Clinical diagnosis online

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Students of natural medicine at Southern Cross University undertake a program of learning that encompasses both scientific and holistic approaches to health and wellbeing. Case based presentations in two inter-related units – Clinical Diagnosis I and Clinical Diagnosis II allow students to develop their skills in patient history taking, problem solving, differential diagnosis and treatment. This paper describes the progression of innovations in teaching these two units from fully face-to-face, to paper-based and CDROM structured case based activities, to an online version that is currently in place. Student feedback on both the CDROM and online versions is discussed and a statistical evaluation of student performance is presented to compare the impact of the two innovations in delivery.

Keywords: clinical diagnosis, authentic assessment, case based, online learning, reflection.

Introduction

Students of natural medicine at Southern Cross University undertake a four-year program of learning that encompasses both scientific and holistic approaches to health and wellbeing. In several of the core units learning is undertaken along case based lines thus allowing students to develop their skills in patient history taking, problem solving, differential diagnosis and treatment. Two of these units are inter-related and are called Clinical Diagnosis I and Clinical Diagnosis II. This paper describes the progression of innovations in teaching these two units from fully face-to-face, to paper-based and CDROM structured case based activities, to an online version that is currently in place. Student feedback on both the CDROM and online versions indicates that both innovations provide enhancements and could also be improved. Students' grades are analysed statistically to ascertain the impacts of each innovation in delivery.

Case based learning

Case based learning has long been regarded as an important element in the study of medicine and allied clinical practice (Alavi, 1995; Benbunan-Fich & Hiltz, 1999; Habeshaw, Gibbs & Habeshaw, 1993). Use of constructed patient cases as stimuli for learning involves the application of theory to clinical problem solving (Ertmer, Newby & MacDougall, 1996). Constructed patient cases may serve as the starting point for anticipating the consequences of one's actions, or for analysing the impacts of actions already taken. In clinical curricula, case based stimuli have been used in association with the anticipatory aspects of analysis such as problem-based learning (PBL). PBL has commonly been adopted as an authentic approach to understanding patient symptoms in the determination of diagnosis and treatment plans (Rendas, Fonsesca & Pinto, 2006; Woods, 2003). The same pedagogical rationale applies in the study of natural medicine, and is perhaps even more critical where holistic approaches underpin the consideration of factors in patient presentation. Fundamentally, problem-based learning must be based on the presentation and solution of realistic problems from clinical practice. Experienced practitioners develop these problems and provide a realistic framework with a structured schedule of activities and review mechanisms for students to complete. University lecturers using such pedagogical approaches to teaching and learning must thus become non-didactic facilitators who support learners in their active quest to understand and apply their learning to the problem case at hand.

The two units – Clinical Diagnosis I and II – are core units in the Bachelor of Clinical Sciences and the Bachelor of Naturopathy at Southern Cross University. The units are taught with a clinically oriented, step-by-step, problem based and case based approach. In these units, students studying to be osteopaths or primary naturopathic practitioners integrate their knowledge of anatomy, physiology and pathophysiology

with their newly developing skills of patient history taking, physical examination, ordering laboratory investigations, diagnosing and treating patients. The process of deriving information from the patient case and developing strategies for decision-making includes asking about symptoms, looking for signs, ordering investigations or proposing diagnoses and treatment options. Therefore this is a multi-step process with more and more data becoming available with each stage of the case presentation and as the student's understanding progresses.

Figure 1 below shows a simplified flow chart of the process for working through a case through four component parts. Students actually work on six cases at a time, each within one system of the body such as the respiratory system, the gastro-intestinal system and so on. Altogether seven bodily systems are studied – three in Clinical Diagnosis I and four in Clinical Diagnosis II. The actions listed on the left are those of the unit assessor.

