

QUALITY MANAGEMENT AND ASSURANCE IN ICT-INTEGRATED PEDAGOGY

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INTRODUCTION AND SCOPE

This is an overview for policy-makers at state, institutional and departmental levels. It deals with quality management and assurance (QA or benchmarking) issues connected with the use of ICT-integrated pedagogy (equated to e-Learning).

Education is a holistic process and all its components are interdependent. Policies for e-Learning and QA cannot exist in isolation, resulting in a huge range of scenarios. In a short brief it is only possible to indicate some of the approaches that have been adopted, but principles will be suggested to help in further cases.

THE CONTEXT

ICT as a catalyst for change

The potential of ICT-integrated pedagogy to transform educational theory and practice has been widely recognised, but institutions have been slow to make major changes for economic, practical and cultural reasons. The invention of the World Wide Web marked the beginning of a significant shift, but the basic model has been ‘horseless carriage’ style development, meaning harnessing new technologies in the service of existing theories of learning and knowledge. Although the methodology of QA in a radically transformed educational world is beyond the scope of this brief, all QA procedures should include an assessment of the extent to which improving innovations are being sought.

Educational sectors

Pedagogy – the method and practice of teaching – is nowadays applied to almost all of Shakespeare’s seven ages of mankind. Although in our connected world the boundaries are becoming increasingly blurred, these ages will be bundled into three overlapping stages: continuing (or further) education including vocational training, higher education (HE) at university, and school education (primary and secondary).

QA policy-making

‘Quality management and assurance’ (QA) is taken to mean the process of ensuring that educational systems, establishments, practices and resources are ‘fit for purpose’. QA is well established in education if only through the process of examinations and assessments. In addition most countries have a system for certifying educational organisations.

We must know what the ‘purpose’ is and decide what we mean by ‘fit’. In principle each educational sector and each subject could have its own purposes and fitness criteria, but usually there will be a national or regional context in which many aspects will be determined. For example, if there is to be a radical change in national educational policies catalysed by ICT, a high level of public consensus will be needed.

Policy-makers will often be constrained by policies made elsewhere. At state level the policy-maker will need an international perspective and issues are likely to be very general, whilst at a departmental level the scope for policy-making is likely to be restricted to course-specific detail. There may however be some institutions whose prestige and independence is such that they could implement major changes without referring to higher authorities. Policy-makers may want to encourage some degree of such experimentation as there can be no progress without it.

Modes of e-Learning or ICT use

Educational practices are built from a variety of components including teaching methodologies, content resources such as books and e-Learning materials, infrastructure such as classrooms and ICT equipment, state and regional policy-making, external training support, assessment, and internal institutional practices. QA should in theory apply to all components. The most important factor however has to be the teachers who collectively and individually blend all these components together to deliver teaching to their students. Their engagement in the process is essential. QA procedures should also be aimed at describing if and how teachers and authors change their practice when adopting ICT-integrated pedagogy.

Modes and methodology of QA

It is only since e-Learning has been taken seriously at institutional and state levels in the 1990s that generic reviews of QA methodology have been published. In the USA, the Institute for Higher Education Policy published its paper 'Quality on the line' in 2000¹. This focuses on Internet-based distance education.

More recently, in 2009 the UK's Higher Education Academy published 'Transforming Education through Technology Enhanced Learning'. Although aimed at Higher Education, and the UK in particular, it contains much information of general relevance. In chapter 7, Bacsich (2009²) reviews benchmarking methodologies used in UK universities, and references parallel work in New Zealand, Australia, Sweden and EU based organisations such as the European Foundation for Quality in e-Learning (EFQUEL)³. Typically these methodologies specify sets of criteria which are scored by evaluators (see Bacsich 2009 for examples). They differ mainly in how the criteria are set and the ways in which the scores are arrived at. They are all outcome-based, and do not prescribe how a project should be set up or e-Learning materials developed.

If a policy-maker has control of an e-Learning programme, then prescriptive QA is possible, and guidelines can be laid down in advance. A QA review will then check to see that the guidelines have been followed.

Limitations of QA and the adoption of new technologies

There is an inherent tension between the processes of QA and the encouragement of pioneering innovation, for which pre-set QA criteria may not exist. It is likely that every pioneering project would in its early stages have scored badly on a pre-existing QA review. Not every innovation succeeds, but that is not an argument against innovation.

