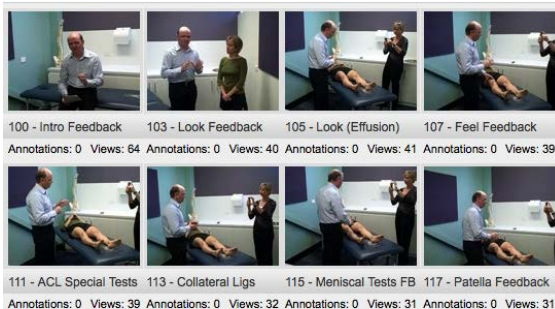




Final Report 2011

An integrated system for online clinical assessment of practical skills (eCAPS) for web- based courses

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List of Acronyms

ALTC	Australian Learning and Teaching Council Ltd
eCAPS	Online clinical assessment of practical skills
CAPS	Clinical Assessment of Physiotherapy Skills
GPs	General practitioners
OSCE	Objective Structured Clinical Examination
PBL	Problem Based Learning



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Executive summary

The online clinical assessment of practical skills (eCAPS) project utilized conventional and emerging web-based video technologies to develop and assess students' musculoskeletal and sports medicine clinical examination skills in remote and online environments. eCAPS was purposefully designed to promote assessment practices and experiences that are learning-oriented, authentic, valid and inclusive.

eCAPS was constituted by three sequential yet interdependent elements: (1) web-video lectures and exemplars of musculoskeletal practical skills sets by experts in the relevant field of focus; (2) asynchronous, learner-generated video demonstrations of a variety of clinically relevant practical skills using portable USB cameras uploaded to a response and feedback online repository for personal and course-community access; and (3) real time (synchronous) assessment of practical skills sets within a simulated Objective Structured Clinical Examination (OSCE) scenario via personal computer video-conferencing (e.g. Skype).

The project was conducted and evaluated in three phases. Such an approach allowed for the refinement of the eCAPS protocol as well as its application to a variety of tertiary learning environments. Phase 1 (a & b) involved the utilization of eCAPS within a fully remote Masters of Sports Medicine cohort. In Phase 2, eCAPS was appropriated for a remote second year medical student cohort. Phase 3 (a & b) involved the application of eCAPS for second year medical students in the blended learning contexts of problem-based learning and individual student engagement.

The evaluation of the project involved reviews by external experts in the fields of musculoskeletal medicine, sports medicine, medical education and educational innovation and technology; semi-structured and focus group interviews with student participants in each project phase; reliability testing; and student performance tracking.

The evaluation findings demonstrate the quality, utility and assessment efficacy of eCAPS in both the online remote and blended-learning contexts. Students valued the flexible online learning and assessment approach and recognized the coherent relationship between course materials, formative assessment expectations, formal and informal feedback mechanisms and summative assessment expectations. The students' clinical examination performances improved significantly from the baseline standards, while the reliability of online video-based judgments was demonstrated to be within acceptable degrees of tolerance.

Given its conceptual simplicity and technological applicability, eCAPS has the potential to provide enhanced learning and assessment opportunities beyond tertiary education contexts, including for example, continuing professional development and the verification of clinical competencies for ongoing registration purposes within medical and health-related fields.



Project outcomes and impacts

The purpose of the online clinical assessment of *practical* skills (eCAPS) project was to develop, implement and evaluate an innovative protocol for the remote and online assessment of clinical examination skills in musculoskeletal / sports medicine. With the assessment efficacy conditions of learning-orientation, authenticity, validity and social justice as foundational to its design, eCAPS utilised a system of integrated online video technologies to enable genuine reciprocity of information and materials between learners and instructors. In so doing, eCAPS directly addressed the challenging issue of enhancing the development and assessment of *practical* skill-sets within an online environment as opposed to the “face-to-face” contact of traditional approaches to the teaching of clinical skills in the field of medicine and health sciences. Significantly, the operation and engagement requirements of eCAPS relied entirely on widely available standard web-browsers / technologies and conventional digital devices.

The intended outcomes of eCAPS included:

- (i) the successful demonstration and evaluation of authentic assessment of practical competencies within online environments
- (ii) the development of a functional model for elearning assessment, from lower to higher levels of learner independence, through performance exemplars and video-based performance improvement approaches (Figure 1)
- iii) the dissemination of innovative elearning assessment practices, to national and international audiences through our multi-institutional Project Team, across a range of health and postgraduate educators.