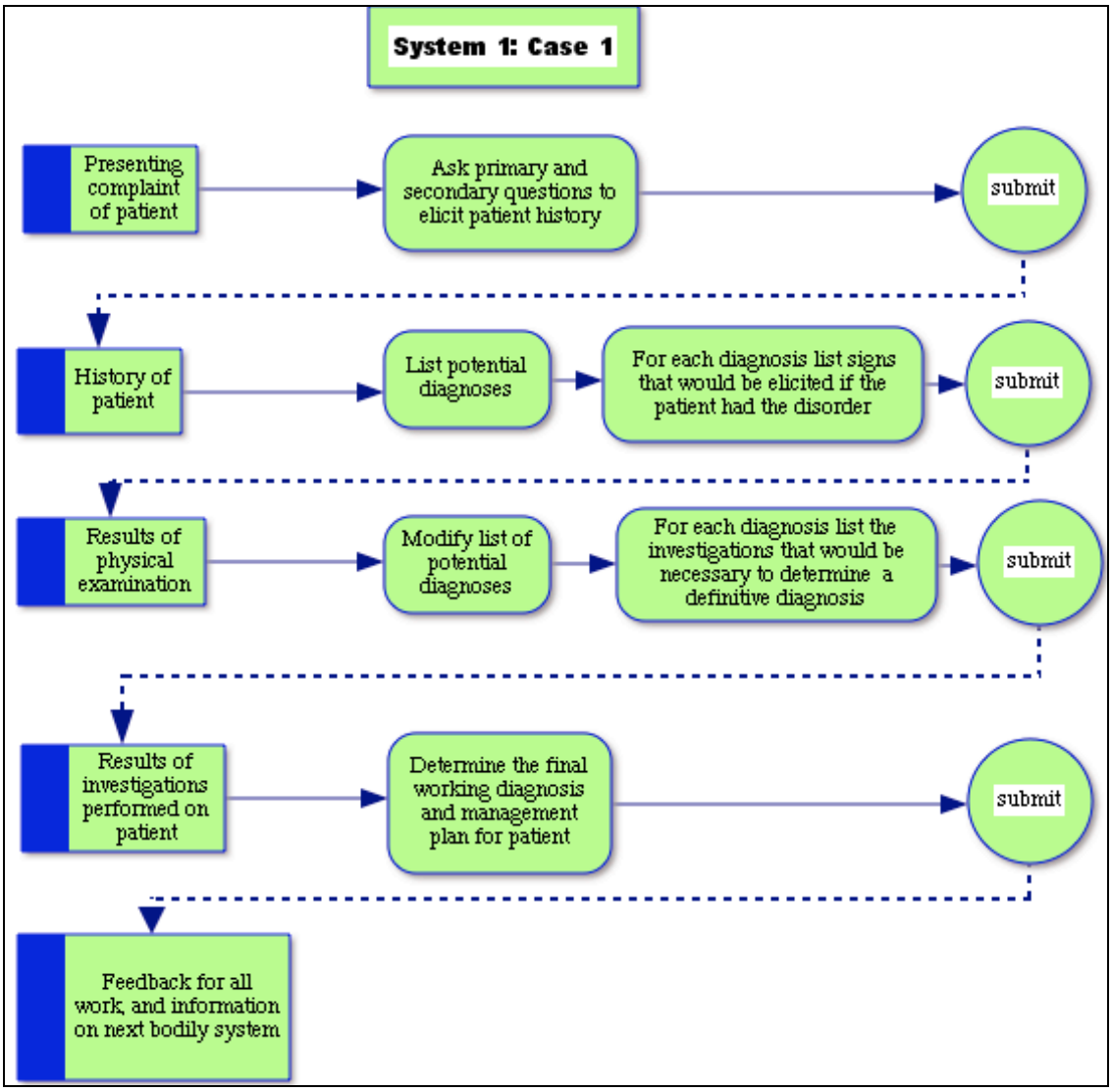

Figure 1: Flow-chart for the process of case study in Clinical Diagnosis I and II.

Authentic learning

For these two units of study, the use of patient cases has necessitated the development of detailed scenarios for seven bodily systems. In order for students to gain a comprehensive understanding of each system overall, six different cases are constructed for each system, totalling 42 cases over the two units studied. The nature of each problem case is carefully selected to represent a broad range of possible patient presentations that practitioners may encounter in clinical practice. Of critical importance is the accuracy and authenticity of each case design. In order for the process of history taking, development of differential diagnoses, understanding of findings from physical examination and pathology results to be credible and logical, each case and its component parts must be designed around realistic factors.

