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Academic Practice in Aligning Curriculum and Technologies

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***Abstract*: Aligning the curriculum elements of learning outcomes, teaching activities and assessment tasks is one of the strategies available to academics to help them adapt to the needs of diverse and ever-changing cohorts of students in technology-rich environments. While curriculum alignment is commonly represented in the literature, little is known about how academics approach this task of designing an aligned curriculum. A two-phase study was undertaken in an Australian research-intensive university to investigate the learning outcomes academics intend for their students, how these relate to the assessment strategies and choices of educational technologies. The results suggest that while academics intend higher order learning for their students, the assessment strategies they choose and the technologies they select may work to encourage lower order outcomes rather than targeting higher order processes.**

***Keywords*: educational technologies, assessment, curriculum alignment, higher order learning, academic practice**

I. Introduction

In their book, Teaching for Quality Learning at University [1], Biggs and Tang suggest that alignment between intended learning outcomes, teaching activities and assessment tasks is central to improving the learning experience of students. These themes of consistency and alignment in curriculum design are reiterated by others [2], [3], [4], including those with a more specific focus on the importance of assessment in driving student learning [5], [6], [7]. Some researchers, however, suggest that while universities profess to intend higher order outcomes for their students, assessment practices predominantly target lower order outcomes [8]. Bryant and Clegg [9] recently lamented that the focus of much of our assessment is on 'testing knowledge and comprehension and ignores the challenge of developing and assessing judgments'.

The results of a study by Samuelowicz and Bain [10] suggest that academics' design of their assessment strategies may be influenced by their perspectives about the role of assessment rather than the learning outcomes they intend for their students. They found that academics with an orientation toward 'reproduction' were likely to require students to demonstrate their knowledge of, for example, lecture content. Those academics who related assessment to students' capacity to integrate, transform and use knowledge purposefully were more likely to design tasks requiring higher order tasks such as evaluation and creation of novel solutions.

Researchers into the affordances of educational technologies have also advocated this alignment. Jonassen and Reeves [11] were among those who saw computers as having the potential to transform learning and assessment to a focus on higher order rather than lower order learning outcomes. Examples include learners using spreadsheets to make and test assumptions, manipulate variables and analyse outcomes and databases where learners systematically organise and classify data [12]; all higher order skills residing in the bottom right hand corner of Anderson et al's [13] taxonomy for learning, teaching and assessing, depicted in Figure 1.

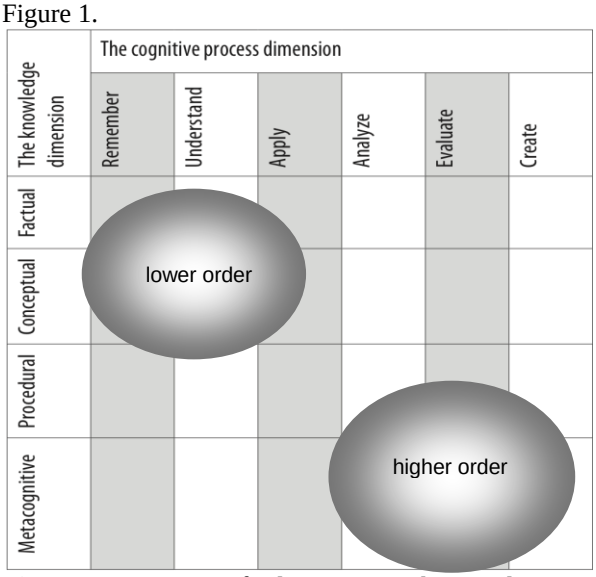

Figure 1. Taxonomy for learning, teaching and assessing

The potential for technologies to support the design, delivery and administration of diagnostic, formative and summative assessment are well documented in the literature [14], [15], [16], [17], [18], [19]. Despite these examples, assessment has been an area slower to adopt new technologies than other aspects of teaching and learning [20], [21]. This slow uptake may be partly due to the preconception that technology-based assessment has been focused largely on developing objective tests [22] which primarily target lower order skills [23], [24]. Concerns about robust delivery, security and authentication may also pose considerable barriers to their widespread uptake for summative assessment [25] along with perceived complexity of many of the tools. While databases and spreadsheets do offer the potential to support higher order learning, Burns [26] acknowledges that the complexity of learning how to use these tools and embed them into learning contexts may prove a barrier for many teachers. This theme is reiterated by Pirnay-Dummer et al [27] in suggesting that if tools are not accessible to practitioners in the field, 'they will only be used in prototype and research settings but not in the real world applications'.