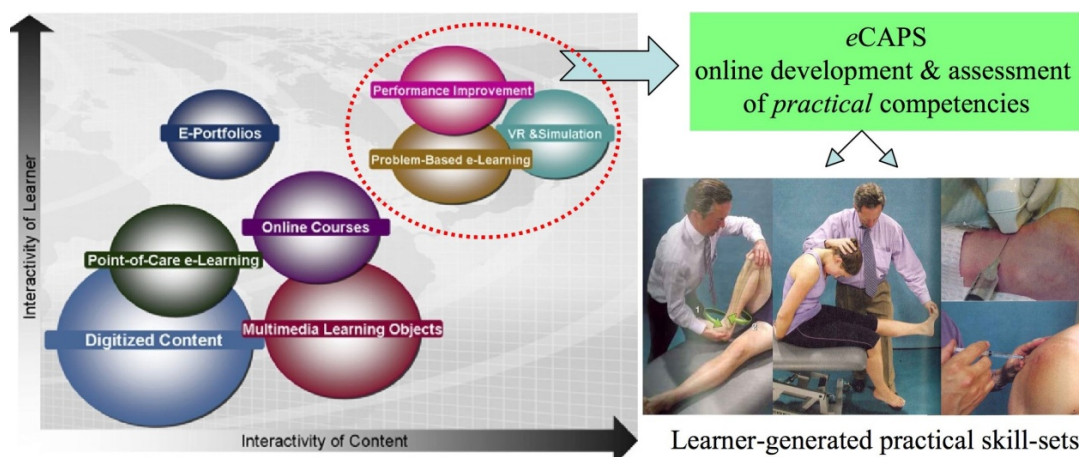


Figure 1. Advancement of learner / content interactivity levels through eCAPS, an online system focusing on performance improvement and learner-centred assessment of practical competencies within an elearning context (adapted from Holzer & Kokemueller, 2007).

The underlying strategy of eCAPS was to promote a progressive organisation of “assessment as learning” experiences (Earl, 2003) that generated both formative and summative information regarding the quality of students’ selected practical competencies. In this regard there was an effort made to instantiate coherence between the formative and summative expectations and resulting information. Formatively, the assessment protocol was designed to support students’ learning and execution of designated practical examination skills, promote dialogue between learners on the content and quality of the performances, and encourage students to reflect on their own practical skills performances within a community of practice

model. Moreover, the protocol required the instructors to provide video feedback annotations on the students' demonstrations of their practical skills and provided course instructors with information on what additional learning support was needed by students to ensure their ongoing development and readiness for the summative assessment of their practical skills. The progressive experiences were organised into three interdependent elements (Figure 2).

Figure 2 – Overview of the eCAPS strategy

Element 1: Practical skill-sets exemplars

This initial element involved the online delivery of clinical examination exemplars by experts in the field of musculoskeletal and sports medicine (including orthopaedic surgeons and sports physicians). These exemplars both complemented the online parent course content, and served as a reference point for the students' development of their own clinical practical skills. A suite of expert response exemplars was developed based on injury scenarios that were similar in nature and breadth to those that the students would be responding to in their asynchronous (Element 2) and synchronous (Element 3) video assessment opportunities. Students were able to view these online response-exemplars in full or in user selected portions as often as they deemed necessary. The exemplars demonstrated the types of responses that the course assessors valued and the way in which the videos should be used to model / demonstrate the respondent's applied knowledge and practical skills. The exemplars thus offered both learning experiences related to the actual clinical skills (content) as well as instructional support on how (process) to provide evidence of an individuals' practical skills through asynchronous and synchronous video recordings.

Element 2: Learner-generated video of practical skills-sets (asynchronous mode)

The students were required to produce and upload mock videos of themselves performing a sample of clinically-realistic practical skill-sets (e.g., demonstrating targeted joint examinations) in response to the sports-injury scenarios developed by field experts. This asynchronous approach entailed the students undertaking multiple replications of the practical skills-sets prior to uploading video materials for formative / summative assessment, encouraging student reflection and adjustment of their own (and colleagues') skill-set execution. The students used digital video cameras (e.g., "Flip" video cameras) to record their practical skills. Using "Flip" digital video cameras allowed immediate playback of recorded material and subsequent downloading of captured video via normal inbuilt connections on their personal computers (e.g., USB ports).

Element 3: Real-time video conferencing assessment of practical skills-sets (synchronous mode)

In this third element, students' practical skills were assessed by musculoskeletal and sports medicine experts in real-time through freely available online video conferencing (e.g. via Skype). During this video conferencing the students were provided with an injury scenario by the assessor in response to which the students were required to demonstrate their practical skills on a mock "patient" to simulate a routine clinical consultation. The assessors were able to prompt the students for more in-depth responses, ask for clarifications and provide immediate feedback to the students on their skills and associated clinical knowledge as per a traditional OSCE approach.

Assessment repository

The asynchronous videos were processed (e.g., collected, transferred and compressed) and then uploaded by students to a secure (password protected) online site that operated as a repository for students' demonstrations of their practical skills-sets. Management of this specially developed repository was assumed by the course coordinators who were able to control viewer access and provide feedback responses to the videos. The assessors randomly selected and marked sample student videos in the repository and provided "indicative" standards on these to the entire cohort. Students were able to view their own / each other's videos as well as the expert feedback provided to the randomly selected "indicative" videos.

Support material

Support material was developed and continually refined to aid students' awareness of and engagement in each phase of eCAPS. This online support material included instructional videos on how to optimise the use of digital video cameras for eCAPS, how to produce / compress the final versions of their videos (this was in addition to the practical skills exemplar videos), and how to upload the joint examination videos to the online repository for assessment and class community viewing.