As detailed by Herrington, Oliver and Reeves (2003), authentic learning activities have real world relevance, are open to multiple interpretations, comprise complex tasks, provide learners with the opportunity to reflect and consider the problem from different perspectives, and are seamlessly integrated with assessment. Consistent with these features, the learning activities in the two units described are undoubtedly authentic, providing 'real world problems' while at the same time presenting a perfectly safe context for students to learn through mistakes they may make (Stein, Isaacs & Andrews, 2004). As students submit their answers to each step of the case, the response they receive to each answer is not given with a mark, nor is feedback provided to individual students, but by virtue of the process of deductive thinking they have already undertaken students are able to self-correct with respect to the next component of the case data revealed to them. Together with the general feedback given for the case steps, students develop a deeper understanding of the dimensions of the clinical problem and the diagnostic process they should be carrying out.

Innovations in teaching clinical diagnosis

The natural medicine program began as an innovation in tertiary study and in the first delivery format until 1999, the two Clinical Diagnosis units were only taught on-campus. Students' answers for each step of each case in each bodily system were handed in at the end of class and feedback was provided in the next tutorial with additional case data also being given at that time. The process allowed for maximum engagement with the patient cases by each student attending class however, little information was given in written form to save the development of new authentic scenarios with each new student cohort since this was a complex and time consuming task. The use of case based learning in these units provided a lynchpin for the remaining clinical units within the course curriculum that includes supervised clinical practice with real patients in the students' final year of study.

In 1999 the two Clinical Diagnosis units were trialled in external format using print-based delivery and with the off-campus students using postal and fax systems for submission of case based answers. In order to preserve the pedagogical activities of deductive thinking with individual support provided for students, a manual release of case data on receipt of each submission was introduced, requiring administrative staff to promptly release each component of patient case data for each student submission received. While making external study of these units possible where this had not been possible previously, both students and staff identified the manual and postal processes of interaction as a time consuming and cumbersome method of engagement.

Technology supported learning

With the institutional drive for online delivery and the implementation of a computer based learning management system, consideration was given in 2000 to delivering the Clinical Diagnosis units online. At that time the target cohort of students were surveyed and it was found that only a small percentage had easy access to a networked computer, while almost all had access to a CDROM drive with their hardware setup. The decision was thus made to further develop the units using CDROM resources to deliver the case study components in a lock-step series of scenarios. The CDROM resources were formatted as read only pdf files (printing of these files was prevented to ensure security of data within and between student cohorts), and the files were locked by a series of passwords. On submission of answers by students, the password to unlock subsequent case data was provided to them by the most rapid means available – for a small number this meant using email, while others phoned in to collect the password and the remainder received their passwords through fax or express post.

While this process was more responsive than traditional post and took account of a diverse range of students' needs and communication possibilities, the method was far from streamlined and occasionally left students waiting over the weekend (frequently their best study time) to receive the next password to enable their progression. In some instances this resulted in the students' engagement in the clinical case being broken at a critical time in the learning process. Such student engagement with their learning is shown as essential, ensuring they can construct meaning from their activities and develop their own understanding (Herrington, Oliver & Reeves, 2003; Jonassen, Peck & Wilson, 1999).

The other problem with the CDROM version of the unit was that the student would often not receive feedback on their work until they were working on the next system. A lack of timely feedback is one of the cardinal sins of teaching off-campus learners (Kerka et al., 2000; Patel, Russell & Kinshuk, 1999; Thorpe, 1998). While the internal students relied on two 3-hour tutorials per week to inform them of omissions and mistakes they had made in the cases, if an external student omitted an important diagnosis, sign or investigation, or had a basic misunderstanding of the case, the inability to get immediate feedback

meant that the same mistake could be repeated throughout the four parts of that case. It was clear that this use of CDROM technology was not effectively improving students' learning, even though previous trials at Southern Cross University using web-linked CDs had been effective and were shown to enhance learning (O'Reilly & Morgan, 1997). Clearly the absence of online connection with its immediacy of feedback was critical to the adequacy of CDs in the clinical diagnosis case based learning.

