

Action Learning in English and Anatomy

*Marie Lenstrup, Peter Lucas, Jon Prinz, George Tipoe, Denis Williamson and Henry Yip**

The University of Hong Kong

Abstract

In 1994, the Medical Faculty started to revise its curriculum, adapting it to recent trends in medical education by allowing for increased student participation. Part of these changes involved recognition of the second language factor in Hong Kong education. An English Enhancement programme for medical students was also started in 1994, and worked in concert with the Gross Anatomy course which is renowned for its (usually unquantified but heavy) terminological load. The concurrent upsurge in interest in Action Research within Hong Kong offered the opportunity to initiate a quantified project that could help monitor the developments in both Anatomy and English Enhancement.

On the Anatomy side, tutorials were observed and audiotaped. Subsequent semi-automated analysis of these tapes quantified student versus teacher participation. Individual student participation was also quantified using a real-time computer analysis (TUTOR — specifically-written for the Action Research project) operated by the observer. Students were also given simple verbal and non-verbal quizzes at the end of the tutorials. In addition, student case presentations were videotaped and practical sessions were observed. The final examination results in Anatomy of previous students were also correlated with their A-level grades in Science and the Use of English. Our general conclusion from these investigations is that language is a vital factor in the acquisition of anatomical knowledge at The University of Hong Kong. This may explain why students have great difficulty, initially, in reading assigned texts. The (expected) rate of assimilation of terms in the first few weeks of the anatomy course is staggering (e.g., 600 terms in the first few weeks alone!). This knowledge has been incorporated into subsequent course revisions, allowing for much more realistic expectations of student progress in a second language setting.

Introduction

Background

In 1993, the Faculty of Medicine at the University of Hong Kong initiated a reform of its curriculum. The Anatomy Department made a major change in its Gross Anatomy course (which is that part of anatomy visible at the naked eye level), starting in the academic year of 1994-1995. This consisted of a 15 per cent reduction in formal teaching, a change of instruction manual for the practicals and more interaction during tutorials. The faculty as a whole did not go through with the reform at that time.

Coincident with this quest for reform, the University introduced English Enhancement programmes in all faculties. Denis Williamson, who was placed in charge of this programme for the Medical Faculty, started to contact faculty members in an attempt to integrate the English course into the medical programme in order to maximise its relevance. In May 1994, an emphasis in English on gross anatomy was agreed upon. In order to assess the success of the two changes in the curricula, we sought and obtained an Action Learning Project (ALP). This motivated the designers of both courses to more formally investigate current practices, to monitor the effects

of the changes that were planned and to document the whole project. The major objectives were (i) to identify major hurdles encountered by students in learning gross anatomy and (ii) to encourage more student participation. Unfortunately, all of this transpired too close to the changes in curriculum to assess any clear baseline in the course that had existed for more than ten years previously.

English

Increasing Student Participation

Already somewhat dissatisfied with the way its first year students were learning Anatomy, the Department held an hypothesis that students' results might improve if students were to play a greater role in the learning process. If the teaching were to be less didactic, and more interactive, students might rely less on 'receiving what they need to know' from the teachers and come to 'investigate more of what they decide they need to know'. This goal of increased student participation also seemed a suitable 'hook' onto which an English Enhancement curriculum could be hung. Enhancement courses are designed to be interactive, with student activities guiding the language that is produced, and student participation being a necessary element of English classroom lessons. The English curriculum, therefore, would take several of the activities that were to be part of the 'new' Anatomy curriculum and practise them in the English Enhancement classroom, with the same students and with content drawn directly from the Anatomy classes.

Baselines

First of all, however, we had to try and get some idea of how much participation there already was in our classrooms and indeed how much or how little we encouraged, or actually allowed, students to participate in our lessons.

Therefore, classroom observations were carried out in both courses, using one or more of the following: a human observer (our research assistant), video recordings, audio recordings and computer recorded data (more on the computer data will be discussed below).

Even at this stage, teachers found areas of their behaviour where there was scope for immediate improvement: From over-explanation by the English teacher to mini-lectures by the Anatomy teachers during tutorials.

- Student activities in the Anatomy curriculum which were chosen to be practised in the English classroom were:
- Oral presentations of patient case-histories
- Reading of an instruction manual in Dissection, before dissection sessions.

Other activities in the English curriculum included the building of Medical terminology from prefixes, roots and suffixes, and the almost constant, small group discussion related to preparing for or performing the above activities.

Oral Presentations

First Cycle Action

Students were given a problem in the form of a set of symptoms experienced by a patient. Their task was to work out a diagnosis of this patient and to present, in a lucid way, how they had

reached this diagnosis. Patient cases always related to the topics/parts of the body being studied in Anatomy, in which the final presentations were made during an Anatomy lesson and in front of the students' 170 colleagues. Students worked their own way through the medical diagnoses of these problems, and brought their data to the English class. Presentation skills sessions trained and polished the way the students presented.

Observations

Although the initial presentations were well attended and well received, by the end of the academic year, when class tests were looming large on the horizon, attendance of the audience dropped considerably. After two years of holding presentations this way, opinions expressed by the students who attended the presentations were that they learned so little from them that the time would be better spent reading their textbooks and preparing for the tests. In short, the presentations had turned into 'exhibition pieces' for the presenters, who undoubtedly learned something new from their problem solving task, but a 'non-event' for the audience.