Major planned innovations will involve several phases such as needs assessment, requirements definition, definition of the new functions, design and plan of change, implementation, evaluation, etc. In each phase QA is required if quality has to be built into the system from the very beginning, providing a kind of formative assessment of project progress. This assumes that the form of the innovation has been foreseen, and in turn this usually implies prior experience. Impacts from new developments such as Web 2.0 are likely to be emergent and arise in unforeseen ways. It could be counter-productive to cramp their style by imposing too rigid a set of formative QA criteria. Once a new system, or even a whole new paradigm, has been invented it should be evaluated to see whether the claims made for it can be substantiated.

OVERVIEW: EDUCATION IN SOCIETY

State-level policy-makers will set the scene for how institutions under their control react to the opportunities brought by e-Learning. The policy might be for radical change, for gradual improvements in increase range and quality, or for shifts in emphasis between various sectors.

Once an overall policy is in place, consultation with educators and wider public interests should then lead to specific policies for the role of ICT and e-Learning, and criteria against which their success can be measured. These may be different for each educational sector. These policies will determine the parameters used by policy-makers at other levels and by those carrying out QA exercises.

THE CONTINUING (OR FURTHER) EDUCATION SECTOR

Continuing education and lifelong learning⁴ have long existed mainly for vocational development in the form of apprenticeships, professional qualifications, correspondence courses, etc. The European Union made a commitment in the Treaty of Rome⁵ (Articles 149 and 150) to support the increased development of quality lifelong learning. ICT supported learning has obvious advantages for this sector because it allows for distance education.

Distance learning is potentially of great significance in countries such as India, Africa and China where there is a widely dispersed rural population badly in need of more educational resources (see for example Cecchini and Scott 2003⁶, Farrell and Isaacs 2007⁷, Trucano 2012⁸).

The worldwide growth in demand for lifelong learning has led many universities to extend their programmes into continuing education, blurring the traditional boundaries between these sectors. Such programmes were partly motivated by the need to increase fee income, but this model received a strong challenge when MIT announced its Open CourseWare⁹ programme, in which materials are freely available on the MIT website¹⁰.

Further blurring has resulted from partnerships between companies and universities. For example, the University of Washington's Professional and Continuing Education Program¹¹ has a range of courses in partnership with the Boeing Aircraft Corporation. Other companies have become providers of online learning materials, for example, Microsoft Learning¹².

All this diversity means that the only practicable way for state level policies to influence QA in continuing education is to focus on outcomes. This is the policy of the European Union. See, for example, the Leuven Communiqué (April 2009)¹³ (part of the so-called Bologna process) as a result of which the European Quality Assurance Framework (EQAVET¹⁴) was set up. This addresses complete courses or programmes and does not make ICT specific policies. The evaluation criteria may however include whether appropriate and effective use of ICT has been made. The Bologna process is not confined to EU countries: the Russian Federation has, for example, adopted policies (AKKORK¹⁵) consistent with Bologna (see also¹⁶).

THE HIGHER EDUCATION SECTOR

In contrast to the Continuing Education sector, HE is usually delivered through state funded and/or regulated bodies, mainly universities, allowing QA conditions to be specified. Independent universities also usually take great care to safeguard their reputations. Universities are mainly self-regulating, so the state level policy-maker is likely to use carrot-and-stick strategies, such as launching special programmes with funding for advancing the use of ICT (carrot), and setting target criteria to be used when the institution is inspected, ranked or funded (stick).

Much work has been done by educationalists who have introduced ICT techniques on their home ground, then gone on to evaluate what they have done, and published research papers. There are many journals, such as 'Computers and Education'¹⁷, 'Research in Learning Technology'¹⁸, 'Australasian Journal of Educational Technology'¹⁹. Such research provides a good measure of post-hoc or summative QA. By contrast, agreed codes for prescriptive QA are hard to find, but see Bacsich (2009) referred to above.

HE institutions have pioneered virtually all modes of ICT use, but it is very likely that the dominant use of ICT by HE students is for e-mail and Internet access, and this needs to be reflected in QA criteria.

THE SCHOOL EDUCATION SECTOR

It is unusual for the schools sector to be involved in authoring courseware. If economic factors permit, it is more likely that the sector will have some kind of infrastructure (such as a school website), and make use of existing courseware. There will be exceptions, such as when an educational courseware developer or researcher involves a school in a partnership.

Sector blurring can occur when universities become involved in the school sector. This could be through outreach programmes, such as the University of Cambridge's Millennium Mathematics Project²⁰, or near-commercial ventures, for example, the SCHOLAR programme²¹ from Heriot-Watt University aimed at secondary education.