Clinical diagnosis online

In keeping with the findings of Carswell et al (2000), by 2004 students were themselves requesting an online method of engagement as they sought improvements to the connections with information and expertise and, with the help of some internal funding by way of an innovations seeding grant, an online version of assessment was designed for these units. We employed the use of a feature within Blackboard™ called Adaptive Release to address the shortcomings of the CDROM presentation of Clinical Diagnosis, while preserving the individual tailoring which the digital files had allowed. Adaptive Release promised to provide the capacity to write a set of algorithms tailoring the systems' response to individual students' submissions. Thus, upon student submission of a document it was intended that the system would allow immediate access to the next part of the case as well as making other supplementary information available to the individual student submitting their work. To optimise this feature of individual student support, a set of reflection sheets was developed and these included all common errors and omissions made by students of Clinical Diagnosis in the past. The aim of these sheets was also to stimulate self-directedness within learners in order that their reasoning and problem-solving skills were further developed (Candy, 2004).

The Adaptive Release function was thus set with an expectation that it would automatically release the next case data to students along with the reflection sheets to consider as they progressed in their clinical problem solving activities. Disappointingly the software did not operate as promised, and a level of manual handling was still required to ensure each individual student received what they needed when they needed it to make progress through the clinical cases.

Evaluation of innovations

To evaluate the effectiveness of the innovations in unit delivery, two cohorts of students were interviewed by telephone by an independent interviewer. The first cohort comprised a sample of ten students from a total of twenty-two who had previously completed the units using the CDROM format for case based activities (between 2002 and 2006). The second cohort comprised a complete sample of eight students from a total of eight who had recently completed the units using the online format for case based activities (2006–2007). In general these interviews sought to gauge the students' experience of the unit assessment tasks, the nature of their expectations and their overall satisfaction with the delivery of the unit. All students interviewed were 'earner-learners' who were in some level of employment while also undertaking the off-campus versions of these units – many of the students were working full time and only had nights and weekends for their studies.

Feedback on CDROM format of cases

All students using the CDROM felt that it was a good way to learn, as the lock-step structure prevented them from getting too far ahead before they had a clear understanding of the cases and the clinical topics overall. Seventy percent of students felt that their learning had not been hindered by the submission process, and 100% of students felt confident in being able to meet the unit objectives. One stated that the learning was "profoundly valuable" and further comments were that it was "intellectually stimulating", and the "self-paced" nature of the resources provided motivation and challenge to successfully complete the units.

Of those students interviewed 80% reported ongoing problems due to unavailability of staff and felt that the "administration of the units were under-resourced", with 10% reporting delays in return of their assignments. Twenty percent of students interviewed reported technical problems and 20% felt stressed by the way the system worked thus taking some time to feel more confident about their own progression.

While all students agreed that academic support was adequate with 30% stating that it was "excellent", 40% of students were disappointed that the unit was ungraded and their result was simply reported as "Satisfactory". Fifty percent of students had not sought to have contact with the academic staff, and those who did felt that replies to their enquiries were not always timely enough: "because I only had specific time to devote to the work, sometimes I would have a question and send an email and not get a reply, so I

would move on without an answer. Although I didn't have any questions that stopped me from moving on, it was a bit frustrating".

Feedback on case activities was seen by 20% as being "a great deal" and by 30% as "not enough". Twenty percent of interviewees expressed disappointment that feedback was only provided in writing and not verbally. Other comments indicated that feedback was "professional", "valuable", and "invaluable because it provided the guidance needed". One interviewee commented: "I don't recall getting as much feedback as I would have liked. Some things were just graded 'satisfactory' so I didn't feel that I got any answers on how I could improve which was annoying".

Overall, the units were seen as "useful and interesting" providing "more confidence as far as diagnosis goes". However, comments with respect to the CDROM delivery highlighted the lack of communication with both administrative staff (for passwords) and academic staff (for feedback) "… you shouldn't be made to feel guilty for asking for help. Staffing issues and funding for staff is not my problem and my studies shouldn't suffer because of under-staffing". Finally one interviewee summed up their study in each unit thus: "It was hard not having contact like you do with internal study. There was so much material to get through and lot of reading, but it was a good unit".

Feedback about online format of cases

While the Adaptive Release feature of Blackboard™ was first adopted in late 2006 to automate the process of issuing passwords to students in a fully tailored system, the scripting of appropriate algorithms was an unfamiliar process for the unit assessor. At the same time the whole unit was moved online including all study resources, communications and assessment tasks, and as a consequence some teething problems emerged with the first iteration of online delivery. In addition the software did not perform as promised and the process thus required manual engagement with each student submission. Student feedback obtained through independent interviews thus encapsulates these issues.