Second Cycle Reflection and Action

Although it was still felt that learning and practising presentation techniques were activities that would be of benefit to students, it was clear that the present arrangements could not continue. The next step, therefore, was to keep the presentations, but to change the context. Presentations became part of Anatomy tutorials. Tutorial groups have 14 to 15 students only. The presentations would therefore be much more informal. It was also suggested that the objective of each presentation would be to teach the other students in the group, who had not gone through the same case. Groups of 14 to 15 students would divide into three smaller groups, each with its own case to work on.

Anatomy tutorial groups also formed the basis of the groupings for English. Students were still given case-histories in the English lesson, which were still related to the topics/parts of the body that students were studying simultaneously in Anatomy. However, this time, and in line with a growing awareness of the techniques of 'Problem Based Learning' (PBL), the cases were divided into stages, allowing students to discuss one stage at a time and to narrow their diagnoses each time they received more information.

This process of discussion markedly changed the activities in the English classroom. Instead of students working on the diagnoses between classes and practising presentations in class, class time was used for the actual discussions, wherein students worked out diagnoses using their own, limited medical knowledge and whatever they could gain from their textbooks. Practice of informal presentations (e.g., using hand held flip charts instead of OHTs in order to present in the smaller tutorial rooms) was fitted in after these discussions.

Observations

Some of the discussions in the English class were a joy to behold. Data from student feedback are still being collated, but initial impressions from watching student behaviour is that students carry out whole discussions in English, and whilst they take a long time to reach decisions, and sometimes make 'medical mistakes', they are really immersed in the activity.

The whole Medical Faculty is planning to make a curriculum switch in September 1997 towards the use of PBL across the board. This initial attempt by the English course has shown that for English, it is indeed a way to involve students in the learning process.

Reading the Dissection Manual (Grant's Dissector 11th Edn.)

This dissection manual was first introduced in September 1994, the year of the curriculum revision, accompanied by some concern from the Anatomy staff that it may be too simple for the students, especially when compared to the dissection manual used in previous years. Actually, it became apparent after a couple of weeks that the dissection manual was proving to be very difficult for many students to understand.

The English course included sessions of reading dissections from the manual (incorporating the activities of reading, discussion and presentation) and synchronising the readings with the actual dissections that students were to perform.

Over the three years that the English course has now been running (bearing in mind that English classes for first year students run for only the first eight weeks of each year) data was collected from students to show:

- (a) that students spend a lot of time reading Grant during the early weeks of the year;
- (b) that actual dissections done by students immediately after English lessons where Grant was read and discussed in class were easier for students than when this was not the case; and
- (c) the actual words and phrases in the manual caused problems to five students who agreed to help out with our data gathering.

There was also anecdotal evidence gathered from Anatomy teachers and other staff involved in the dissection sessions which supported the idea that the dissection performed was of a higher quality than in the years before any of these revisions took place.

Current Reflection

In order to ease the pressure on student reading for dissection, the current thinking is considering a change to the present set up by introducing either:

- (a) a new set of dissection instructions, written locally, to replace Grant; or
- (b) a set of 'pre-teaching' sessions in the English class, which would heighten student awareness of the 'problem' words and phrases highlighted by students in (c) above.

There is also scope here for an analysis of the discourse used in Grant's Dissector. Like some other types of instruction manuals (one thinks of manuals that accompany some computer software) there is a noticeable gap between the perceptions of experts who read the manuals and find them simple to understand, and the perceptions of novices, who read the manuals and often find them largely incomprehensible. Why is this so? What features does the language of Grant's Dissector have that puts it in this category?

Initial investigation shows that there is a lot of 'exophoric reference' in the manual; i.e., text which refers to a body of knowledge that a reader is assumed to have. Items are named, but not explained. Anatomy teachers, of course, already have this body of knowledge (which is undoubtedly why they considered the book to be easy), but new medical students have not yet had time to build up such a body, and this is perhaps a main reason why they find reading the manual so difficult in the early weeks of their first year.

The discourse analysis will form the basis of continuing research on the English side of the project.

Anatomy

Course Innovations in the Gross Anatomy Course from 1994

A set of objectives were introduced as a structure for the entire course. These were contained in a course booklet handed to each student at the start of the course.

A change was made in the dissection manual as students now used Grant's Dissector (11th edn, Sauerland, 1994), which was much shorter than the previous dissector (Zuckerman, Darlington and Lisowski, 1981). It was hoped that the new dissector would be simpler for the students to follow.

Incorporation of students into one of 12 groups preserved throughout the 18 months of the course, for the purposes of small-group tutorials and case presentations. Tutorials were increased in number. Previously, these 90-minute sessions, involving 14-16 students and one teacher, had been loosely arranged. The structure was now understood by all students to be based around objectives given in the course book. Given that all students knew the objectives beforehand, it was hoped that this would increase student participation.

The introduction of student case presentations

Between four to five representatives of each group presented the anatomical aspects of a clinical case in a 10-15 minute period in a lecture theatre in front of the other students and a team of four lecturers. In addition, half of the students underwent team-building sessions organised by staff of the Personal Development and Counselling Centre at the University just prior to the start of the year.

Methodology

Analysis of Linguistic Load

The students were given assigned reading for every week of the course in both the dissection manual and textbook. One staff member went through the set readings given for the first semester, noting the point within these two books where each specialised term (anatomical or clinical) was introduced for the first time. Afterwards, the number of new terms introduced in each week was tallied. This provided a quantified assessment of the assumed terminological 'learning curve' in English that students have to scale. In addition, *Nomina Anatomica*, the international standard for anatomical terms, and medical dictionaries were scanned to find out the size of the anatomical and medical lexicon.

Tutorials

Tutorials formed a focal point of the new course. These had existed in the Gross Anatomy course before, but in smaller numbers and had generally taken a didactic form. The emphasis now was on increased student participation.