Conceptual contributions

As mentioned earlier, eCAPS drew extensively on contemporary conceptual understandings of assessment for learning (Black & Wiliam, 1998; Boud, 2007; Earl, 2003) authentic assessment, validity (Messick, 1989; Kane, 2001), and social justice (Lingard, 2005) to fulfil the purpose of generating truly interactive online courses that demonstrably enhance student learning of practical skill-sets in an equitable and accessible manner.

Within higher education courses and indeed any formal educational context, assessment serves multiple purposes beyond the generation of summative grades.



Arguably one of the more productive purposes of assessment tasks is the enhancement of learning. Assessment for learning (Black & Wiliam, 1998; Taras, 2002), including formative assessment, is fundamentally grounded in constructivist theories of learning (Brooks, 2002; Shepard, 2000). The constructivist theory recognises that learning occurs as a result of interactions between learners and within contexts, and that students actively appropriate and adapt new knowledge in relation to former understandings and cognitive structures. In this regard, learning is not a passive process of knowledge transmission, but rather it is a complex process dependent upon students' previous knowledge, the mode of learning (e.g. kinaesthetic, visual, auditory), the context, and the task (Rovai, 2004).

Assessment tasks should provide instructors with information which can be used as feedback to modify the teaching and learning activities in which students are engaged (Sadler, 1998) and provide students with relevant and interpretable information to engage with so that they can monitor and successfully plan for their own learning (Sadler, 1998; Higgins, Hartley & Skelton, 2002). The importance of access to substantial assessment feedback (Hounsell, 2007) in developing the practical skills of students was expressly recognised in the development of eCAPS, particularly in relation to the utilisation of innovative online technologies to produce repositories for the assessment interactions of individuals and cohorts. In this way students were able to receive comprehensive, customized feedback on asynchronous learner-generated demonstrations of their clinical examination skills. Students were able to revisit both the online feedback and the performance exemplars to facilitate the development of their skills and optimise their achievement outcomes in the synchronous element of eCAPS.

eCAPS was firmly based on the principles of authentic assessment, developed to challenge the lack of connectedness and meaning of standardised tests and to enhance the educative value of assessment (Wiggins, 1998). Authentic assessment requires students to demonstrate and effectively and elaborately communicate an in-depth understanding of subject matter (Herrington, Oliver & Reeves, 2003). More specifically, authentic assessment provides assessable learning experiences that are connected to the world in which the students (practitioners) live or work (Hayes, Mills, Christie & Lingard, 2006; Shepard, 2000). That is, the learning experiences that form the medium for information gathering have application and meaning for learners' lives and are not abstract or disassociated. Wiggins (1998) suggested that authentic assessment should be realistic, replicating the manner in which the knowledge and processes being assessed are utilised in real life contexts, and that such practice exemplifies the promotion of ecological validity. The tasks should also require students to demonstrate a range of knowledges and processes in a manner beyond the passive recall of content. In keeping with authenticity and validity principles, eCAPS was designed in such a way so as to compel learners to repeatedly demonstrate and refine their practical skills in realistic clinical conditions, marking its substantive and learning-oriented nature.

Initiatives to promote authentic and learning-oriented assessment in tertiary courses are not new (e.g., McLoughlin & Luca, 2002; Rovai, 2004). Similarly, the use of technology for assessment has previously been advocated for and demonstrated in several content domains, including medicine and science (Cantillon, Irish & Sales, 2004; Crisp, 2007; Turner et al., 2006). This said, the authentic assessment of practical skill-sets online has proven to be a challenging endeavour for tertiary education that has not, to date, been adequately negotiated. At best, online assessments have provided authentic problem solving "cases" (Cook, 2007) but have not required students to actually perform practical skills in the demonstration of their problem-solving and clinical capacities. eCAPS represented a concerted effort to extend the value of technology beyond merely delivery efficiency (Northcote, 2003) by genuinely utilizing the interactive capacities of the online technologies to target the psychomotor domain in an inherently educative manner.



Implementation and evaluation of eCAPS

A phased approach for the implementation and evaluation of eCAPS was utilised to optimise the development and refinement of the online content and assessment materials as well as the technologies, and to apply the proposed protocol in multiple tertiary learning contexts.

Phase 1a

eCAPS was initially piloted with a cohort of online Masters of Sports Medicine students (general practitioners) undertaking separate courses dealing with common upper and lower-limb injuries in recreational / athletic settings. In this phase, all the students (full-time clinicians) were provided with access to the online course material and performance exemplars (eCAPS Element 1) and were required to produce and upload asynchronous videos (eCAPS Element 2) of selected clinical examination skills. While the synchronous element (3) of eCAPS was not fully implemented with this cohort, trials of this real-time video process were conducted in conjunction with a selection of other online assessment items during this phase of the project.

Phase evaluation:

- Preliminary and formative feedback was collected as available from the cohort of students (general practitioners) through informal email correspondence and short post-Skype video interviews.