In this sector the institutional prescriptive QA policy will be very similar to the process used for selecting text books and other resources, relying on reviews, feedback, and external advice. Summative QA policy will be integrated into the procedures for QA of the entire school's performance. There may be specific QA criteria laid down for ICT by regulating bodies. For example, there may be a National Curriculum and it may include specific targets relating to ICT skills.

MODES OF USE OF ICT

Modes of use of ICT are often blended together. For example, courseware may include various forms of assessment. There are some overall themes for QA in e-Learning that apply in nearly all cases discussed below:

- accuracy of content
- provision for disability access (ICT is more often an enabler of access than a barrier – ‘talking textbooks’, for example)
- security of personal data
- technical robustness
- usability and human-computer interface (HCI) issues
- exam room supervision and facilities issues

Courseware content

When an e-Learning package attempts to teach something, it will be called courseware. It could be said to be the ICT equivalent of the textbook, but of course it should take advantage of capabilities of ICT that are not possible in printed text. Here are some examples of skills or qualities that courseware often attempts to impart, often blended together:

- general academic learning
- particular mental skills – such as language, arithmetic, accountancy
- practical skills – e.g. driving test, pilot’s licence, medical qualifications, vocational qualifications
- personality qualities, such as leadership, innovativeness, empathy

QA for courseware must include the same criteria as would be used were ICT not being used. Criteria need to be specified to determine whether learning objectives are being achieved. Some criteria can be objectively assessed (such as arithmetic skills), but others require subjective judgement (such as ‘leadership qualities’). ICT can often be used to assess the objective criteria, but human judgement is needed for subjective cases.

QA should address the question of whether e-Learning can achieve wider education goals than specific attainment targets. For example, does a rigid target-regulated system suppress creativity and demoralise some able students? Or does e-Learning allow for some individualisation that helps to motivate pupils better than whole class teaching?

More advanced courseware designs make use of facilities that only ICT can offer, especially interactivity and interconnectivity, and will usually include some formative assessment. The policy-maker may want to include in QA criteria some measure of how well innovative possibilities are exploited.

Computer managed learning

This is often delivered through a 'Virtual Learning Environment' (VLE), also known as Course Management System (CMS), or Learning Management System (LMS). There are several proprietary products and there are Open Source systems like Moodle²² and Bodington²³. A VLE allows the student greater flexibility to study in any place where there is a network connection and at any time, but the medium has also evolved to help teachers and lecturers set and mark course assignments, keep track of the progress of individuals, and make course materials available.

The QA focus for computer managed learning is likely to be on the quality and accuracy of the feedback, how usable the system is from both the teacher's and student's points of view, system security and reliability, and whether the system and the way the institution uses it enhances the quality of teaching and at what costs, both direct and indirect such as staff time.

Formative and summative assessment

Assessment can be categorised on a scale from 'high stakes' to 'low stakes', according to the consequences of the result to the candidate. University entrance exams, for example, are usually considered high stakes. QA criteria should be set appropriately.

Assessments can also be categorised on a scale from 'objective' to 'subjective'. For example, a spelling test is objective, but an essay about a novelist cannot avoid subjectivity in marking. ICT is ideally suited to objective question marking, and the most popular format is some form of multiple choice. There are many types of multiple choice questions (MCQs) and the QTI standard (see the section 'Technical QA' below) attempts to cover those in common use. Advances in knowledge and language processing techniques are leading to systems that can be used for more subjective questions. An example is e-Rater²⁴ from ETS. Although agreement with human marking is as good as agreement between human markers, there is controversy about the use of such systems.

QA policy towards using ICT in assessment will need to address some human-computer interface (HCI) issues. These go further than straightforward usability issues, especially for high stakes assessments where it needs to be demonstrated that the medium (for example, ICT vs pen and paper) of assessment does not affect the outcome. There may be deeper academic issues too: 'what you test is what you get', so QA criteria should ask whether a course is being unduly influenced by assessment considerations. For example, if a course director replaces descriptive essay type questions with objective questions in order to save staff costs, does that adversely affect the quality of the course?

Item banking and adaptive testing

Item banking is the process of building and maintaining a library of test items (exam questions) in order to re-use them by recombining them to build complete tests of controlled difficulty. It is most often applied to objective test items because 'Item Response Theory' (IRT) based on the seminal work by Rasch²⁵ provides a precise mathematical model of difficulty. Each item, however, has to be 'pre-tested' by a significant number of representative candidates in order to determine how difficult the item is. The whole process of calibration and test construction is only made feasible through the use of ICT. A test constructed in this way could be paper-and-pen or computer-delivered.

An obvious concern when item banking is used for high stakes testing is security. Nothing can stop candidates remembering test questions and writing them down after a pre-test or a real exam. This drawback is mitigated by building up very large banks of thousands of items.