All eight students interviewed reported problems with online access to unit information and 80% expressed disappointment in the slow response to their submitted work. Fifty percent felt that the time taken in receiving a response delayed their progress. Only one had requested an extension as a solution.

On the other hand, all students were satisfied with the way the units were structured and enjoyed working through them. All were generally positive about meeting the unit objectives. Even those students who reported struggling in some aspects felt they had improved since undertaking the units and they felt they continued to improve in clinical practice. All students agreed that academic support was "good", "supportive" and "helpful". Two commented that they were "extremely impressed" with the contact from unit assessor at the start of their study and 50% found contact by email to be "efficient" and "prompt".

Feedback received was seen as "constructive" and "brilliant because you could learn from the responses and see where you were going wrong" as well as "helped to calm my nerves and helped my learning process because I was able to integrate comments given to my work". Sixty two percent felt that the ungraded nature of the units was inadequate as this did not provide sufficient feedback on performance.

Overall the online format of the units were described as putting the "onus on the student to identify what you need to learn" and "it wasn't passive learning, I had to be very involved to complete the unit[s]". The case based approach was also recognised as important "The case learning is very practical, working through and getting other perspectives. I like the format, it has practical applications".

Addition of reflection sheets to online case activities

The development of student reflection sheets was another initiative instigated to accompany the online delivery. These sheets were intended to provide immediate generic feedback for automatic issue by the Adaptive Release system in response to any student submission. It was important that these reflection sheets were not developed as a list of ideal answers. Morgan et al (2004) identified one of the issues of concern in student assessment as being the fact that students often do not learn how to locate information. Within the reflection sheets therefore, it was important to encourage the student to continue their search for the information. The reflection sheets were designed to include a large number of possibly correct answers but also include a number of answers that, upon investigation of the information, the student would realise would be unlikely.

One example of the reflection sheets is seen in the case of a patient with peripheral oedema. Numerous causes of oedema such as liver cirrhosis, congestive heart failure, lymphatic blockage and kidney disease would be included in the reflection sheet, as each disorder is an important cause of the presenting complaint. In that case however, the urinalysis found no protein, thus excluding kidney disease as a possible cause. Through the reflection sheet, the student was therefore reminded of the importance of considering each of these disorders, including any disorders in future parts that they may have overlooked. The reflection sheet does not provide the "answers", as students must deduce whether each diagnosis is still possible.

Interviewees described the sheets as "helpful", "useful" and "good" with 75% agreeing that they were beneficial. The unit assessor's intensions to prompt students to think further was also achieved as revealed in comments such as "the only feedback received was the reflection sheets. I wasn't sure about some of the responses and I tended to try to figure things out for myself rather than worry about this too much. It's very practical learning and you need to be a bit resourceful and think for yourself". Another commented: "I used the reflection sheets to help study for the exam and found these really helpful".

The online version of resources, cases, reflection sheets and interaction with assessor were summed up thus: "I initially struggled with the online aspect and found it a bit stressful but it got better once I felt more confident about how it worked", "the frustration of things not opening up when I needed them was difficult", "I really enjoyed it and got a lot out of [it]… I'm pleased I completed it", "I derived a lot of knowledge…", "…by far the best I have done".

Student performance

Statistical analysis was conducted of the grades achieved by students completing the first unit Clinical Diagnosis I with the CDROM innovation and the online resources. Clinical Diagnosis I is not a "Graded" unit. Instead, the student receives marks of "satisfactory" (S or 2), "borderline satisfactory" (B or 3) and "unsatisfactory" (U or 4). In addition, to monitor progress more closely and to compare one cohort to another, the unit assessor further breaks the "unsatisfactory" and "satisfactory" work into two subsets, extremely good (SA or 1) or extremely unsatisfactory (UA or 5), and also records notable observations about the progress of the students. Although it is difficult to assign a percentage to these grades due to the varying importance of the material and the varying degree to which the student was correct or incorrect, these grades equate to approximately the following percentage scale: SA (1) 95-100%; S (2) 65-95%; B (3) 50-65%, U (4) 25-50%, UA (5) 0-25%. All grades in both cohorts (CDROM and online) were awarded by the same unit assessor, and all cases were identical throughout the analysis period.