Phase 1b

The online Masters of Sports Medicine students (again, individual general practitioners) similarly formed the focus group for this second phase of the project. The students were engaged in each of the elements of eCAPS. This included student access to the updated and refined online course material and performance exemplars (eCAPS Element 1), the requirement for participating students to produce and upload asynchronous video performances of clinical examination skills to an updated and more functionally viable assessment repository (eCAPS Element 2), the provision of audiovisual feedback on their videos by field experts, and the synchronous assessment of the students clinical examination skills via Skype video conferencing (eCAPS Element 3).

Phase evaluation:

- Following their synchronous assessment experience, the participating students were formally interviewed regarding the nature of their engagement in the assessment process as well as their perceptions of how the protocol could be further developed and refined.
- Prior to Phases 2 and 3, the online materials and technologies of eCAPS were reviewed by a reference group of experts (academics, clinicians) in the field of musculoskeletal medicine, sports medicine, and medical education. These reviewers provided useful evaluative comments on the coherence of the learning materials and assessment expectations, and the potential applications of the protocol for other learning sites within the medical and health sciences.



Phase 2

To explore alternative audiences, applications and the scalability (e.g., of particular relevance to university medical courses with large class sizes etc) of the online approach to learning and assessing practical skills in musculoskeletal / sports medicine, eCAPS was introduced to an initial (volunteer) sample cohort of second year medicine students at The University of Queensland (n=20). A ten-week online knee injury module for this project cohort was specifically developed using the eCAPS community of practice framework. The module reflected refined course materials and performance exemplars specifically adapted to the learning status of the students as well as a redeveloped video assessment repository reflecting the evaluation outcomes of Phases 1a and 1b.

Phase evaluation:

- Following the synchronous video assessment phase, each individual student participated in a formal, digitally recorded semi-structured interview, (ethics obtained through the Behavioural & Social Sciences Ethical Review Committee, The University of Queensland) that focused on the nature of their engagement with the content, learning expectations and assessment requirements of the module.
- The one-to-one interviews were transcribed in full and thematically coded (Denzin & Lincoln, 2003) with the assistance of NVivo qualitative analysis software.
- The inter-rater reliability between face-to-face and online video judgements of clinical skills was examined during the synchronous assessment element of the Phase 2 implementation of eCAPS.

Phases 3a and 3b

The final phases of the eCAPS project involved the implementation of an updated online knee injury module, delivered over five weeks in response to feedback provided by participants in Phase 2 of the project. The module was again delivered to a further sample of second year medical students who participated voluntarily in two distinct experimental cohorts: (1) problem based learning groups (n=40); and (2) individual engagements (n=26).

Phase evaluation:

- In both phases, baseline video performance data were collected on the students' clinical knee examination standards. All the students had previously engaged in some form of clinical examination learning as part of an earlier year 1 musculoskeletal medicine / orthopaedic unit. These baseline standards thus provided sample evidence for the standard of clinical examinations in the second year medicine cohort as well as a reference point for changes in knowledge and capacity following the asynchronous and synchronous video elements of the eCAPS module.
- Semi-structured interviews were conducted with each individual participant in Phase 3a (Problem Based Learning (PBL) group engagement), while focus group interviews were the basis for the student reviews in Phase 3b (engagement on an individual basis).
- The final modules and assessment processes were reviewed a second time by members of the external reference group to ascertain professional perceptions of the efficacy of eCAPS and garner recommendations regarding its appropriation in allied fields of the medical and health sciences.



Project facilitators

Overall, evidence for the viability, efficacy and utility of eCAPS was convincing based on the formal and informal responses of all stakeholders (e.g. students, course coordinators, external medical educators and clinicians) interviewed during the project. A number of facilitation factors contributed to this outcome.

The appropriation of accessible online-technologies that were either already used by students (such as web-browsers, basic video editing software) or the use of technologies which were operationally simple (e.g. “Flip” video cameras, secure Drupal shared video sites) ensured that the technology itself had a minimal impact on the students’ engagement with the content or the assessment requirements, and the response quality of the students.

The quality and utility of the online content and performance exemplars and the assessment processes were no doubt influenced by the significant contributions and reviews of experts in the field of musculoskeletal / sports medicine and educational technology. Content and review contributions were made by orthopaedic surgeons, sports physicians, family practice medicine and sports medicine education experts, and educational technology experts who were able to provide constructive reflections on the module content and its presentation, the technological efficiencies of the process, and the quality and validity of the students’ clinical performance evidence. The protocol was successfully refined following each phase of the project as a consequence of the reviews and specific technical contributions.

The students involved in eCAPS were either practicing general practitioners (GPs) enrolled in the Masters of Sports Medicine program (Australian and international doctors) or second year medical students in the School of Medicine at The University of Queensland (Ipswich and Brisbane campuses). In all cases it is likely that the intellectual quality and educational investments of the students (clinicians) contributed to the high quality of the outcomes that were observed. While eCAPS was mostly incorporated into the course expectations of the Masters students, involvement in eCAPS was voluntary and in addition to an already demanding scholarship program for the second year medical trainees. After the successful implementation of eCAPS in the medical student cohorts, they received post-hoc sign-off (pass/fail) for their lower limb musculoskeletal module in their clinical skills unit (interestingly, the majority of these volunteer students attributed their sustained involvement in eCAPS to the extremely high quality and accessibility of the online materials as well as a desire to increase their professional knowledge and expertise in knee injury clinical examination).