The greatest advantage to test quality is that the process eliminates 'unfairly hard' exam papers. There are other advantages such making it possible to set papers more frequently or even on demand. Item banking also makes *adaptive testing* possible: by adjusting difficulty dynamically a test can be made suitable and fairer for a very wide range of abilities.

Specific QA issues that arise here are item security and the quality of the calibration process. Note that IRT makes it possible to incorporate self-checking calibration procedures. There have been reports of cheating being detected by such procedures.

E-Portfolios

Many courses with a vocational or skills side to them require students to build up a portfolio of work. The portfolio may form part of the work on which the student is eventually assessed, or it may be used for career purposes (at a job interview for example). There are clearly advantages if these portfolios can be electronic or fully online. QA criteria will be needed for usability and security.

Innovative ICT uses

We have already remarked on the tension between prescriptive QA criteria and the desirability of innovating. Here are a few examples.

- Peer-to-peer (P2P): P2P learning, and more controversially P2P assessment, involve handing over some aspects of the teaching and/or assessment process to the students themselves. An example is Nortcliffe and Middleton (2011)²⁶.
- Virtual experiments and field trips: real experiments and field trips can be expensive and time-consuming, limiting their number. Some of the skills can be learnt through simulations. For example, see Bioscope and Experiment Simulator²⁷.
- Computer games: Marc Prensky (2001)²⁸ and others advocate that computer games can teach knowledge and skills, though the games players may find themselves learning unwittingly. Mitchell and Savill-Smith (2004)²⁹ have reviewed the literature on this.

Projects such as those listed above, and many others, show that major shifts are possible through a series of smaller evolutionary changes. Possible paths from 'horseless carriage' innovations to more radical change can be envisaged (for example, Raikes and Harding 2003³⁰). As experience of innovative uses grows, it will become possible to devise appropriate QA criteria for future or retrospective use.

TECHNICAL QA

Although educational aims must be uppermost, policy-makers will want to audit the technical quality of e-Learning systems and may want to take account of these issues when defining QA criteria for commissioning or purchasing courseware.

Usability and HCI

Usability evaluation is the subject of recent research (e.g. Adito et al. 2005³¹), but an objective set of agreed criteria is hard to define.

Interoperability

Interoperability is an ‘under the bonnet’ engineering standard and should not affect the user’s experience, but from the policy-maker’s point of view, it is important as it increases the flexibility of use of the courseware. For example, if the licence to use a piece of courseware has been purchased to run on one particular VLE product, but an institution decides to switch to a rival VLE, the purchased courseware ought to be able to run on the new VLE. The main organisation that provides standards for this is the IMS Global Learning Consortium³². IMS-GLC has sponsored a standard for online assessments called QTI³³ (Question & Test Interoperability). Another standard that is often required by the US Department of Defence contracts is the ‘Sharable Content Object Reference Model’ (SCORM³⁴).

Examination conditions

Assessment using ICT raises many issues that need to be the subject of QA, especially for high stakes assessment, such as equipment reliability, security, exam room management, etc. There is now an international standard covering these aspects (ISO/IEC 23988³⁵).

CONCLUSION

Although complex in detail, quality assurance procedures for ICT-integrated pedagogy all come down formulating a clear policy, then to deriving QA criteria based on best practices. Particular regard should be paid to the experiences and professional development of teachers and lecturers, encouraging the adoption of advantageous innovation, and avoiding the trap of suppressing innovation through the application of over-rigid criteria.

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'Quality management and assurance' (QA) is the process of ensuring that systems, establishments, practices and resources are 'fit for purpose'. Each educational sector and each subject could have its own purposes and fitness criteria. Education is a holistic process and its components are interdependent, so that ICT-integrated pedagogy (or e-Learning) cannot be quality-assured in isolation. Together these factors result in a complicated range of scenarios. Maintaining current educational standards requires that most current QA outcome based criteria will carry over into e-Learning practice. Rather than recommend precise policies, the Policy Brief aims to draw attention to some of the new ICT-linked issues involved that require additional QA criteria. One of the most important issues is the impact on the professional development of teachers and lecturers. Another is the potential of ICT to enhance education, requiring flexibility to avoid suppressing innovation through the application of over-rigid criteria.

Author: Robert Douglas Harding

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8 Kedrova St., Bldg. 3
Moscow, 117292
Russian Federation
Tel: +7 (499) 129 29 90
Fax: +7 (499) 129 12 25
E-mail: Liste.info.iite@unesco.org
<http://www.iite.unesco.org>

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