Statistical Analysis

Initially cross tabulation analyses were performed on the "grade" outcomes (grades 1 to 5) and for the "binary" outcomes (Pass or Fail) for Clinical Diagnosis students by "instruction method" (CDROM or online) and the "systems" of the body (GIT, Respiratory and Endocrine) assessed. Pearson's Chi Squared tests and Fisher's exact test were used to assess differences between the systems and instruction method. This method ignores the inherent dependence of response as 24x3 scores are nested in "student" (18). These analyses were fitted using SPSS Version 14.

In order to account for the lack of independence of the outcome observations, multilevel (or mixed model) analyses were conducted for both the "grade" outcomes and for the "binary" outcomes (Pass or Fail). The "grade" outcomes were assumed to have a normal response and the "binary" outcomes (Pass=1, Fail=0) were modeled by a generalised mixed model with a logit link. All models were fitted in R statistical package with LME4. The multilevel structure of hierarchy was observations (Part and case [24]) nested in "system" (3), nested in "student" (18). For the "grade" outcomes, the variance for the system level was not different to zero so observations were nested in "student" only. The fixed effects of "instruction method", "system" and cohort-by-system interaction were included in the models fitted, with any non-significant effects (except for the cohort main effect) excluded from further analyses. The model comparisons were conducted with the Chi-square test of differences between likelihoods.

Results

A total of eighteen students ("students") were included in the study with ten using the CDROM and eight using the online "instruction method". Tables 1 and 2 present the number and percentages for "grade" outcomes (grades 1 to 5, where 1 is extremely good and 5 is extremely unsatisfactory) and for "binary" outcomes (Pass or Fail) by "Cohort" (instruction method), collapsed over "system". [U1]

Table 1: Grade outcomes (grades 1-5): Number and percentages by cohort (instruction method)

			Grade					Total
			1 SA	2 S	3 B	4 U	5 UA	
	CDROM cohort	Count	39	545	110	18	8	720
		% within cohort	5.4%	75.7%	15.3%	2.5%	1.1%	100.0%
	On-line cohort	Count	84	453	30	7	2	576
		% within cohort	14.6%	78.6%	5.2%	1.2%	.3%	100.0%
Total		Count	123	998	140	25	10	1296
		% within cohort	9.5%	77.0%	10.8%	1.9%	.8%	100.0%
		% within grade	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Table 2: Binary outcomes (Pass/Fail): Number and percentages by cohort (instruction method)

		Pass	Fail	Total
CD-rom cohort	Count	694	26	720
	% within Cohort	96.4%	3.6%	100.0%
	% within Outcome	55.0%	74.3%	55.6%
on-line cohort	Count	567	9	576
	% within Cohort	98.4%	1.6%	100.0%
	% within Outcome	45.0%	25.7%	44.4%
Total	Count	1,261	35	1,296
	% within Cohort	97.3%	2.7%	100.0%
	% within Outcome	100.0%	100.0%	100.0%

Multilevel results for grade outcome and binary (pass/fail) outcome

System and cohort-by-system interactions were non-significant and are excluded from the presented models. Similarly, due to the random effect at the system within student level being close to zero, only nesting of observations within students was retained. Table 3 presents the results of these analyses with Cohort being significant for grade outcomes (p=0.009) and of borderline significance for binary outcomes (p=0.098). Table 4 presents the estimated means for the two cohorts for the grade and binary outcomes.

Table 3: Results of multilevel analyses for the grade (1-5) and binary (pass/fail) outcomes

			Parameter Estimate	SE	T statistic	P value
Grade Outcome	Fixed effects	Intercept	2.182	0.055	39.92	0.000
		Cohort (online)	-0.241	0.082	-2.94	0.009
	Random effects	Student	0.025	0.160		
		Residual	0.307	0.554		
			Parameter Estimate	**SE**	**Z statistic**	**P value**
Binary Outcome	Fixed effects	Intercept	3.484	0.298	11.674	0.000
		Cohort (online)	0.862	0.521	1.654	0.098
	Random effects	Student	0.423	0.651		

Table 4: Estimated Cohort means for the grade (1-5) and binary (pass=1, fail=0) outcomes

Outcome	**Cohort**	**Mean**	**SE**	
Grade (1-5)	CDROM	2.182	0.055	
	Online	1.941	0.061	
		Mean (logit scale)	**SE**	**Prob of pass**
Binary (Pass=1, Fail=0)	CDROM	3.479	0.296	0.970
	Online	4.344	0.425	0.987

Summary means

Table 5 presents overall mean score for individual students for both grade and binary scores.