Tutorials were observed. The observer acted, in one capacity, as a 'critical friend' (though this epithet is recognised as a distortion of action learning procedures). The observer issued reports to tutors afterwards.

All 90-minute tutorials were audiotaped. Utilising the stereophonic capacity of recorders, the students' participation was recorded onto one channel through microphones wired in series laid on

the table, while the tutor was recorded on the other. These tapes were later digitised, allowing automated analysis of the proportion of time that tutor and tutees spoke.

In some tutorials, the observer also operated a specially-written computer program called MUTTER. This involved assigning keys on a notebook computer keyboard to participants in the tutorial. When anyone started to speak, the key assigned to them would be pressed. The program logged the time spent talking. When they stopped, a second key press stopped the computer log.

Afterwards, analysis of a combination of (ii) and (iii) provided a profile of the tutorial, charting the interactions of the participants. Since there was only one research assistant, but three anatomy staff on the project simultaneously running tutorials, most tutorials only had audiotape records.

At the end of the tutorials, quizzes were given to test students' memory of the topics that had been covered during these 90-minute sessions. Each quiz had a verbal (MCQ) and non-verbal element. The latter involved the labelling of a diagram, which used as little linguistic content as possible. As shown in Figure 1, students could select from a list of terms that included the correct identifications of structures in the diagram by placing a letter against a particular structural feature. In tutorials with an observer and MUTTER, the computer key identifying that participant was entered on the quiz sheet. This allowed correlation of participation in the tutorial and quiz scores.

Lectures

Lectures were videotaped using a small video camera connected to a notebook computer, placed in a convenient location (e.g., on a lectern) and facing the audience. Using a specially-written program, the computer captured a frame from the camera and stored it. Subsequent to the lecture, adjacent frames were played back into computer memory and compared. A digital subtraction allowed all areas of the image that showed colour shifts to be summed. These colour shifts represented movements in the audience. A record of these movements could then be picked up over the course of the lecture.

Case Presentations

In the first two years of the course, representatives from student groups presented cases in a lecture theatre. These were videotaped in a conventional manner. Each presentation was scored by judges from the academic staff.

Practicals

Dissection sessions are a traditional method of teaching three-dimensional morphology. Success in these problem-solving practicals depends heavily on group cooperation. These sessions were both videotaped in the same manner as lectures and also observed with an eye to the roles adopted by students around the dissection tables.

Analysis of Examination Scripts

Randomly-selected scripts from a term test were assessed for their language by the research assistant. Scripts were assigned to one of three grades on the basis of their use of English. Emphasis was placed on clarity and lack of ambiguity rather than on grammatical and spelling mistakes that did not distort meaning. These grades were then correlated with the mark that had been given by the examiner.

Five-minute tests on topics being currently taught in Gross Anatomy were set at the end of the English lessons. These were marked by anatomy staff. Grades awarded by the examiners were also

compared with the length of answers given by the students, as measured simply with a ruler. Final examination papers in Anatomy were not available for study. However, actual grades were examined in relation to the English and Science A-level grades obtained prior to entry to university.

Questionnaires

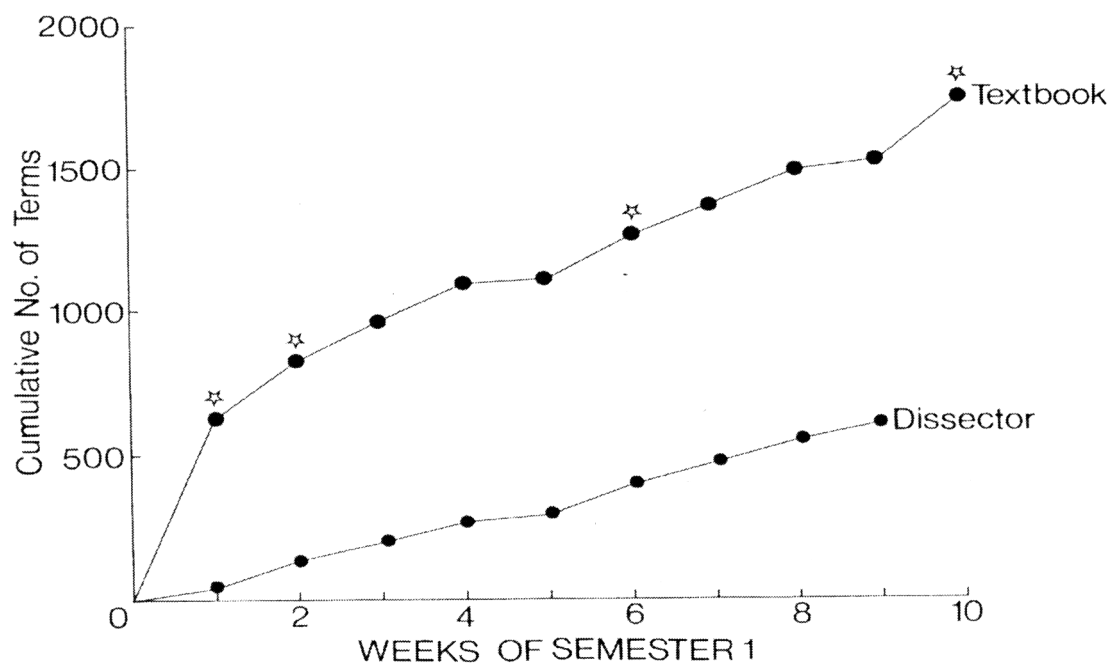
Students were issued with questionnaires that attempted to identify the characteristics they wished to see in an ideal teacher. Blind to these results, staff on the project were issued with a series of audiotapes of tutorials, representing one to two tutorials chosen at random from those facilitated by each staff member. These were coupled with questionnaires, paralleling much of the student questionnaires, which were completed before and after listening to each tape.