Project limitations

There were few limitations affecting the implementation and evaluation of the various roll-outs of the eCAPS trials. Notably, although the Master’s students’ grades were influenced by the quality of their submitted online performances in the assessment elements of eCAPS, this was not the case *a priori* for the second year medical students (as noted above, a subsequent decision independent of the eCAPS project team was made whereby students involved in this Australian Learning and Teaching Council (ALTC) funded project and meeting a minimum performance standard received sign-off for their clinical skills handbook). There is the possibility that this altered performance condition may have affected the intent of their participation in eCAPS. However, as mentioned earlier, the students across all cohorts appeared to be motivated beyond the minimum standard (participation), alleviating concerns over the possible contextual influences on performance.



Typically, the web/video technologies utilised in eCAPS were user-friendly and effective. However, where the synchronous video performances were communicated via wireless technologies, they were more susceptible to drop-outs and electrical interference (particularly with several overseas sessions, although all were recoverable and did not have any notable effect on the candidates' physical examination procedures). These difficulties were largely alleviated through direct cable internet connection alternatives.

Possibilities for implementation of eCAPS

The multi-phase approach to the project demonstrated the flexibility and applicability of eCAPS across a range of teaching and learning environments, including fully online undergraduate and postgraduate courses; blended learning arrangements to support and promote learning dialogue in problem-based learning scenarios; and blended learning arrangements to support individual student engagement in the learning and competency assessment of practical skills sets.

The potential online applications of eCAPS beyond the selected medical courses involving clinical examinations of musculoskeletal (sports-related) injuries are numerous. eCAPS is fundamentally the technologically supported relationship between practical skills content and the formative and summative assessment of students' video demonstrations of these skills. eCAPS can therefore be utilised for the web-based teaching and assessment of a wide variety and complexity of practical skills in numerous educational contexts. For example, there is significant scope for eCAPS to be applied in the online delivery of continuing professional development (as per a pending grant application we have submitted to utilize eCAPS within a hospital emergency medicine training environment), the verification of professional competencies for ongoing registration and for accreditation purposes in community education courses (e.g., as per a grant application in preparation for an ARC Linkage project for sports first aid and trainer courses).



Evaluation outcomes

Overall, the formal and informal evaluation processes yielded strong evidence regarding the efficacy of eCAPS for the online and remote assessment of clinical skills in musculoskeletal / sports medicine. More generally, the evaluation findings contributed to broader understandings of the potential utility of technology for enhancing learning and assessment coherence in both remote/online settings and blended learning contexts.

Quality

The external reviews of eCAPS provided by experts in the fields of musculoskeletal medicine, sports medicine and educational technology and innovation both highlighted the quality of the protocol and its constituent materials, and contributed to their refinement across the three phases of the project. Recognition of the high quality of eCAPS was verified by the students through the semi-structured and focus group interviews in which the students repeatedly nominated the delivery and assessment mode of eCAPS as superior to their previous and current experiences of conventional teaching and learning approaches to physical examination skills of the musculoskeletal system in this instance. In particular, the students valued the flexibility and readily accessible online demonstrations and explanations provided by the relevant field experts, the peer input and support provided for the production of their own videos, and the feedback offered by the expert members of the project team on the quality of their demonstrated clinical skills.

The medical students and participating general practitioners valued the consistent content and performance standards provided by eCAPS, contrasting them to the varied messages and approaches of different clinical tutors whose own experiences and understandings of musculoskeletal examinations were varied and generally not at the level provided by the online exemplars in the eCAPS materials.

Student engagement

Across the three phases of the project, the students were almost unanimous in their appreciation of the online course materials and assessment expectations, and their recognition of the educative contributions of each element of eCAPS to the enhancement of their musculoskeletal clinical examination skills. In particular, the students noted the quality and accessibility of the online course materials and the clear relationship between the course content (instantiated in the performance exemplars) and the asynchronous / synchronous assessment demands.

The students indicated that the exemplars provided a substantiation of the criteria against which they were to be assessed, as well as a clarified reference point for judging and modifying their own clinical examination skills.

The synchronous video assessment phase allowed for the efficient assessment of sequential “patient” examinations by the volunteer medical students by offsite experts in the field. This enhanced the accessibility and quality of the judgements and the feedback provided to the students.

The learning context of eCAPS had implications for the nature of the students' engagement in the process as well as the potential learning outcomes. In the remote online context of the Masters program, the participants reviewed their own videos



more frequently than the “onsite” PBL medical students prior to uploading their asynchronous assessment videos to the assessment repository. This also appeared to be the engagement experience of the individual second year medical students who were involved in the modules separate to a PBL group structure.