Table 5: Individual student mean scores for the grade (1-5) and binary (pass=1, fail=0) outcomes

		CDROM cohort			Online cohort		
Outcome	Student	Count	Mean	SD	Count	Mean	SD
Grade	1	72	2.19	0.642	72	1.89	0.430
	2	72	1.82	0.454	72	1.93	0.565
	3	72	2.21	0.604	72	1.81	0.399
	4	72	2.21	0.555	72	1.79	0.409
	5	72	2.51	0.872	72	2.35	0.632
	6	72	2.22	0.510	72	1.94	0.471
	7	72	2.18	0.657	72	1.83	0.531
	8	72	2.24	0.544	72	1.99	0.517
	9	72	2.11	0.491			
	10	72	2.13	0.502			
Pass/Fail	1	72	0.97	0.165	72	1.00	0.000
	2	72	1.00	0.000	72	0.97	0.165
	3	72	0.97	0.165	72	1.00	0.000
	4	72	0.97	0.165	72	1.00	0.000
	5	72	0.86	0.348	72	0.94	0.231
	6	72	0.97	0.165	72	0.99	0.118
	7	72	0.96	0.201	72	0.99	0.118
	8	72	0.97	0.165	72	0.99	0.118
	9	72	0.99	0.118			
	10	72	0.97	0.165			

Summary of results

The online cohort scored significantly higher grades when assessed by the "grade" outcomes (grades 1 to 5; p=0.009) but this did not reach statistical significance for the "binary" outcomes (Pass or Fail; p=0.098). The largest differences in "grade" outcomes involved the specific grades "extremely good" (SA or 1) and "borderline satisfactory" (B or 3). A total of 14.6% of the online cohort had achieved SA compared to 5.4% of the CDROM cohort. Meanwhile, 15.3% of the CDROM cohort scored "borderline satisfactory" while only 5.2% of the on-line cohort scored that grade.

Discussion

Evaluation of both innovations in delivery have now been undertaken by an independent research assistant and show that while technology issues have sometimes been of concern, students' access to these units of study has been significantly extended to those who cannot attend a university campus, and at the same time their learning has been enhanced. Limitations of CDROM resources arising from their need for prompt administrative support in handling passwords and the separate issue of providing prompt pedagogical feedback provoked the urgent adoption of online delivery mechanisms as an alternative.

Student grades for Clinical Diagnosis I were analysed statistically and results indicate that a significant difference in student performance can be seen when using the online case based activities and reflection sheets over the CDROM resources. Most notably, 14.6% of the work submitted by the online cohort was "extremely good" (SA, 1) in comparison to 5.4% of the work submitted by the CDROM cohort. Likewise, 5.2% of the online cohort's work was "borderline satisfactory" (B, 3) in comparison to the 15.3% recorded in the assessment work by the CDROM cohort.

Conclusions

The two units Clinical Diagnosis I and II have been transformed over time from face-to-face lectures and case based tutorial feedback, to online delivery with tailored pacing and automated reflection sheets that prompt deep learning by external students. An interim version using CDROM was developed for use while the target cohort of students did not as a whole have access to networked computer technologies. Now that the target cohort of students has ready access to networked computer technologies, these units stand as a unique innovation in the discipline of natural medicine, engaging students in authentic case based activities online.

Through evaluation of both units through student interviews, case based and problem based approaches to teaching and learning of clinical diagnosis procedures and protocols in natural medicine have been shown to be stimulating, motivating and robust. Throughout the two technology innovations in delivery over the past six years, the question of case based and problem based learning has not been in any doubt as to their effectiveness and relevance. The authentic nature of patient cases has well withstood the test of time as well as proving to be of greater importance to students than the series of complications that the innovations in delivery presented in some instances.

With the introduction of online delivery, several factors have played a role in the students' experience of the units including the unit assessor's initial unfamiliarity with scripting algorithms for Adaptive Release, failure of the software to deliver functionality as promised, students' uncertainty with the online learning environment and the additional inclusion of reflection sheets for immediate circulation of generic feedback. Notwithstanding the room for improvement, online cases have been shown as having a positive impact on student grades in relation to the unit Clinical Diagnosis I.

