"WELL NOBODY READS LEARNING OUTCOMES DO THEY?" – AN EVALUATION OF CAA AND ITS FEEDBACK ON DIRECTING STUDENT LEARNING

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"Well Nobody Reads Learning Outcomes Do They?" – An Evaluation of CAA and its Feedback on Directed Student Learning

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Background

Traditionally anatomy is taught to dental students in the first one or two years of their course and not revisited. The problem with separating this basic, discipline-specific knowledge from that needed for clinical practice is that students can view anatomy as a mass of facts, learnt for examinations and then forgotten. Such superficial learning can be partly overcome by using case-led or problem-solving approaches but the students do not have enough clinical experience to see these examples as anything more than vignettes. Therefore a collaborative project between an anatomist, dental surgeon and a learning technologist was funded by the LTSN-01 to develop six clinically relevant anatomy tutorials for final year students, running on the university's virtual learning environment. Participation was voluntary in the first year of the project upon which this study is based.

The vertical integration of basic and clinical science is one of the important principles adopted by the General Dental Council in its document that sets out the framework for dental education in the UK (ref here!). This integration is also of pedagogical importance as it provides a means to "link theoretical ideas with practice" (Ramsden, 2003) and thus can contribute to effective teaching, moving students further up the critical matrix of learning (Light and Cox, 2001). This issue of integrating factual content with professional practice throughout a professional programme (ie vertical integration) is faced by many subject areas, for example Law, Speech and Language Sciences and Medicine, and so it is hoped that the results of this initial study will be of interest to those beyond Dentistry.

Aim

To evaluate the role of computer aided assessment and its feedback in directing students' learning in virtually taught courses and to investigate the impact of differences in attitudes to study on a virtually taught anatomy package.

Methods

Each tutorial contained two formative tests consisting of extended matching items. The questions were set by subject experts, who have extensive experience of designing EMIs for paper-based examinations, and reviewed by the learning technologist with the 'Guide to Objective Tests' published on the Computer Aided Assessment (CAA) Centre website in mind. Questions were tested and validated by a senior member of staff in the School of Dental Sciences who was otherwise unassociated with the project.

The same feedback was given for both correct and incorrect answers and was written using the draft 'Checklist for Effective Feedback' (lent to one of the authors by the Director of the FDTL-4 OLAAF project). Compliance was achieved for the majority of the checkpoints, for example, "feedback focuses on the task without directing attention to the learner" and "feedback includes details of the correct answer rather than simply indicating whether the answer was correct or not", however it was not possible to ensure that "feedback does not include marks" due to the fact that the only assessment tool available was that within Blackboard[™] which always shows students their marks if feedback is given. Relevant medical (Ende 1983, Hewson and Little 1998) literature was also used to guide the writing of feedback.

The pre-tutorial test asked purely anatomical questions with the aims of reminding the students of the vocabulary and language of anatomy and triggering the recollection of information learned in the early years of their course, for example:

Question 1 Matching

Within the skull there are numerous foraminae that transmit structures that enter and leave the cranium.

From the list to the right select the structures that are transmitted by openings shown in the list on the left $% \left({{{\rm{T}}_{\rm{T}}}} \right)$

_ Vale	A. mandibular division of trigeminal	
Stylomastoid	B. maxillary division of trigeminal	
	C. internal carotid artery	
 Superior orbital fissure 	D. external carotid artery	
_ + foramen lacerum	E. facial nerve	

- F. oculomotor nerve
- G. trigeminal nerve
- H. jugular vein
- middle meningeal anastomoses

4 points

- J. infraorbital nerve
- K. pons
- L. none
- M. facial artery
- N. glossopharyngeal nerve
- O. vagus

Figure 1. Example pre-test question

Question	Correct Match	Selected Match
Ovale	✓ 1 mandibular division of trigeminal	× 3 internal carotid artery
Stylomastoid	✓ 5 facial nerve	×6 oculomotor nerve
Superior orbital fissure	✓ 6 oculomotor nerve	×10 infraorbital nerve
foramen lacerum	✓ 12 none	× 15 vagus

Feedback: The foramen ovale transmits the mandibular division of the trigeminal nerve. The maxillary division is transmitted by foramen rotundum while the opthalmic division leaves the skull via the superior orbital fissure

The only cranial neve transmitted by the stylomastoid foramen is the facial nerve

The superior orbital fissure transmits numerous structures the most important of which are; CN III, IV, VI and ophthalmic division of the trigeminal nerve.

The foramen lacerum transmits no structure of any significance.