The medical students who participated in the modules within their PBL groups tended not to *a priori* review their videos before uploading them to the assessment repository. Rather, as contributing members of a group, the students were prompted by the asynchronous assessment expectations to provide immediate face-to-face feedback on each other’s clinical skills. That is, while they might not have directly viewed their own performances on the digital “Flip” cameras for formative purposes, they received rich formative information from each other as part of the process of generating a video of sufficient quality for uploading to the shared web-site. Moreover, the asynchronous requirements of eCAPS promoted the social engagement of the medical students in a manner that consolidated the learning of key skills and knowledge, as each individual student not only had to perform the practical skills (for which they could receive feedback from their peers) but also acted as a “mock” patient (getting a sense of what the physical examination technique feels like from a patient perspective) and videoing their peers (necessitating an understanding of the physical examination technique so as to adequately capture clinically relevant video evidence via appropriate camera positioning and angles on which a judgement could be made).

The project participants (students and assessors) recognised the coherence between the learning (or content) expectations and the assessment expectations of eCAPS. Such coherence was important for promoting the content, structural and substantive validity of the assessment protocol, and for ensuring students’ optimal engagement with the learning material and performance outcomes.

Feedback

In terms of feedback for performance improvement, the students had several information sources including the skills-set exemplars of phase one (against which students referenced their own performances), self-analyses of their execution of the skill-sets using the digital “Flip” cameras, and reference to instructional materials within the web-based parent course. Once the learner-generated video materials had been uploaded for official assessment, the expert assessors provided additional feedback to the students with respect to their practical examination competencies.

The online assessment response repository provided useful annotated feedback to students to prompt further engagement with key material and make adjustments to their practical performances (evidenced in their detailed interview responses as well as the changes in the performance quality between the asynchronous and synchronous phases). The video-based assessment repository also provided useful information for course developers and assessors as to apparent gaps in the emerging skills and knowledge of the students, allowing for appropriate additional teaching and learning support to be offered to the students between the asynchronous and synchronous phases.

The Phase 3 trial of indicative standards and feedback proved to be an efficient and effective means of promoting higher levels of summative achievement. Although many of the students in this phase would have preferred, not unexpectedly, to receive feedback specifically directed towards their own recorded clinical examinations, almost every student in both cohorts viewed the indicative feedback videos and reviewed their own asynchronous video performances in preparation for their synchronous video assessments. In this regard, the feedback was sufficiently rich and relevant to individual students even though not specifically related to their



own performances, *per se*. This was likely due in large part to the overall coherence of the integrated learning and assessment expectations.

Making judgements

Evidence for the inter-rater reliability of online and face-to-face video judgements of students' clinical examinations skills was collected during the project. The reliability of online practical skills assessment judgements were found to have a good to strong correlation with the face-to-face assessments of practical skills involved in joint examinations covered within the sports medicine materials ($r = 0.77$). This has significant implications for the suitability of the eCAPS protocol for efficacious assessment in online and remote learning contexts, as well as for potential applications beyond formal education contexts such as continuing professional development and skills monitoring processes.

Performance outcomes

There were significant increases evident in the performance of the physical examination skills as assessed by the specifically designed criteria / standards marking sheet developed as part of the current project. Across the various cohorts, analyses indicated a range of notable improvements in performance across baseline to asynchronous to synchronous video assessments (e.g. 30 per cent to 85 per cent increases in the clinical assessors marks of the students' performances). In particular, experienced medical educators and clinicians assessing the learner-generated asynchronous and synchronous videos universally commented on the development of the systematic, confident and competent examination skills demonstrated by the second year medical student cohorts. A nationally prominent orthopaedic surgeon (who provided exemplar video materials as part of the eCAPS project) further commented that he saw evidence from the second year medical student videos that was consistent with knee examination skills exhibited by final year / resident level medical trainees.

Overall, the video / web-based technologies were relatively simple and easy to use (albeit demanding sufficient internet bandwidth). In this regard the technology did not appear to impede the response quality of the students or the capacity of the expert assessors to make reliable judgements of their performances. Indeed, several medical students indicated that they perceived their performances were less inhibited than otherwise may have been the case in a conventional OSCE environment.



Dissemination

Consistent with the ALTC Dissemination Framework recommendations, the eCAPS design and evaluation information has been disseminated through both “engaged and active” strategies as well as via more traditional “information provision” avenues. These forms of dissemination are outlined below in Table 1.