Web 2.0 and social networking tools have emerged as having potential to help overcome these technology barriers, in that they are designed to be easy to use and offer read write capabilities. For example, tools such as blogs and wikis have the potential to capture both the processes of student learning and the final artifact to be submitted, in collaborative or individual contexts [28], [29], [30], [31], [32]. Shepherd raises the possibility that these technologies could enable better assessment of 'aspects of learning that have proved difficult to assess using more conventional means' [33].

Abel [34] raises the importance of alignment in applying learning technologies; if the aim is to support the development of higher order thinking, then technologies and assessment task requirements must be aligned with this aim. This theme is also recognised by Russell, Elton, Swinglehurst and Greenhalg [35] who caution that although online collaborative activities such as online discussions can benefit the development of academic skills, the technology itself does not automatically trigger this development. In a study of group participation in a discussion forum, Ma [36] reported that the tool supported the assessment of higher order thinking to only a very limited degree; textual analysis demonstrated that three of six groups studied did not move into the types of interaction coded as higher order learning.

Given this consistency in advocating alignment between learning outcomes, assessment strategies and educational technologies, this study was designed to examine whether this alignment was evident in academic practice in curriculum design.

II. The Study

This study was undertaken at an Australian research-intensive university to explore:

- The types of outcomes teaching academics envisaged for their students;
- The alignment of assessment strategies with these intended outcomes; and
- The selection of technologies in relation to these assessment strategies.

An exploratory mixed methods approach [37] was used, with an initial survey distributed to gather baseline data and a series of in-depth interviews conducted to explore the issues emerging from the survey. Due to space limitations, this paper reports on Phase Two of the study, the in-depth interviews. More details about Phase One are available in a prior publication by McNeill, Gosper and Hedberg [38] although some information is provided in the next section to contextualize Phase Two.

2.1 Phase One – survey

Phase One of the study involved an initial survey to gather baseline data about curriculum design with technologies across campus. The initial survey posed a series of questions about learning outcomes, assessment methods currently used and online tools used for assessment. The convenors of online units using the University's Learning Management System (LMS) were invited to participate in the survey. Invitations were emailed to a total of 482 unit convenors, with 133 responses (27.5%).

The qualitative analysis tool NVivo, making use of a schema based on Anderson et al's Taxonomy [39], was used to code the types of learning outcomes the unit convenors intended for their students. There were examples in the sample of targeting higher order outcomes such as evaluation, creativity and metacognition, however most were coded as targeting 'understanding concepts'. The findings indicated a lack of a shared language about learning outcomes and there was insufficient information given in the outlines to code some outcomes.

Responses about assessment strategies showed a predominance of assignments and exams, with insufficient information available in most cases to determine whether these strategies were aligned with the learning outcomes. In the cases where academics indicated that they had difficulty assessing some outcomes, these were often related to generic skills such as communication or the skills to work in a team.

The use of technologies for assessment indicated a predominance of online assignment submission, discussion forums and online quizzes, in keeping with previous studies [40]. Although the reasons given for the selection of these tools were most frequently coded as 'to enhance student learning', further investigation was required to determine whether these technologies were selected to match the intended learning outcomes or integrated as part of an aligned curriculum. Phase Two of the study was undertaken to explore the 'real' nature of learning outcomes that were listed and the alignment of these outcomes with assessment strategies and technologies in the context of specific units.

2.2 Phase Two – in-depth interviews

The next phase of the study was designed to explore the issues emerging from Phase One in the specific teaching and learning context of the units. The initial survey in Phase One provided insights from across campus but there was insufficient detail to establish a clear picture of some aspects of the curriculum design of the respondents' units.

In-depth interviews enabled a more detailed exploration of the curriculum context of the units however results were not intended to be generalisable. They enabled a greater understanding of how individual academics intended their learning outcomes, structured their assessments and used technologies.

In Phase One of the study, respondents were invited to supply their contact details if they were willing to participate in subsequent phases. Of the 133 respondents, 51 supplied

their contact details. From these respondents, ten were selected to be interviewed for Phase Two. These interviewees were selected on the basis of their survey responses about their units to cover maximal variation across disciplines, enrollment modes and levels of units.