Results and Discussion

Samples of results are given here to indicate the value or lack of it of some of the innovative measures of participation that we attempted. These are selected because they proved important in reflecting on what to do next.

Figure 1 plots the astonishing rate at which students are apparently expected to pick up anatomical terms. The textbook includes many more terms than the dissector, but the latter is intended only to include as much as is necessary in order to proceed with a practical task whereas the former must describe structures fully. Nevertheless, it is doubtful whether 600 or more terms really need to be thrown to a student within the first week of university.

Figure 1: The anticipated rate at which students learn terms describing the human body at the 'naked eye' level.



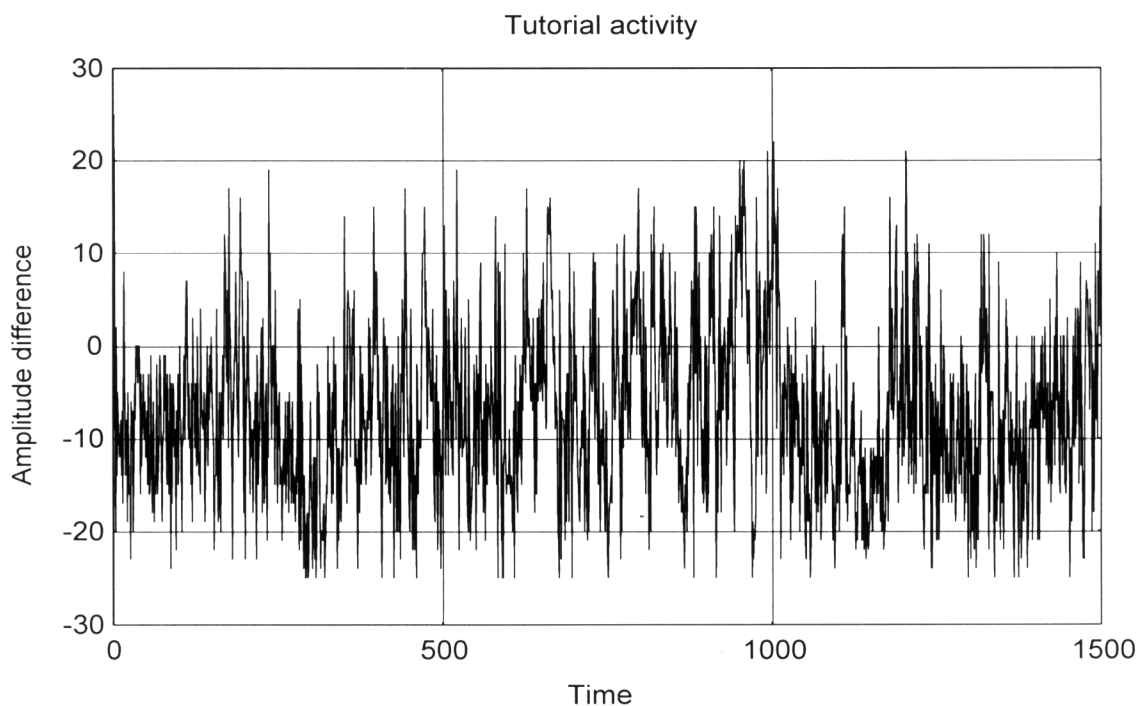
The dissector introduces only those terms required for identification whereas the textbook includes full descriptions in relation to common clinical problems. Thus, some clinical terms are also introduced. The stars indicate the commencement of new regions of the body.

An investigation of core medical dictionaries, i.e., those that do not delve into sub-specialties, reveals a lexicon of about 25,000 terms. In contrast, the total terminology in *Nomina Anatomica* is just less than 6,000 terms. Thus, although the terminological load in anatomy is very high, it is not exceptional within the framework of a medical career.

