exploration of issues relating to learning approaches and learning styles highlighted two key points worthy of further discussion. Firstly, deep learning

approaches characterised by reflection, pursuit of understanding and wider research were evident in a number of the approaches described by students. Application of deep approaches appeared dependent on question format and quality of item construction with more carefully designed questions found to force students to read more widely and deviate from the standard techniques that they would employ. These findings support the conclusions drawn by Conole and Warburton (2005) that higher order learning approaches can be tested if careful consideration is directed at question design. The second key finding to emerge related to learning styles and the apparent benefits of the format for visual learners. The more visual nature of the assessment mode was identified by a small number of students as a factor which enhanced their ability to retain and recall information.

Aspects of assessment design including clarity of instructions, question wording and question weighting emerged as factors which affected student understanding and on-task processes. Where questions were found to be vague or ambiguous, students reported spending disproportionate amounts of time trying to interpret the meaning or trying to make visual judgements on the differences in spelling between distracters. Further, where questions were negatively phrased these were found to be a source of frustration and viewed as trick questions. These issues appear to be borne out of both pedagogical and technical limitations in the construction of specific questions. This finding supports previous claims by King and Duke-Williams (2001) pointing to the challenge faced by academics when designing online test items. The provision of staff development opportunities relating to effective question design may need to be extended or made mandatory for those academics who wish to use e-assessment within their courses. To ensure e-assessments engender the learning approaches academics desire, greater consideration may also have to be given to the way formative/low-stakes summative assessments are embedded within modules. A finding to emerge from interviews with a number of Life Science students suggested that they would adopt more active learning approaches if their assessments did not allow an unlimited number of attempts.

Analysis of the accounts revealed two points of note relating to the students' use of feedback provided in their formative e-assessments. Firstly, use of feedback was found not to be restricted to questions that were answered incorrectly. Students also invested time reviewing feedback for questions answered correctly to seek additional contextual information or, if the answer had been guessed, to establish the reason why that answer was correct. Secondly, quality of feedback was a clear point of controversy. The majority of students were found to value detailed explanatory feedback. The absence of feedback or provision of feedback that was insufficiently detailed was identified as a source of frustration among the students, who emphasised that this did not help them to improve their learning.

Indicative of the findings reported by O'Hare (2001) and Patterson and Bellaby (2002), students largely perceived formative e-assessments to be a valuable learning aid which could further and consolidate learning. A key finding to emerge however related to student concerns about the dangers posed by over-reliance on the use of e-assessment. Particular concerns were noted regarding preparation for, and ability to adapt to, new assessment formats when students progress to later years of study. Advantages of the format outlined by students included the more relaxing nature of the assessment than paper-based test and the scope for greater thinking due to the absence of the physical demand of writing. However, the potential for students to apply strategic measures in this form of assessment was viewed as a limitation, while a desire for more interactive learning opportunities was also identified.

Conclusion

Examination of student reflections on formative e-assessment revealed that the majority of the students used formative e-assessments to pro-actively identify areas of strength and weakness with a view to directing their revision. Students primarily adopted sequential approaches to the completion of the tasks, answering questions using largely deductive analytical techniques. Assessment design issues emerged relating to the use of unprompted question types, clarity of instructions and question wording, and the transparency and flexibility of marking. Students were consistently found to use feedback provided within formative e-assessments to enhance or reinforce their learning by identifying errors or misconceptions in knowledge. Concerns relating to variations in the quality of feedback provided within formative assessments emerged alongside evidence that students desired more detailed explanatory feedback. Where feedback was not provided or was insufficiently detailed, students were critical of this and made little or no use of that provided.

The phenomenological approach adopted in this study is limited by its inability to provide sufficient grain size to examine thought processes, but does provide sufficiently rich information to look at expectations and perceptions. The aim of mapping cognitive processes to student interaction with online tests and examinations is challenging and open to further investigation. Future research is also required to establish whether the tentative findings reported in this study are consistent across science-based subjects and future research may wish to examine student experiences in other disciplines and on the basis of variables such as age and gender. While acknowledging that generalisation from this research are limited, the study contributes to the discussion surrounding student perceptions of e-assessment. The findings indicate that academics should seek to ensure that e-assessments are aligned to learning outcomes, and that task goals are clearly communicated to students to encourage adoption of learning approaches appropriate for the task. In addition, institutions may wish to review existing training provision relating to e-assessment design to ensure that academics are equipped with the skills required to develop higher-order questions that are clearly worded and transparent in their marking. While the results of this research indicate that e-assessment does have the potential to enhance the effectiveness of student learning, effective assessment design and the need for transparency in all aspects of the assessment process are shown to be important determinants of the quality of learning engendered.

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