Figure 2. Example pre-test feedback

The post-tutorial test asked questions that applied the subject matter just covered in the tutorial to a clinical situation likely to be encountered, testing the ability of the student to apply theoretical knowledge to real life situations. Therefore in the question below, the student is being asked to apply their knowledge of the structure of the skull (where the bones/holes are, which nerves go through which holes, what the nerve functions are etc) to an example case study of a patient who has suffered a head injury.

Example post-test question and feedback:

Question 1	Matching 0 of 4 points	
	A patient attends circumorbital ecchymosis (bruising) of the right eye after having been involved in a fight the previous evening. On examination the patient is found to have the following symptoms, all confined to the same side as the bruising, ophthalmeplegia (paralysis of eye movements), mydriasis (dilated pupil), loss of the corneal reflex, anaesthesia of the forehead and ptosis.	

From the option list select the nerve that, if damaged, would result in the following symptom.

Question	Correct Match	Selected Match	
ophthalmeplegia	🗸 16 III, IV & VI	× 5 V(div1)	
absence of the corneal reflex	✓ 5 V(div1)	×8 VI	
forehead anaesthesia	✓ 5 V(div1)	× 17 Ⅲ, VI	
mydriasis	✓ 3 III	×11	

Feedback: The observed effects of this trauma are due to damage to structures that pass through the supraorbital fissure. Supraorbital fissure syndrome (opthalmoplegia, mydriasis, loss corneal reflex, forehead anaesthesia)can occur with base of skull fractures, or complex zygomatico-orbital fractures. To cause it the superior orbital fissure becomes narrowed or is impinged on in some way, thereby disrupting the nerves that pass through it.

Dealing first with the ophthalmaplegia. The main nerve that supplies the extraocular muscles is the oculomotor nerve but two further nerves are also involved each supplying a single muscle and these are the trochlear and the abducent. Their role in control of extraocular eye movements must not be overlooked.

The afferent limb of the corneal reflex involves the ophthalmic division of the trigeminal nerve passing through the fissure. Damage to the nerve in the fissure will result in the loss of the reflex.

This nerve goes on to supply an area of skin over the forehead and this anatomical fact explains the forehead anaesthesia.

Finally, within the oculomotor nerve are found preganglionic parasympathetic axons controlling pupil constriction. Consequently, damage to this nerve will result in the action of sympathetic dilator axons being unopposed and the consequent pupil dilation.

Evaluation of data

A priority sequence model (Morgan 1998) was used to evaluate the entire project, although the areas of interest here are:

- whether attitudes to study had an effect on the student's likelihood of completing all the materials
- whether test scores had an effect on the students likelihood of completing all materials
- what the students thought of the assessment and feedback materials and how they used them



• whether the students would continue using materials as their summative assessments approached.

The priority sequence model involves two phases; qualitative and quantitative. The qualitative phase was a series of semi-structured in-depth interviews using a purposive sample of students (see Table 1) and a discussion guide setting out areas that needed to be covered in the interviews. The interviews continued until data saturation was achieved, ie, no new opinions were raised (n=13). The discussion guide was designed to be as broad as possible, and included several assessment-related topics for example: use of feedback, focussing effects of tests, patterns of use etc.

Completion of Course	Pretest score in comparison to year-group (W[ell], P[oor], M[ean], D[idn't attempt])	Post test score in comparison to year-group (W[ell], P[oor], M[ean], D[idn't attempt])	Pre to post test comparison (p[ositive] or n[egative]
С	W	W	Р
PC	W	W	Р
PC	W	W	Ν
NC	D	D	0
С	Р	Р	Р
NC	Р	Р	Ν
PC	Μ	W	Р
PC	D	W	0
NC	Р	D	0
С	Р	Μ	Р
С	Р	Μ	Р
PC	Р	Р	Р
NC	D	D	0
8PC, 4C, 4NC	3W, 1M, 6P, 3D	5W, 2M, 3P, 3D	8P, 3N

C= Completer. Defined as person completing more than four tutorials at 10/12/4 (2 weeks post release of last tutorial)

PC= Partial completer. Defined as person completing two-three tutorials at 10/12/4

NC = Non completer. Defined as person completing zero-one tutorials at 10/12/4

Well defined as one standard deviation above the mean score of the year

Poor defined as one standard deviation below the mean score of the year

Pre to post test comparison defined as - post-test score minus pre-test score. This was calculated in all tutorials and a mean taken defining it as a negative or a positive value.

Table 1. Purposive Sample details

The data from the interviews was analysed by one of the authors and validated by an independent researcher using framework analysis (Bryman and Burgess 1994) and the constant comparative technique (Glaser 1965). The analysis drew out common concerns that were then used in the quantitative phase. This phase involved the construction of a questionnaire that the whole year group was asked to complete. Questions were devised using the common concerns from the first phase and a series of questions taken from the Assessment Experience Questionnaire (currently being rewritten by the FDTL4 funded FAST project).