Table 1. Completed/accepted eCAPS dissemination activities

Engaged and active dissemination strategies	Information provision strategies
Project forums: - Engstrom, C. & Hay, P. (2008). Participants at the Australian Learning and Teaching Council Forum on Assessment in Tertiary Institutions, Adelaide, 18-19 November, 2008. - Engstrom, C. & Hay, P. (2009). Participant at the Australian Learning and Teaching Council Forum on Assessment in Tertiary Institutions, Melbourne, 18-19 November. - Hay, P., Engstrom, C. & Dickens, S. (2010). Online clinical assessment of practical skills, Keynote workshop, ALTC Assessment Forum, University of Technology, Sydney, November, 2010.	Reports: - PP8-893 Progress report I, February 2009 - PP8-893 Stage 1 project report, August 2009 - PP8-893 Progress report II, June 2010 - PP8-893 Final report, November 2010
Institutional workshop presentations: - Engstrom, C. & Hay, P. (2009). Use of technology to support assessment of clinical skills: considering the possibilities, School of Human Movement Studies, May, 2009. - Engstrom, C. & Green, A. (2009). Assessment of clinical examination skills in musculoskeletal medicine: the potential of eCAPS, School of Medicine, 2009. - Engstrom, C. (2009). Online Clinical Assessment of Practical Skills (eCAPS). Workshop presentation for Centre for Educational Innovation and Technology (CEIT). - Engstrom, C. & Hay, P. (2009). Online clinical assessment of practical skills. Invited presentation, Teaching and Learning week, The University of Queensland. - Hay, P. & Engstrom, C. (2010). Promoting assessment authenticity and efficacy for online clinical	Conference presentations: - Engstrom, C., Hay, P., Macdonald, D., Green, A. & Friis, P. (2009). Promoting assessment authenticity and efficacy through an integrated system for online clinical assessment of practical skills. Paper presented at ATN Assessment Conference, RMIT University, Melbourne, 19-20 November. - Engstrom, C., Hay, P. & Green, A. (2009). eCAPS - Online Clinical Assessment of Practical Skills for Web-Based Courses. Invited paper presented at Queensland Health Medical Education Officers Conference, Brisbane, 24 April, 2009. - Hay, P. & Engstrom, C. (2010). Promoting assessment efficacy for online assessment of practical skills. Health and Physical Education Research Forum, The University of Queensland, 13-15 August, 2010. - Hay, P., Engstrom, C., Dickens, S.,



assessment of practical skills (eCAPS). Invited presentation, Teaching and Learning week, The University of Queensland. • The eCAPS project team is currently in discussions with several tertiary and professional educational groups regarding the potential collaborative application of eCAPS in various settings.	Green, A. & Friis, P. (2010). Promoting assessment authenticity and efficacy through an integrated system for online clinical assessment of practical skills, ATN Assessment Conference, University of Technology, Sydney (UTS), Sydney, 18-19 November, 2010.
Blended Learning Forums: • Blended Learning Conference 2010- Developing Blended Learning Communicates - eLearning Expo, The University of Queensland	

Currently, the eCAPS project leaders are in the process of finalising several manuscripts for submission to international journals of higher education, educational assessment, and (online) medical education. In all dissemination strategies the project team has and will fully acknowledge the funding of the project by the ALTC.



Moving forward

The successful implementation of innovative web-based projects such as eCAPS are important for enhancing education and assessment practices in contemporary higher education and continuing professional development environments. In making such contributions eCAPS connects directly with the ALTC Strategic Priority areas of 'principles for assessment and assurance of graduate learning outcomes'. In this regard, eCAPS compliments other ALTC funded projects such as 'Development of the Clinical Assessment of Physiotherapy Skills (CAPS): A standardised and valid approach to assessment of clinical competence in physiotherapy' (Griffith University) and 'Computer aided feedback and assessment system' (University of South Australia) in promoting efficacious assessment practices in higher education.

Several promising disciplinary and interdisciplinary linkages have emerged as a result of the project and its "engaged" dissemination. In particular, the eCAPS project team has established further collaborative and productive relationships with key teaching and learning personnel in the School of Medicine, The University of Queensland, exploring the possibilities for developing and implementing further "fit-for-purpose" practical modules based on the eCAPS approach. This disciplinary expansion builds on the positive outcomes derived from the Phase 2 and 3 evaluations conducted with the active involvement of the School of Medicine at both the Ipswich and Brisbane campuses.

The assessment efficacy of eCAPS for promoting and assessing practical skills remotely has been recognised by a number of health professional organisations. As a consequence, educational and research links beyond the tertiary sector are also in development. These links include collaborative initiatives for the provision of professional development to medical practitioners in Emergency Medicine (including in rural and remote centres), and the ongoing verification of practical skills competencies in several medical disciplines as well as community oriented sports first aid educational programs.