The interviews were semi-structured, using a series of questions designed to explore issues from Phase One as a guide. Of particular interest were:

- whether the outcomes convenors envisaged for their students differed from those stated in the unit outlines;
- which assessment strategies were currently used and how they related to the learning outcomes; and
- how specific technologies were used to support assessment.

To provide a more comprehensive understanding of the convenors' decisions about their curricula, their perspectives on the role of assessment and feedback in teaching and learning were also explored. The interviews were recorded and transcribed for greater accuracy in analysis against the coding schema developed for each question, using Anderson et al's Taxonomy [41] and Samuelowicz and Bain's Orientations Toward Assessment [42] as frameworks. Individual interviews were written up using a template developed from the initial analysis of the results, to provide a more holistic approach to analysis.

III. Results

In the interviews, convenors were asked to describe the types of outcomes they had stated in their unit outlines. Table 1 illustrates how the outcomes were coded against Anderson et al's [43] taxonomy for learning, teaching and assessing. Percentages indicate how many of the interviewees' stated outcomes relate to each category.

Table 1. Stated learning outcomes

The knowledge dimension	The cognitive process dimension					
	Recall	Understand	Apply	Analyze	Evaluate	Create
Factual						
Conceptual		A B C D E F G 70%	A C D F G H J 70%	C I J 30%	I 10%	
Procedural		A B C D F G 60%	B C D F G H 60%	C I J 30%	H I 20%	
Metacognitive			H 10%			

The interviewees were then asked to explain the types of learning outcomes they intended for their students, which were then coded against Anderson et al's framework. The results are presented in Table 2.

Table 2. Intended learning outcomes

	Recall	Understand	Apply	Analyze	Evaluate	Create
Factual		A D 20%	A D 20%	C 10%		
Conceptual	A D 20%	A C D F G J 60%	A C D F G H J 70%	A C D G J 60%	J C D G 40%	C D J 30%
Procedural		A C F G 40%	A C D F G H J 70%	A C D G H J 60%	A C D G H J 60%	A C D G H J 60%
Metacognitive			H 10%	A D H 30%	H 10%	

When the intended outcomes were analysed using the framework, they covered a much greater range on the matrix than those stated in the survey responses. Most interviewees described higher order intentions than suggested by the wording of the outcomes stated in the unit outlines. For example, the learning outcomes in interviewee G's unit outline were coded as requiring students to understand and apply concepts and/ or procedures. When asked to explain what she intended for her students, she described processes that were coded as applying, analyzing, evaluating creating concepts and/or procedures.

This gap between their intentions and those expressed in their outcomes was recognized by some of the interviewees. When Anderson et al's [43] framework was discussed in the interviews, many of the convenors indicated that their intentions were more towards the bottom right hand area of the framework (See Figure 1), yet acknowledged that the unit outlines were directed toward the top left hand sections. Interviewee G acknowledged that, although important, higher order outcomes on the knowledge dimension were lacking in her current curriculum:

I think the procedural and metacognitive are the areas where we don't really do a lot.

The interviews also shed light on the confusion some convenors felt about how to express the outcomes. One of the interviewees (B) indicated that she had not engaged with how to construct the outcomes and others acknowledged that the stated outcomes were not an accurate reflection of what was required.

3.1 Assessment and alignment

In the interviews, the academics were asked to describe their assessment strategies and how they related to the unit outcomes. These were then coded against Samuelowicz and Bain's [44] categories for orientation towards assessment. Table 3 summarises these results.

Table 3. Convenors' orientation toward assessment

Assessment Orientations	Respondents
Assessing students' ability to reproduce information presented in lectures and textbooks	C, D, E, G
Assessing students' ability to reproduce structured knowledge and apply it to modified situations	C, E G, H, J
Assessing students ability to integrate, transform and use knowledge purposefully	A, B, C, D, F, G, H, I, J

When the assessment strategies were examined in relation to these intentions, there were examples of alignment. Interviewees C, D, G, and H described tasks such as quizzes where students reproduced information and applied it to structured situations.

In some cases, the interviews provided opportunities for the convenors to explain the links between the intended learning outcomes and the assessment strategies which were not obvious initially. For example, interviewee H described a capstone unit where final year students were required to integrate their previous learning and use it purposefully in a new context (third row in Table 3). The others in this category from the table above assessed the end product but not the process. In another example, interviewee G described the purpose of an assessment task where students are required to demonstrate research skills to develop an annotated bibliography:

So it's not like giving them their nugget of knowledge that they take with them because what we know (about the specific discipline) in 10 years times will be quite different to what we're teaching now. It's also to challenge their ideas….