Interviewees were also asked to complete the Approaches and Study Skills Inventory for Students (ASSIST) questionnaire designed by Entwistle (Tait, Entwistle and McCune, 1997). This questionnaire aims to rate students on their tendencies towards each of the Deep, Strategic and Surface Apathetic approaches to learning. It should also highlight whether they conceive of learning as 'reproducing' or 'transforming' and whether their preferred learning environment is one in which 'understanding is encouraged' or 'information is transmitted'.

Results

A number of interesting themes emerged from the qualitative phase:

Several of the interviewees expressed unease at having to use a computer to work through the tutorials "I don't like computers really...if I can help it I try not to use computers", "I'm not particularly hot [at using the computer]", "I've never been one for computers" so questions on the ease of access and student's perceptions of their level of computer skills in comparison with their peer group and also in comparison with other year groups were included in the quantitative questionnaire.

It was implicit throughout the data that the learning outcomes for the tutorials were not the directing force for the students' learning and in some cases it was explicit that the students never looked at them with quotes such as "well nobody reads learning outcomes, do they?". The students broadly agreed that the pre-tests focussed their attention on specific areas of the tutorial and were therefore the directing influence on their learning – "Pre-tests were good in the fact that they kind of made you focus on what you needed to know" although one student deliberately chose not to do the pre-tests because "I didn't really want to make myself feel a bit thick. I prefer to learn something and then test myself".

There were also recurring statements that supported the intentions that the CAA feedback would aid their understanding and direction of learning – "There'd be no point in doing them [the tests] if you didn't get feedback on what we got wrong". Statements were also made which highlighted that the tutorials made the students realise how much of the previous years' work they had forgotten and needed to revise "kinda positive - reaching this stage of the

course and realising 'O my god I don't know this stuff ' you're just a bit frightened".

The degree to which the interviewed students claimed that the pre-tests rather than the learning outcomes focussed their learning was not expected and questions designed to test whether all students followed this pattern, and whether they did in fact read and understand the learning outcomes were included in the quantitative questionnaire.

Analysing the ASSIST data in the subsets of Completers, Partial Completers and Non-completers showed some interesting trends: Completers had the seemed to have the strongest tendency towards the Deep Approach to learning; Partial completers seemed to have the strongest tendency towards the Strategic Approach and those who counted as non-completers seemed to show the strongest tendency towards the Surface Approach (see Table 2). On testing using one-way ANOVA, even when putting the Completers and Partial Completers into the same category (using one-way planned ANOVA), these tendencies were shown not to be significant (see Table 3). However, there are a number of factors that need to be taken into consideration:

- lack of significance could have been due to the purposive rather than random nature of the sample and the small sample size.
- final year dental students are usually very focussed on successful completion of their studies. It is a degree programme that requires students to work hard, but which offers significant rewards to those who complete it successfully. The general assumption is that these students are unlikely to have strong surface apathetic attitudes to study.

Group means			
Groups	Completer	Partial	Non
	-	Completer	Completer
Ν	4	5	4
Deep Approach	0.76	0.68	0.61
Seeking meaning	0.76	0.65	0.59
Relating ideas	0.79	0.7	0.68
Use of evidence	0.79	0.81	0.61
Interest in ideas	0.7	0.57	0.55
Strategic Approach	0.63	0.7	0.68
Organised studying	0.64	0.56	0.69
Time management	0.56	0.56	0.64
Alertness to assessment demands	0.51	0.71	0.7
Monitoring effectiveness	0.74	0.89	0.71
Achievement motivation	0.68	0.76	0.64
Surface Apathetic Approach	0.52	0.6	0.61
Lack of purpose	0.3	0.5	0.4
Unrelated memorising	0.55	0.56	0.63
Syllabus boundedness	0.66	0.78	0.69
Fear of failure	0.54	0.59	0.73
Pref for learning environments			

Deep (encouraging understanding)	0.74	0.67	0.53
Surface (transmitting information)	0.86	0.95	0.95
Conceptions of Learning			
Learning as reproducing	0.75	0.95	0.85
Learning as transforming	0.87	0.83	0.73