References

- Black, P. & Wiliam, D. (1998) Assessment and classroom learning, *Assessment in Education*, 5(1), 7-73.
- Boud, D. (2007) Reframing assessment as if learning was important, in: D. Boud & N. Falchikov (Eds) *Rethinking assessment in education* (Oxon, Routledge), 14-25.
- Brooks, V. (2002) *Assessment in secondary schools. The new teacher's guide to monitoring, assessment, recording, reporting and accountability*. Buckingham: Open University Press.
- Cantillon, P. Irish, B. & Sales, D. (2004) Using computers for assessment in medicine, *British Medical Journal*, 329, 606-609.
- Cook, D. A. (2007) Web-based learning: pros, cons and controversies, *Clinical Medicine*, 7(1), 37-42.
- Crisp, B.R. (2007) Is it worth the effort? How feedback influences students' subsequent submission of assessable work, *Assessment and Evaluation in Higher Education*, 32(5), 571-581.
- Denzin, N.K. & Lincoln, Y.S. (2003) *Collecting and interpreting qualitative materials* (Thousand Oaks, Sage).
- Earl, L. M., (2003) *Assessment as Learning: Using classroom assessment to Maximise Student Learning* (Thousand Oaks, Corwin Press).
- Hayes, D., Mills, M. Christie, P. and Lingard, B. (2006) *Teachers and Schooling Making a Difference*. Sydney: Allen & Unwin.
- Herrington, J., Oliver, R. & Reeves, T.C. (2003) Patterns of engagement in authentic online learning environments, *Australian Journal of Educational Technology*, 19(1), 59-71.
- Higgins, R., Hartley, P. & Skelton, A. (2002) The conscientious consumer: reconsidering the role of assessment feedback in student learning, *Studies in Higher Education*, 27(1), 53 – 64.
- Holzer. P. & Kokemueller, P. (2007) Internet Platforms for Lifelong Learning: A Continuum of Opportunity, *Otolaryngologic Clinics of North America*, 40(6), 1275 - 1293.
- Hounsell, D. (2007) Towards more sustainable feedback to students, in: D. Boud & N. Falchikov (Eds) *Rethinking assessment in education* (Oxon, Routledge), 101-113.
- Kane, M. (2001) Current concerns in validity theory, *Journal of Educational Measurement*, 38(4), 319-342.
- Lingard, B. (2005) 'Socially just pedagogies in changing times', *International Studies in Sociology of Education*, 15(2): 165-186.
- McLoughlin, C. & Luca, J. (2002) A learner-centred approach to developing team skills though web-based learning and assessment, *British Journal of Educational*



Technology, 33(5), 571-582.

Messick, S. (1989) Validity, in: R. L. Linn (Ed), *Educational measurement (3rd Edition)* (Washington DC, American Council on Education and National Council on Measurement in Education) 13-103.

Northcote, M. (2003) Online assessment in higher education: The influence of pedagogy on the construction of students' epistemologies, *Issues in Educational Research*, 13(1), 66-84.

Rovai, A.P. (2004) A constructivist approach to online college learning, *Internet and Higher Education*, 7, 79-93.

Shepard, L. (2000) The role of assessment in a learning culture, *Educational Researcher*, 29(7), 4-14.

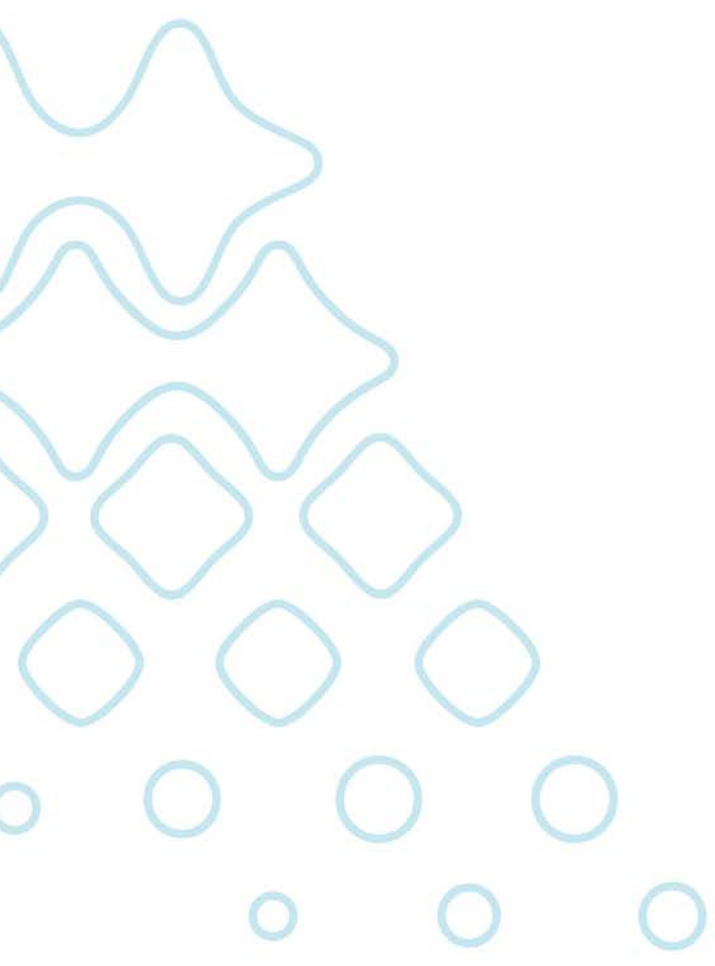
Sadler, D. R. (1998) Formative assessment: revisiting the territory, *Assessment in Education*, 5(1), 77-84.

Taras, M. (2002) Using assessment for learning and learning from assessment, *Assessment & Evaluation in Higher Education*, 27(6), 501-510.

Turner, M.K., Simon, S.R., Facemyer, K.C., Newhall, L.M., Veatch, T.L., (2006) Web-based learning versus standardized patients for teaching clinical diagnosis: a randomized, controlled, crossover trial, *Teaching and learning in Medicine*, 18(3), 208-214.

Wiggins, G. (1998) *Educative assessment: designing assessments to inform and improve student performance* (San Francisco, Jossey-Bass Inc).





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