While there were examples of alignment between assessment strategies and outcomes, there were also several examples of apparent misalignment between what the convenors intended for their students and how they had structured the assessment items. For example, all the convenors described the outcomes they intended as higher order when discussing the Anderson et al's [45] framework, yet there were few examples of where their intentions matched the assessment strategies for eliciting the outcomes. Interviewee A intended the unit to elicit higher order outcomes from the students, yet analysis of the assessment tasks suggests that in fact they required students to apply concepts and procedures in structured case studies.

Assessment emerged as a problematic issue for some of the interviewees. For example, interviewee J described the challenge of designing assessment tasks to encourage students to move beyond simply understanding or applying theories or concepts. Tasks targeting higher order skills such as analysis, evaluation and creating alternative solutions were seen by this interviewee as requiring more time for marking and giving individualised feedback. Three interviewees (C, E and H) described challenges relating to the time required for negotiating with individual students to engage them in authentic assessment tasks with higher order targets such as creativity.

Metacognition seemed particularly problematic. Three of the convenors (C, D and G) articulated that they wanted to assess metacognition but acknowledged that this was difficult to design into the curriculum. Interviewee J acknowledged having attempted to design metacognitive reflection into his assessment, but that *identifying a good reflection from a bad one was difficult* because criteria were not stated.

Interviewee A's assessment included a metacognitive element in that students needed to reflect on what worked well and what they would change next time.

Scaffolding toward expertise emerged in some responses. Interviewees C and G's comments were coded into each of the categories, suggesting that while they considered it important for students to be able to integrate knowledge and use it purposefully, the foundations of being able to reproduce the foundation concepts and apply them to structured contexts were also part of the scaffolding process.

Assessing graduate capabilities, in particular in relation to procedural knowledge was problematic for some interviewees. From interviewee G's perspective:

I guess our procedural is things like accessing databases or those sorts of things but it's not actually (assessed). Even though we might have nice things (in the learning outcomes) about interacting sensitively, we don't actually evaluate that.

The graduate capabilities prioritized by the convenors also emerged in some responses. Interviewee J prioritized academic writing skills as one of the skills he tried to encourage in his students and provided comprehensive feedback to inform students' subsequent tasks. The feedback given to individual students on their submitted, summative tasks was designed to guide their learning but no scaffolding processes during the unit were described.

When asked about the role of assessment, the interviewees described it as an important part of the curriculum and all described themselves as using it to guide student learning and to reward student effort. Table 4 summarises how the responses were coded.

Table 4. Convenors' perspectives about the role of assessment

Category	Respondent
Making students study	A, D
Rewarding effort	C, D, E, G, H, J
Guiding students' learning	A,B,C,D,E,F,G,H,I,J

Examples from each of these categories include the use of quizzes to ensure that students had done the required readings before attending classes (A), coded as *Making students study*, and allocating marks for participation in discussion forums (E) as *rewarding effort*. Interviewee D was an example of convenors with beliefs relating to all the categories, since she used quizzes to make students study and many of her comments about the types of feedback she gives to students suggested that *rewarding effort* and *guiding students' learning* were also priorities.

While many of the interviewees' beliefs about the role of assessment were coded as *guiding student learning*, few indicated that they had designed their curriculum to in fact guide learning, for example using scaffolding during the unit. Rather than *creating*, most tasks were designed to reward the

application of procedures with only the High Distinction students rewarded for adding a creative element.

3.2 Technologies to support assessment

All but one of the interviewees used some form of technologies to support assessment. This is to be expected from a sample gathered in an online survey; those using the Learning Management System (LMS) and having contributed to an online survey are more likely to use these tools than other academics. Table 5 summarises how these uses of technologies for assessment were coded, based on Anderson et al.'s framework.

Table 5 – Technologies used to support assessment

	Recall	Understand	Apply	Analyze	Evaluate	Create
Factual	A - quiz D - quiz	A - quiz D - quiz G - quiz				
Conceptual	D - quiz	A - quiz E - forum G - quiz	D- wiki G - quiz H - forum	C- forum D - wiki J - quiz		
Procedural		H - forum	A - p/folio D - wiki	C - forum	H - blog	
Metacognitive			A - p/folio			

All of the interviewees used technologies to deliver at least some aspects of their units, for example, using the University's LMS to deliver content to students, such as readings, module materials or guides for project planning or report writing. Some of the convenors used technologies to support the administrative side of assessment and others used technologies for formative purposes to scaffold learning.