Table 2. Grouped results from the ASSIST questionnaire

Attitude criteria	Significance measures	Significance measures
	of difference between	of difference between
	groups (C, PC, NC)	groups (C, PC, NC)
	using one-way ANOVA.	using planned one-way
	S= Significant	ANOVA.
	NS = Not significant	S= Significant
		NS = Not significant
Deep Approach	0.174, NS	0.102, NS
Seeking meaning	0.153, NS	0.125, NS
Relating ideas	0.612, NS	0.506, NS
Use of evidence	0.175, NS	0.072, NS
Interest in ideas	0.237, NS	0.295, NS
Strategic Approach	0.412, NS	0.761, NS
Organised studying	0.418, NS	0.317, NS
Time management	0.773, NS	0.485, NS
Alertness to assessment	0.134, NS	0.332, NS
demands		
Monitoring effectiveness	0.126, NS	0.221, NS
Achievement motivation	0.345, NS	0.306, NS
Surface Apathetic	0.443, NS	0.442, NS
Approach		
Lack of purpose	0.339, NS	1.00, NS
Unrelated memorising	0.455, NS	0.221, NS
Syllabus boundedness	0.644, NS	0.788, NS
Fear of failure	0.348, NS	0.166, NS
Pref for learning		
environments		
Deep (encouraging	0.083, NS	0.035, S
understanding)		
Surface (transmitting	0.316, NS	0.441, NS
information)		
Conceptions of Learning		
Learning as reproducing	0.451, NS	0.232, NS
Learning as transforming	0.172, NS	0.844, NS

Table 3. Results of tests to determine whether there are any statistically significant differences in attitudes to study between completers, partial completers and non-completers

The completion rate for the overall evaluation was 70%, a high enough level to take the responses received as being representative of the year group as a whole.

• How good did the students perceive their computing skills to be? 81% said that they perceived their skills to be as good as or better than the rest of their year group and 83% thought that the computing skills of their year were as good as or better than students in the years below them. 84% agreed or strongly agreed with the statement "I found the tutorials easy to access and use" (8% were undecided and 8% disagreed). Students were also asked whether a lack of computing skills made it difficult to complete the tutorials and 87% said that it did not (6% were undecided and 6% said that it did).

• Did the students read and understand the learning outcomes?

82% agreed or strongly agreed with the statement "I read and understood the learning outcomes for the tutorials" (12% were undecided, and 6% disagreed).

• Did the students use the questions in the pre-tests to focus/direct their learning efforts as they worked through the tutorials?

63% agreed or strongly agreed with the statement "the questions in the pretests focussed my learning" (14% were undecided and 23% disagreed).

• Would the students have liked more questions in both the pre and post tests?

63% would have liked to see more questions in the tutorials (16% were undecided and 21% would not have liked more questions)

• Will the students be using the tutorials and the tests again?

75% said that they would be using the tutorials again, 13% were undecided and 12% said that they would not be using them. In fact, 55% of the students have accessed the materials since the end of the project (although it has not been possible to determine whether they were retaking the tests and how many of the tutorials they accessed) and the authors expect this number to rise in the days before and during the final examinations (ie at the end of May and beginning of June).

• Did the students find the pure anatomy (pre-test) questions more difficult than the applied anatomy (post-test) questions?

39% of the respondents found the pure anatomy questions more difficult than the applied questions, 38% were not sure and 23% did not find them more difficult.

• Did the students feel that the feedback helped develop their understanding of the materials in the tutorials?

73% of the respondents thought that the feedback given in the tests helped with their understanding of the tutorials overall. 17% were undecided and 10% though that the feedback made no difference to their learning.

• Did the students understand the feedback?

The students were asked whether they agreed with the statement "I didn't understand the feedback". 77% of respondents disagreed with this statement,

21% were undecided and 2% agreed that they didn't understand the feedback.

• Did the students take time to read the feedback carefully?

79% of the evaluation respondents claim to have read the feedback to questions carefully, 13% were undecided and 8% say that they did not take any extra time to read and digest the feedback.

• Did the feedback prompt students to re-read the tutorials as soon as they had completed the tests?

67% of respondents claim that they did re-read the tutorials as a result of the feedback received from the tests, 13% were undecided and 20% said that the feedback did not influence whether they went through the tutorials again.

• Did the students intend to use the feedback from the questions to help them revise?

52% of respondents agreed with the statement "I will use the feedback to help in my revision", 25% were undecided and 23% disagreed with this statement.

• Did the students intend to use the tutorials and tests overall as part of their revision programme?

82% of the respondents said that they intended to use the tutorials as part of their revision programme, 10% were undecided and only 8% said that they did not intend to use the tutorials in their revision. (Note, the answers to this question tally reasonably well with those to the earlier question 'will you use the tutorials again' although it appears that adding the word 'revision' may have skewed the results more in favour of tutorial use!).