Tutorials

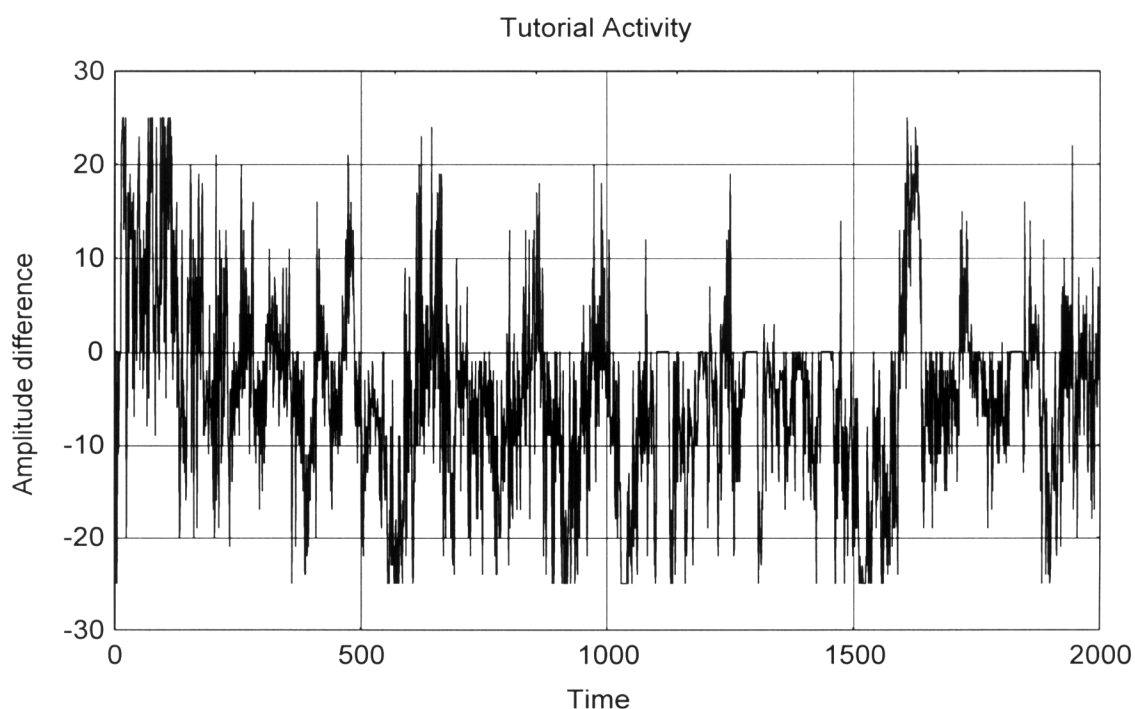
Tutors differed substantially in the format that they adopted for these sessions. Some tutors would lead the session with a rapid 'question & answer' format, while others would assign topics to groups of students who then made mini-presentations after some minutes of reflection and group discussion. These differences emerged very clearly in the digital analysis of the audiotapes. In Figure 2, it can be seen that both tutor and students have very short utterance time, reflecting a 'question & answer' format while in Figure 3, the staff member is initially either giving a mini-lecture or issuing instructions. Following this, students are then giving mini-presentations. These differences are easily confirmed by listening to short excerpts from the tapes. In either format, the staff member is clearly not dominating tutorial time.

Figure 2: Digital analysis of audiotaped data from a tutorial run on a 'question & answer' basis.



The time axis is in seconds. The vertical axis reflects sound levels on the two channels recorded. Levels above zero reflect teacher dominance, while the opposite shows student dominance.

Figure 3: Analysis of a tutorial utilising a 'mini-presentation' model format. Axes as in Fig. 2.



Students still dominate tutorial time as a whole but their individual contributions last longer. It is possible to analyse the timespan of each utterance using this program. However, MUTTER was used for most analysis of this type.

Analysis of the tapes was, however, inadequate to document student interaction and the evenness of coverage of topics in tutorials. Instead, the observer's reports proved invaluable in this regard, initiating a change of tutorial format on several occasions. As an example of a simple observation that escaped the tutor's attention, students assigned a topic for mini-presentation actually tended to sub-divide the topic between themselves very quickly and then proceed to revise it solitarily in the minutes available to them. Subsequently, the tutor involved attempted to interact with student groups periodically during their preparation in an attempt to engender more group learning.

MUTTER was important in defining the levels of participation of individual students. Generally, students had very short mean and total utterance times of students during these sessions, regardless of the format adopted by the tutor. However, actual timings depended on whether pauses were recorded or not. To test whether this was a cause for concern or not, two observers recorded one tutorial using two computers. High correlations were found between their results.

Sample data for four students from a 90-minute tutorial are shown in Table 1. One male student dominated, although no overall differences between the contributions of males and females were found. Curiously, this male student fared worse in the tutorial quiz than one of the females who spoke very little (83 seconds during the whole tutorial). In general, there was no correlation between levels of participation and retention of information as judged by the tutorial quizzes.

Table 1: Selected results from one tutorial using MUTTER.

SEX	Total utterance time (sec)	mean utterance time (sec)	verbal test score (out of 10)	non-verbal test score(out of 12)
male	68	5	10	9
male	370	16	8	10
female	47	9	4	12
female	83	12	10	12

MUTTER documents participation in the tutorial, as expressed in total and mean utterance times. This appears uncorrelated with tutorial quiz results.

Lectures

The pattern of student activity within a typical lecture is shown in Figure 4. Students tended to take some time to settle down. However, following this, activity levels were low with periodic bursts of note-taking. Activity levels rose towards the end of a lecture as students apparently 'packed up' early. At present, all that can be gathered from such activity records is that zero activity is indistinguishable from sleep. High levels likely reflect restlessness and fidgeting. Periodic bursts represent note-taking.

Figure 4: Results of a video recording of a whole lecture (the time axis records the number of frames, each being 20 seconds apart).