As can be seen from Table 5, the focus of these tools /strategies was predominantly on lower order outcomes such as the use of online quizzes or discussion forums to assess students' recall or understanding of concepts. There were, however, examples of technologies being used to assess higher order learning. One interviewee described the use of blogs (H) to capture students' evaluation of their own procedures in capstone unit projects and another (A) used an e-portfolio to capture student application of metacognitive processes.

Many of the uses of discussion forums as part of assessment seemed to target lower order learning. When asked what students were required to do to do well in these tasks, interviewee E described needing to put some of the key concepts into their own words and respond to the postings of other students. This is in keeping with her belief that assessment was to '*assess students' ability to reproduce information presented in lectures and textbooks* and *assess students' ability to reproduce structured knowledge and apply it to modified situations'.*

While some convenors did use social networking tools, in some cases these were used for capturing and assessing lower order outcomes such as applying procedures on the wiki, where students worked on a collaborative research project. Interviewee D indicated in the initial survey that she was concerned about assessing group work and described her choice of a wiki to quantify the different contributions of group members. Students were allocated marks based on the number of contributions they made to the group wiki-based task.

Some of the interview responses indicated a considered approach to choosing technologies to scaffold student learning. For example, interviewee A described the series of quizzes as designed with the primary intention of encouraging students to keep up with the content. The questions targeted students' ability to, for example, understand terminology and concepts. Interviewee D described structuring assessment tasks to require students to complete the readings prior to the lectures and tutorials because she intended that the sessions were interactive. Assessment questions focused on students recognizing terminology or understanding concepts. Not all the tasks were submitted for marks, but she was concerned that students could not move to higher order learning without a grasp of the *foundation* concepts. Those convenors who indicated that *making students study* was an important role for assessment used quizzes to this end. For example, interviewee G described her quizzes as rewarding student effort and described the questions as targeting lower order *understanding*.

Interviewee H's use of technologies demonstrated a focus on process; the use of the University's LMS to deliver scaffolding materials for students in dispersed locations (sometimes work-based) and others for assessment of process. She designed a series of tasks to guide students' learning towards a series of project deliverables. Drafts of, for example, project plans and progress reports, were submitted for feedback prior to the next stage being commenced. Interviewee H was the only interviewee who indicated that she used feedback to directly scaffold students' efforts in the subsequent tasks. The other interviewees, while intending higher order outcomes, designed the tasks to focus on the product of the assessment tasks rather than the process. Interviewee D described being impressed by a presentation on encouraging students to incorporate their feedback in the next task, yet described a concern about implementing this strategy in her teaching for fear of increased workload.

IV. Discussion

During the interviews, Anderson et al's [46] framework was explained and interviewees were asked to indicate where they considered the learning outcomes they intended for their students would be positioned on the grid. While all the convenors indicated higher order learning outcomes such as *analysis, evaluation* or *creativity*, these were not stated in the outcomes they articulated in their unit outlines, which typically focused on lower order outcomes such as '*understanding* or *applying concepts* and *procedures'*. One of the aims of this phase of the study was to explore whether this was because there was little higher order learning being targeted or whether it was that the outcomes in the unit outlines did not accurately reflect what went on in the unit. Many of the interviews suggest that the convenors' intentions for higher order outcomes were not clearly aligned with the curriculum design. It seems that there is a gap between the convenors intentions and the unit design.

The design of their assessment tasks did not always reflect convenors' intentions either. Assessment was acknowledged

by all interviewees as important to student learning, yet the assessment strategies are often targeted at lower order outcomes, which are easier to assess [47]. For many, the assessment strategies described in the interviews seemed more aligned with what Samuelowicz and Bain [48] describe as their beliefs about its role in teaching and learning rather than the intended learning outcomes. This was evident in the responses of academics who considered the role of assessment to include rewarding student effort. They were more likely to include strategies such as quizzes or discussion boards with a participation component in the assessment.

For some interviewees, there was apparent alignment between the stated learning outcomes and the assessment strategies, even if these differed from the intentions academics described toward higher order outcomes. The findings suggest that alignment is more likely with a focus on lower order outcomes. This may be due to the availability and ease of use of tools such as quizzes. Strategies for assessing higher order outcomes were not as well developed and there were few examples of tasks designed to focus on higher order processes.