Conclusions

For the purposes of this paper the questions to be answered were:

• whether attitudes to study had an effect on the student's likelihood of completing all the materials

It appears that attitudes to study did not have any effect on the students' likelihood of completing the materials and tests. However, this will be tested more rigorously in the next phase of the project (see future plans section below).

• whether test scores had an effect on the students' likelihood of completing all materials

The tracking facilities available to the authors (in terms of the number of times that a student had accessed a test and the scores that they had achieved each time the test was accessed) proved inadequate to answer this question. The authors are currently seeking ways to address this question in the next stage of the project. • what the students thought of the assessment and feedback materials and how they used them

It is clear, both from the qualitative and quantitative evaluation results that the students liked the assessments and feedback and that many of them did use the feedback to help them to learn the materials. As previously stated, the authors had not expected the students to use the pre-tests rather than the learning outcomes to focus their efforts. It appears therefore, that one of the keys to devising formative assessment that is completely integrated with content written for self-directed learning is to ensure that any introductory assessments are broad enough to cover all the elements listed in the learning outcomes. This will mean that it does not matter whether the students read and digest the learning outcomes – as long as they have completed any pretest questions.

• whether the students would continue using materials as their summative assessments approached.

Although it has previously been stated that the tracking facilities available within the VLE were not good enough to enable the authors to answer some of the earlier questions, it has been possible to track how often students accessed the section of the VLE that contained the materials (this section had no other content). The materials have been accessed over 100 times in total (by 38 out of 69 students) since the end of the project, indicating that not only did the students say that they were going to use the materials as their summative assessments approach, but that they actually are doing so. Informal evaluation of the students' clinically relevant anatomy skills will take place during their vivas (formal evaluation and measurement of improvement is not possible for this stage of the project because the tutorials were not a compulsory element of the programme).

Future plans

The authors have been awarded an internal grant to support the continuation and expansion of this project into a second year. The tutorials will be used with students in all the clinical years of the undergraduate degree in a staged fashion (two tutorials will be used with the 3rd year students, four tutorials will be used with the 4th year students and all six tutorials will be used with 5th year students). The tutorials will also be released to 2nd year postgraduate students. This will increase the overall group size from around 70 to between 240 and 275. The authors are also in the process of seeking approval from the school Board of Studies to include the completion of the tutorials as a compulsory element of the undergraduate programme (although the assessments will remain formative only) and indications are that it is likely that this approval will be given. The tutorials will not be compulsory for the postgraduate students, however, anecdotal evidence is that postgraduate dental students are even more highly motivated than they are as undergraduates and the authors feel that it is likely not to matter whether the tutorials are compulsory or not – if they are there, the students will use them.

Whether this is a reliable assumption will be shown over the next twelve months.

The extension project (as with the original project) extends beyond the assessment materials and attitudes to study covered in this paper and includes the writing and formatting of all content, the use of images, ensuring that all materials are presented in a form that complies with accessibility and readability guidelines. The elements that are relevant to this paper are:

• Refining of existing questions and addition of questions, ensuring that all questions are related to the stated learning outcomes.

The relationship between stated learning outcomes, tests within the package and actual student learning will be the subject of further detailed evaluation. The authors will again be using the Priority Sequence model to help determine a framework for the qualitative evaluation and will use the results of that evaluation and the Assessment Experience questionnaire to drive the contents of the quantitative evaluation. The authors also hope to use the tracking of student results (described below) and measures yet to be agreed from the students' summative assessments to help determine whether the tutorials and assessments have an effect on actual student learning.

• Using the Attitudes to Study questionnaire with all participating students, rather than just those being interviewed.

The Attitudes to Study questionnaire will be administered to all students before they are introduced to the tutorials and after they have completed them. The authors hope that this will enable them to determine whether the initial attitudes to study have an effect on the likelihood of completing the materials, whether there are differences between the undergraduate year groups and the postgraduate cohort, and also whether the very different mode of teaching used in the tutorials has an effect on the student's attitudes to study (whilst remembering that there are many different factors that can influence student attitudes over the course of their studies).

• Tracking the number of times that students access the tutorial materials, and attempting to track the results they get each time they take one of the assessments.

Improvements to the tracking facilities within the VLE will enable the authors to keep a better track of how often each student accesses the tutorials over the course of the study and thus to be able to validate (or not) some of the results from the quantitative analysis that will again take place. The authors believe that some students complete evaluations (even anonymous ones) with an eye to what they think their tutors want them to say, rather than totally honestly. The authors are also hoping to keep a better track of the student assessment results, whether by using a different assessment engine or by asking students to record their marks in an online database each time they take and/or re-take an assessment.

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