Overall conclusions to be drawn for future delivery of these units are: provide problem-free access to unit resources and interactions with staff; ensure appropriate scripting of Adaptive Release algorithms and its full functionality for individual tailoring of system responses to student submissions; provide timely and fulsome feedback as is now available in reflection sheets; establish clear expectations for students; and maintain a security of case resources to prevent cheating and preserve complex cases already developed.

In addition, the use of reflection sheets in the online version has proved to be critical in developing students' skills in critical reflection and in deepening their understanding of diagnostic decision-making. Reflection sheets can be further developed to provide more distinct feedback with the fully functional use of Adaptive Release. With this additional enhancement, individual student performance may be tracked and thus possibilities for converting from an ungraded to a graded unit may also be explored further. Such personalisation of learning is something which is currently in focus internationally with the OECD, the EU, New Zealand and Australia recently publishing reports on initiatives making progress in this regard (Redman, 2008). A more personalised system of learning through use of online clinical cases is a development we are now exploring further.

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References

Alavi, C (Ed) (1995) *Problem Based Learning in a health science curriculum*. London: Routledge

Benbunan-Fich, R & Hiltz, S (1999) Educational applications of CMCs: Solving case studies through asynchronous learning networks. *Journal of Computer Mediated Communication, 4*(3)

Candy, P (2004) *Linking Thinking: Self-Directed Learning in the Digital Age*. Canberra: DEST

Carswell, L, Thomas, P, Petre, M, Price, B & Richards, M (2000) Distance education via the Internet: The student experience. *British Journal of Educational Technology, 31*(1), 29–46

Ertmer, P, Newby, T. & MacDougall, M. (1996) Students' responses and approaches to case-based instruction: The role of reflective self-regulation. *American Educational Research Journal, 33*, 719–752

Habeshaw, S, Gibbs, G & Habeshaw, T (1993). *53 Interesting Ways to Assess Your Students*. Melksham, UK: Cromwell Press

Herrington, J, Oliver, R & Reeves, T (2003). Patterns of engagement in authentic online learning environments. *Australian Journal of Educational Technology, 19*(1), 59–71. http://www.ascilite.org.au/ajet/ajet19/herrington.html

Jonassen, D, Peck, K & Wilson, B (1999) *Learning with Technology: A constructivist perspective*. Upper Saddle Rver, New Jersey: Merrill, an imprint of Prentice-Hall

Kerka, S, Wonacott, M, Grossman, C & Wagner, J (2000) Assessing Learners Online: Practitioner File. Retrieved 5 June 2003

Morgan, C, Dunn, L, Parry, S & O'Reilly, M (2004) *The Student Assessment Handbook – New Directions in Traditional and Online Assessment*. London: RoutledgeFalmer

O'Reilly, M. & Morgan, C. (1997). Designing WebCDs: A low cost option to enhance learning and interaction. In *What works and why: Reflections on learning with technology. Proceedings ASCILITE Perth 1997*. http://www.ascilite.org.au/conferences/perth97/papers/O'reilly/O'reilly.html

Patel, A, Russell, D & Kinshuk (1999) Assessment in a cognitive apprenticeship-based learning environment: potential and pitfalls. In S Brown, P Race & J Bull (Eds.), *Computer-Assisted Assessment in Higher Education*. Birmingham: SEDA: Kogan Page

Redman, C (2008) *Contributions of video-podcasting and blogging to increase reflection in science education learning at tertiary level.* In EdMedia World Conference on Educational Multimedia, Hypermedia & Telecommunications, Vienna, Austria, pp. 3908–3916

Rendas, A, Fonsesca, M & Pinto, P (2006) Towards meaningful learning in undergraduate medical education using concept maps in a PBL pathophysiology course. *Advances in Physiology Education, 30*, 23–29

Stein, S, Isaacs, G & Andrews, T (2004) Incorporating authentic learning experiences within a university course. *Studies in Higher Education, 29*(2), 239–258

Thorpe, M (1998) Assessment and 'third generation' distance education. *Distance Education, 19*(2), 265–286

Woods, D (2003) ABC of learning and teaching in medicine: Problem based learning. *British Medical Journal, 326*, 328-330

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