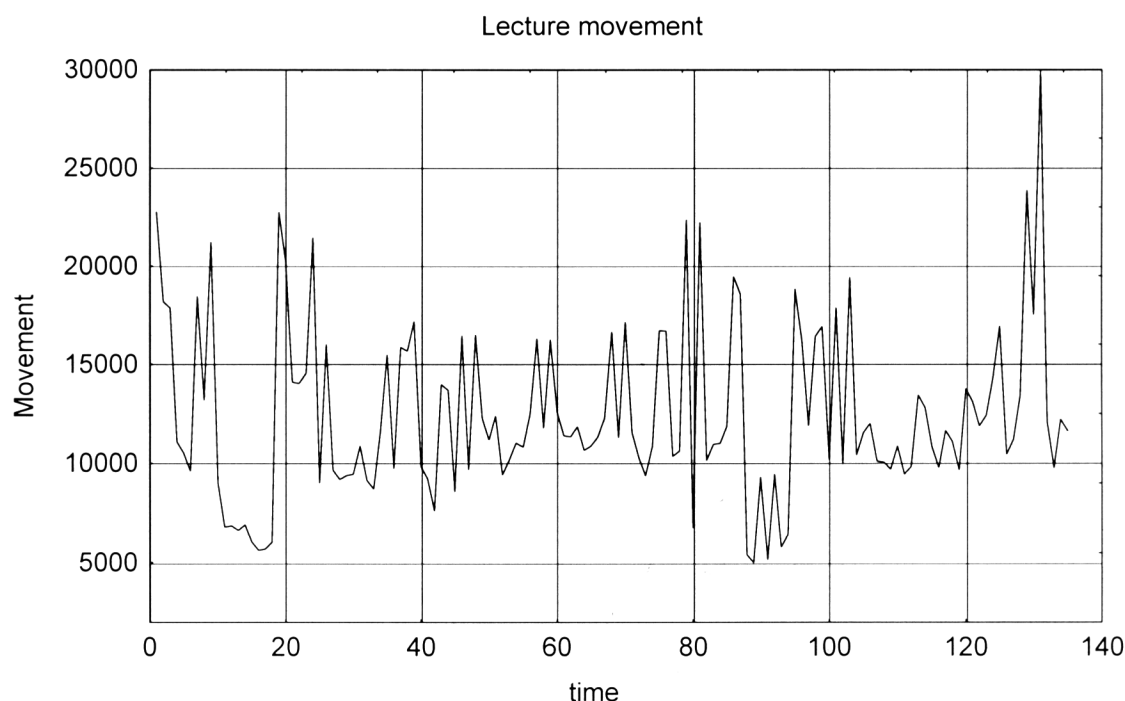


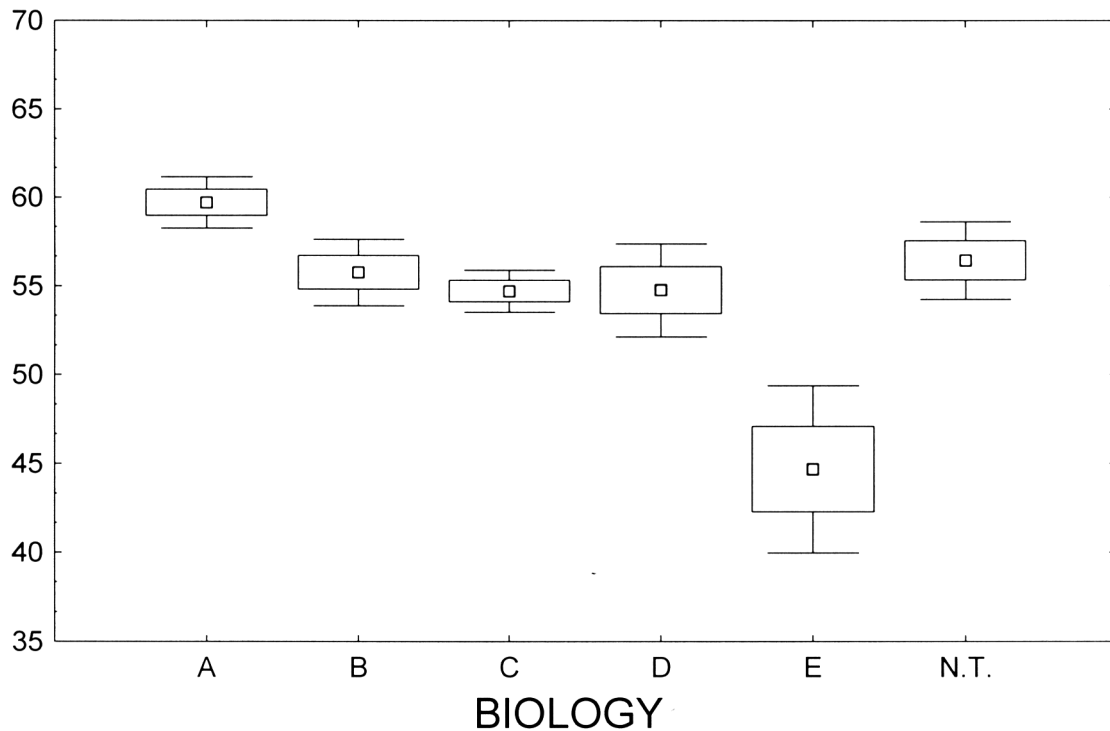
Figure 4 shows that students took time to settle down, then showed brief periods of note-taking. Activity fell to very low levels during two periods.