Notions of scaffolding to enable students to develop mastery were raised by some of the respondents, but in most cases these were not included in the assessment tasks. The use of a portfolio in interviewee A's unit did require students to submit a series of tasks demonstrating their cumulative learning, however the tasks themselves required lower order thinking and were designed to assist students with keeping up with the content of the unit. Feedback was not provided.

The assessment of graduate capabilities was an issue for several respondents both in terms of assessment strategies and alignment with stated outcomes. Since graduate capabilities are often related to the development of processes and skills as well as addressing attitudes and beliefs, challenges arise when the focus of assessment is on an end product as opposed to the developmental process.

The academics' descriptions of their uses of technologies suggested that this is another area where there is a focus on lower order outcomes. Even where there were intentions of capturing higher order processes as well as outcomes, for example, evidence of group collaborative processes, in fact the descriptions of how the technologies were used suggests a gap between intentions and practice.

Many of the interviewees also demonstrated tendencies to rely on the technologies themselves [49] rather than the task design to elicit intended outcomes. Examples are discussion forums and wikis. Several of the interviewees included forums as part of their assessment, yet the task descriptions for postings and the elements assessed, such as frequency of posting, may encourage a focus on lower order rather than higher order thinking among students. The use of wikis was another example where there was apparent reliance on the technology to capture group work for assessment, yet the task was assessed using the number of postings rather than the quality of the postings and the extent to which participants contributed to higher order outcomes.

The occurrence of missed opportunity emerged as a theme from the study – academics had heard of technologies and many were keen to explore their uses, yet the underutilization of the functionality of the technologies meant that their potential was not achieved. The use of online quizzes without provision of formative feedback is an example. The literature suggests that feedback is most effective when it provides details on how to improve rather than whether a response is right or wrong [50] and tells the student what needs to be fixed or revised [51]. Especially with novice learners, such as those in units where convenors were concerned with foundation principles, Paas, Renkl and Sweller, [52] suggest that hints or worked examples can effectively reduce the cognitive load of learners. The quizzes used by interviewees A and G were included to help reinforce foundation principles, yet the accuracy of responses was verified without any further details.

Quiz tools' capacity to provide feedback on student performance was another missed opportunity for one convenor. Interviewee B's series of quizzes was designed to both encourage students to study and also to reward their effort but these were delivered on paper in class. She then manually marked and entered the results online and had analysed the data over several semesters to inform her own teaching.

For some interviewees, it seems that their beliefs about the role of assessment influenced their choice of technologies rather than their intended learning outcomes. Even if the intended outcomes were higher order such as analysis, evaluation or creation, most of the convenors saw assessment as rewarding student effort and this was reflected in their choice of technologies for use in their units. Examples include discussion forums where students were rewarded for consistent effort or quizzes encouraging students to keep up with the unit content.

V. Conclusion

The study was designed to explore academic perspectives about the types of learning they intend for their students and whether this is reflected in their practice. For example, while higher order learning is considered as one of the key graduate attributes by many universities, there are indications that this may be a cause of confusion for some academics. Many of those interviewed do intend higher order outcomes for their students, yet are unsure how to articulate these in a consistent way or how to design assessment tasks or technology usage to elicit these outcomes. There was little evidence of the interviewees using the principles underpinning higher order learning to inform their choice of assessment strategies and technologies.

These results will be used to inform a follow up survey, to see if these findings are replicated in a wider group. In order to overcome the problem of inconsistent use of the terminology used in the framework, additional descriptors will be provided reflecting the academics' language. This will help to establish a more accurate picture of academics' intentions, their assessment strategies and technology usage as well as their confidence in curriculum design to elicit their intended outcomes. Designed as a diagnostic tool, the survey will be delivered to academics to assist them in planning the alignment of their units and also inform ongoing professional development activities.

References

[1] J. Biggs and C. Tang, *Teaching for quality learning at university* (3rd ed.), Open University Press, Berkshire, 2007.

[2] D. Laurillard, *Rethinking university teaching: a conversational framework for the effective use of learning technologies* (2nd ed.) Routledge, London, 2002.

[3] P. Ramsden, *Learning to teach in higher education*, Routledge, London, 1992.

[4] L. Steffe & J. Gale (Eds.) *Constructivism in education*, Lawrence Erlbaum, Hillsdale, New Jersey, 1995.

[5] D. Boud Assessment and learning: contradictory or complementary? *In P. Knight (Ed.) Assessment for Learning in Higher Education, Kogan Page, London*, 1995a, pp. 35-48.