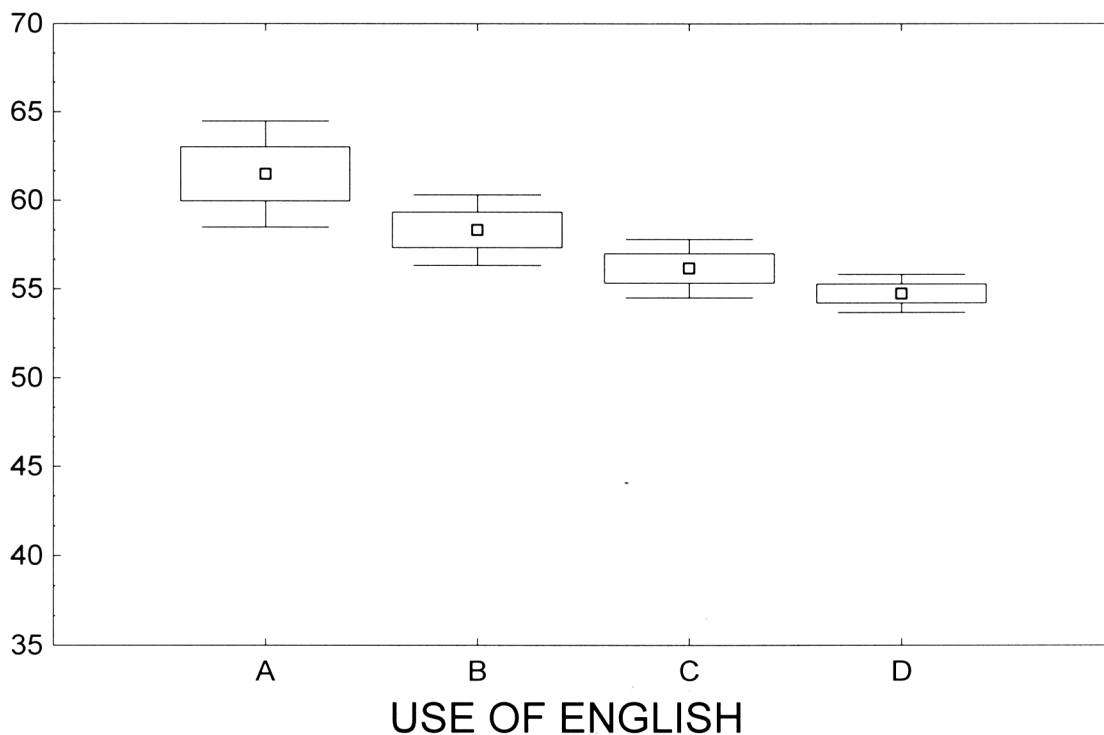
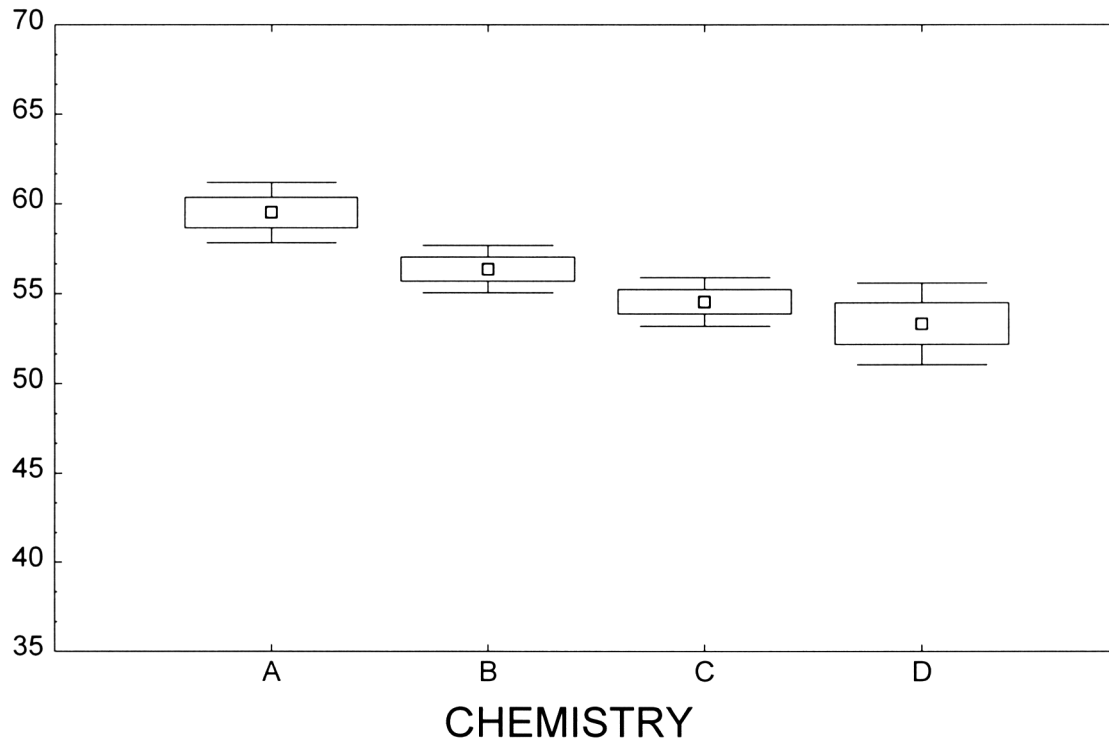
Test Marks

Despite final anatomy scripts being unavailable, an indication of the importance of language skills could be obtained by correlating students' final grades in Anatomy with their A-level grades. Results of the grades of 292 students who entered the faculty in 1990-1993 are shown in Figures 5-7. It should be emphasised that there is a 'close' system of marking within the Department of Anatomy: small differences in marks reflect substantial differences in performance.

Surprisingly, grades in A-level Biology have little clear relationship with the final Anatomy grade. (Figure 5). It does not even seem to matter much if Biology was taken or not, while it does matter if students only barely managed to pass the subject with a grade 'E'. The entrance level in Chemistry, the only required subject in which a 'D' or above is needed, is rather more significant and exhibits a clear relationship with final examination marks (Figure 6). It is striking, however, that the relationship between the final examination score and the grade in Use of English (Figure 7) is more important than that in Chemistry.

Figures 5-7: show the relationship between A level grades in Biology, Chemistry and Use of English on the horizontal axis versus the final Anatomy examination score on the vertical axis (means are the small squares, the lines indicate two standard errors from the means). N.T.=Not Taken.





The research assistant also analysed half the answers (N=82) of one 10-minute term test question, assessing the quality and quantity of the written English. Scripts were assigned to one of three categories of language quality (good, intermediate or poor English) on the basis of communicative efficiency, rather than formal correctness. This means that errors that distorted or obscured

meaning (lexical mistakes, unfinished sentences, missing sentence elements and wrong word order) weighed more heavily than simple grammatical mistakes (e.g., lack of subject/verb and adjective/verb congruency, incorrect punctuation or missing articles) or spelling mistakes that, although disturb the smooth flow of text, do not distort meaning. Language does not lend itself well to quantification, but since student scripts were assessed by an experienced EFL/ESL teacher, results are deemed reliable. Quantity was assessed merely by measuring the length of the answers with a ruler, all on lined paper and none with diagrams.

Both the style of English and length of answer, particularly the latter, are significantly correlated with examination marks ($r=0.38$, $p<0.001$ and $r=0.56$, $p<0.001$ respectively). Since it might (incorrectly) be assumed that the examiner based assessment on the length of answer, a multiple correlation employing both variables was performed. This shows that the correlation with length hardly rises at all ($r = 0.60$ for both measures combined). The most tempting conclusion is that a student who is better at English is quite simply able to write more within the time limit. However, it is also possible that other factors contribute to the finding: either that students with poor English have fewer resources for learning the subject matter of the course, or that poor English is one characteristic of a student with low potential for academic achievement in general (on this last point, however, see below). Assessing the quantity of the answer with a ruler obviously does not take into account variation in the size of handwriting, word or line spacing (some answers were double-spaced), but this method was quick and appeared to produce a significant result.

Five-Minute Paper Performance

Members of the English Centre gave out questions for very short (5 minute) tests at the end of several of their English enhancement sessions. One of their aims was to check the results from class tests with three separate examiners. Examiners were instructed to mark solely on content. Marks on these tests strongly support a relationship between length of answer and the mark given (Table 2). In one of the tests (marked by examiner A), 11 students completely misunderstood the question and wrote long answers off the point (for which they received no marks). Removing these scripts from the data set greatly improves the positive correlation between answer length and mark (Table 2).

Table 2: Correlation between length of answer to three different 5 minute papers with examiners' score.

Examiner	N	Correlation coefficient
A	74	0.38
	63*	0.63
B	84	0.57
C	71	0.47

N is the number of scripts; * ignores 11 scripts on incorrect topic; $p<0.001$ in all cases.

Correlations between average tutorial quiz, case presentation and term test scores per group of students were investigated (e.g., Table 3), but showed no obvious relationship. There was also no obvious relationship with team-building.

Table 3: The performance of four groups over a semester in terms of tutorial quizzes, case presentations and end-of-term (end-of-semester) marks.

GROUP	mean verbal test score (out of 10)	mean non-verbal test score (out of 12)	Mean case score (out of 5)	mean written term test mark (%)	mean practical term test mark (%)
B	6.9	6.9	3.3	51.3	59.8
C	5.8	7.6	4.2	55.2	59.1
K	7.5	7.8	3.8	55.7	55.8
L	7.1	6.8	3.7	50.5	63.6

Groups shown in bold had been subjected to 'team building' sessions in an attempt to increase group cooperation.

Practicals

A critical feature for the success of a gross anatomy course is the use that students make of practicals. Critical decisions need to be made between problem-solving, relatively-unguided, dissection sessions and spoon-feeding demonstrations. Videoing of dissection sessions revealed little about general activity levels. However, observations by the research assistant showed a highly variable pattern and a misuse of these sessions by many students. In Table 4, there is an attempt to categorise the roles that students play in terms of a hospital analogy. The surgeon is the dissector, the intern is his helper, the nurse is the intern's helper, the administrative staff are heads-in-books (usually but always the dissector) and the relatives are inactive, often loitering. In the six sub-groups in Table 4, which observed over four dissection sessions, the total number of roles exceeds the group size showing that students do change roles. However, two of the sub-groups clearly had a large number of inactive members.

Table 4: The roles played by students during dissection sessions, averaged over observations of four 3-hr sessions.

GROUP SIZE	Surgeon	Intern	Nurse	Administrative staff	Relatives
6	3.0	0.3	2.3	3.7	1.0
7	2.7	0.3	0.0	0.0	4.0
4	2.0	1.0	0.0	0.3	0.7
4	1.3	1.0	0.0	1.0	1.3
6	2.3	0.0	0.7	2.0	1.0
7	2.3	2.3	0.3	1.3	3.0

Group size here refers to the group around a dissection table (a sub-group of those referred to in the rest of this paper.)

Major Findings and Current Reflection

The project has documented an important link between ability in English and success in Gross Anatomy. The reason for this is fairly clear — anatomy is terminologically intensive. Anatomy is not exceptional, merely being a microcosm of the medical world as a whole, which contains an enormous specialised vocabulary that grows steadily.

We could not establish any clear correlation between levels of participation by students in classes and their subsequent ability to retain information, either in the short or long term. This could be simply a feature of the current examination system, which fails to give a reward for anything other than success in the final examination, the latter of which depends heavily on book work.

The medical faculty at the University of Hong Kong is now changing to much more of a problem-based, problem-solving environment with continuous assessment. The current study provides clear baseline data for comparisons with this future course. It also provides techniques that aid this continuous assessment and place it on far more of a quantitative and objective basis. The real-time video analysis has been adapted to incorporate aspects of MUTTER. Participants in small groups can now be identified in real-time video, with their movement being automatically and their utterance length, semi-automatically recorded. This has been linked to a note-taking and point-scoring ability such that individual contributions of value can be recorded on file. The equipment required is unobtrusive and can be operated by the facilitator of the group. This offers the possibility to produce an objective record of the progress of small groups in tackling problems which has been sadly lacking in systems of continuous assessment (where everyone tends to get the same passing mark).

* The authors' names have been arranged in alphabetical order.