[6] G. Gibbs and C. Simpson, "Conditions under which assessment supports students' learning", *Learning and Teaching in Higher Education, 1, University Press, Gloucestershire*, 2005, pp. 3-31.

[7] S. Toohey, *Designing courses for higher education*, Open University Press, Buckingham, 1999.

[8] D. Boud and N. Falchikov, "Redesigning assessment for learning beyond higher education", *Higher Education Research and Development, 28, Taylor & Francis, Abington* , 2005, pp. 34-41.

[9] C. Bryan and K. Clegg (Eds.), *Innovative Assessment in Higher Education*, Routledge, Abington, 2006, p. 3

[10] K. Samuelowicz and J. Bain, "Identifying academics' orientations to assessment practice", *Higher Education Research and Development, 43, Taylor & Francis, Abington*, 2002, pp. 173-201.

[11] D. H. Jonassen and T. Reeves (Eds.), *Learning with technology: using computers as cognitive tools*, Macmillan, New York, 1996.

[12] D. H. Jonassen, C. Carr and H. P. Yueh, "Computers as mindtools for engaging learners in critical thinking", *Tech Trends, 43(2*), Springer, New York, Inc, 1998, pp. 24-32.

[13] L. Anderson, D. Krathwohl, P. Airsasian, K. Cruikshank, R. Mayer, P. Pintrich, et al. (Eds.), *A taxonomy for learning, teaching and assessing: A revision of Bloom's taxonomy of educational objectives*, Longman, New York, 2001.

[14] D. Charman, Issues and impacts of using computer-based assessments (CBAs) for formative assessment. In S. Brown, P. R. & & J. Bull (Eds.), *Computer-assisted Assessment of Students*, Kogan Page London, 1999.

[15] G. Crisp, *The e-assessment handbook*, Continuum International Publishing, New York, 2007.

[16] C. McLoughlin and M. Lee, "Personalised and self regulated learning in the Web 2.0 era: International exemplars of innovative pedagogy using social software", *Australasian Journal of Educational Technology, 26(1)*, ASCILITE, Australia, 2010, pp. 28-43.

[17] M. Cubric, "Using wikis for summative and formative assessment", *REAP International Online Conference on Assessment Design for Learner responsibility, Strathclyde, 29th - 31st May, 2007*.

[18] M. Jenkins, "Unfulfilled promise: formative assessment using computer-aided assessment", *Learning and Teaching in Higher Education, v1, University Press,*

[19] C. McLoughlin, "Broadening assessment strategies with information technology", *in S Naidu (ed.), Learning and teaching with technology: principles and practices, Kogan Page, London,* 2003.

[20] R. Byrnes and A. Ellis, "The prevalence and characteristics of online assessment in Australian universities", *Australasian Journal of Educational Technology, 22(1),* ASCILITE, Australia, 2006, pp. 104-125.

[21] R. A. Ellis and P. Goodyear, *Students' experiences of e-learning in higher education: the ecology of sustainable innovation*, Routledge, New York, 2010.

[22] D. J. Nicol and C. Milligan, "Rethinking technology-supported assessment in terms of the seven principles of good feedback practice", in C. Bryan and K. Clegg (Ed.), *Innovative Assessment in Higher Education*, Taylor and Francis, London, 2006.

[23] G. Crisp, *The e-assessment handbook,* Continuum International Publishing, New York, 2007.

[24] M. Northcote, "Online assessment in higher education: The influence of pedagogy on the construction of students' epistemologies", *Issues in Educational Research, 13,* Institute for Educational Research, Australia, 2003.

[25] G. Crisp, *The e-assessment handbook*, Continuum International Publishing, New York, 2007.

[26] M. Burns, "Tools for the mind", *Educational Leadership, v63, i4,* Association for Supervision and Curriculum Development, MA, 2005, pp. 49-53.

[27] P. Pirnay-Dummer, D. Ifenthaler and M. Spector, "Highly integrated model assessment technology and tools", paper presented at the *International Conference on Cognition and Exploratory Learning in Digital Age, IADIS*, Rome, 2008, p. 3

[28] M. K. Boulos, I. Maramba and S. Wheeler, "Wikis, blogs and podcasts: a new generation of Web-based tools for virtual collaborative clinical practice and education", *BMC Medical Education, 6(1),* Springer, London, 2006.

[29] D. Churchill, "Blogs, other Web 2.0 technologies and possibilities for educational applications", paper presented at the *4th international conference on Informatics, Educational Technology and New Media*, Sombor, Serbia, 2007.

[30] K. Gray, C. Thompson, J. Sheard, R. Clerehan and M. Hamilton, "Students as Web 2.0 authors: Implications for assessment design and conduct", *Australasian Journal of Educational Technology, (26(1)*, ASCILITE, Australia, 2010, pp. 105-122.

[31] J. Hewitt and V. Peters, "Using wikis to support knowledge building in a graduate education course", paper presented at the *World Conference on Educational Multimedia, Hypermedia and Telecommunications (EDMEDIA),* Chesapeake, VA, 2006.

[32] C. McLoughlin and M. Lee, "Personalised and self regulated learning in the Web 2.0 era: International exemplars of innovative pedagogy using social software", *Australasian Journal of Educational Technology, (26(1)*, ASCILITE, Australia, 2010, pp. 28-43.

[33] K. Shephard, "E is for exploration: Assessing hard-to-measure learning outcomes", *British Journal of Educational Technology, v40, i2*, Wiley-Blackwell, CA, 2009, p. 386.
[34] R. Abel, "Innovation, adoption and learning impact: Creating the future of IT", *Educause Review, 42(2)*, Educause, Boulder CO, 2007, pp. 12-30.
[35] J. Russell, L. Elton, D. Swinglehurst and T. Greenhalg, "Using the online environment in assessment for learning: A case study of a web-based course in primary care", *Assessment & Evaluation in Higher Education, 31(4)*, Taylor & Francis, London, 2006, pp. 465-478.
[36] A. W. Ma, "Computer supported collaborative learning and higher order thinking skills: A case study of textile studies", *Interdisciplinary Journal of e-Learning and Learning Objects, v5*, Informing Science Institute, CA, 2009, pp. 145-167.
[37] J. Creswell and V. Piano Clark, *Designing and conducting mixed methods research*, Sage, Thousand Oaks, 2007.
[38] M. McNeill, M. Gosper and J. Hedberg, "Engaging students with higher order learning (or not): insights into academic practice", paper presented at the *ATN Assessment Conference*, Adelaide, November 3 – 4, 2008.
[39] L. Anderson, D. Krathwohl, P. Airsasian, K. Cruikshank, R. Mayer, P. Pintrich, et al. (Eds.), *A taxonomy for learning, teaching and assessing: A revision of Bloom's taxonomy of educational objectives*, Longman, New York, 2001.
[40] R. Byrnes & A. Ellis, "The prevalence and characteristics of online assessment in Australian universities", *Australasian Journal of Educational Technology, 22(1)*, ASCILITE, Australia, 2006, pp. 104-125.
[41] L. Anderson, D. Krathwohl, P. Airsasian, K. Cruikshank, R. Mayer, P. Pintrich, et al. (Eds.), *A taxonomy for learning, teaching and assessing: A revision of Bloom's taxonomy of educational objectives*, Longman, New York, 2001.
[42] K. Samuelowicz and J. Bain, "Identifying academics' orientations to assessment practice", *Higher Education Research and Development, 43*, Taylor & Francis, London, 2002, pp. 173-201.
[43] L. Anderson, D. Krathwohl, P. Airsasian, K. Cruikshank, R. Mayer, P. Pintrich, et al. (Eds.), *A taxonomy for learning, teaching and assessing: A revision of Bloom's taxonomy of educational objectives*, Longman, New York, 2001.
[44] K. Samuelowicz and J. Bain, "Identifying academics' orientations to assessment practice", *Higher Education Research and Development, 43*, Taylor & Francis, London, 2002, pp. 173-201.
[45] L. Anderson, D. Krathwohl, P. Airsasian, K. Cruikshank, R. Mayer, P. Pintrich, et al. (Eds.), *A taxonomy for learning, teaching and assessing: A revision of Bloom's taxonomy of educational objectives*, Longman, New York, 2001.
[46] ibid
[47] P. Race, *The Lecturer's Toolkit* (3rd ed.), Routledge, London, 2006.
[48] K. Samuelowicz and J. Bain, "Identifying academics' orientations to assessment practice", *Higher Education Research and Development, 43*, Taylor & Francis, London,2002, pp. 173-201.
[49] D. Gibbs and M. Gosper, "The upside-down-world of e-learning", *Journal of Learning Design, 1(2)*, Queensland University of Technology Press, Australia, 2006, pp. 46-54.

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