Enhancing practical teaching with patient-based, interactive, online practical sessions

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Background

The student cohort within the undergraduate medical degree comprises approximately 300 students per academic year. Thus there is a reliance on large-group didactic teaching as it is difficult to schedule and resource small-group sessions.

However, small-group teaching is of paramount importance and helps students integrate concepts in a less intimidating and more interactive environment. Practical sessions also allow students to gain hands-on experience of vocational technical skills within the classroom setting. The practical teaching within the first year of the MBBS degree has been affected over the years by infrequent updating and utilise old and unreliable equipment. The purpose of this project was to update a number of the practical teaching sessions to enhance student learning and engagement.

We developed a range of interactive practical sessions using a commercial standardised platform and state-of-the-art equipment. The software was programmed according to our specific requirements and allowed the incorporation of instructional guidance, patient-case scenarios and formative assessment with feedback. The equipment could be connected to the package allowing real-time recording of the physiological parameters being measured. For the initial phase of this project we focussed on four practical sessions:

1. Measurement of nerve conduction velocity - this session was a demonstration that was being converted into a small-group practical session
2. Measurement of lung volumes using spirometry - this session was being converted from a traditional practical to a patient-centred practical
3. Blood pressure measurement - this session was being converted from a traditional practical to a patient-centred
4. Diagnoses using urinary dipsticks - this was an entirely new practical session

Practical development process

The four different practical sessions were developed as part of an ‘innovations in teaching’ grant: with one undergraduate student taking ownership of the overall project development process of one of the practical sessions. The programmes were created under the day-to-day supervision of grant co-recipient Dr Sohag Saleh and overall supervision of Prof. Mary Morrell. The students followed a ‘blue-print’ with each practical requiring a physiological process, a clinical context, a patient journey, integrated formative assessment and content aligned to learning objectives.

Practical details

<u>Nerve conduction velocity practical</u>

This practical followed the journey of a patient with Guillain-Barre syndrome (a rare disease affecting the peripheral nerves) and recorded the students’ own electromyograms (EMGs). By measuring the latency period of an EMG evoked by electrical stimulation of the median nerve at the wrist and subtracting this value from an EMG evoked at the elbow, the students were able to calculate their own nerve conduction velocity.

The course-lead was extremely happy with this practical, which allowed him to get the students more involved and made the session less didactic. The practical itself was also very well-received by the students as they were allowed to 'electrocute' their friends and colleagues. It received exclusively positive feedback during the student evaluation process and has subsequently also been utilised on the biomedical science degree.

Measurement of lung volumes practical

This practical followed the journey of a patient with chronic obstructive pulmonary disease (COPD) and allowed the students to create a spirogram utilising a pneumotachometer. They subsequently measured the on-screen parameters to calculate their own lung volumes and capacities. These values were then compared to the patient with COPD, to emphasise the effect of this condition on commonly assessed ventilation parameters.

This practical was also embraced whole-heartedly by the course lead and was very well-received by the students, who felt more able to understand the abstract concept of a spirogram when it was given a personal context. This practical has subsequently also been utilised on the biomedical science degree.

Blood pressure measurement

This practical followed the journey of a patient with secondary hypertension and allowed the students to measure their own blood pressure utilising two separate approaches: the conventional method of auscultation using a stethoscope and a blood pressure cuff and a different technique involving a cardiomicrophone, which allowed the Korotkoff sounds to be visualised on screen (note: the appearance of Korotkoff sounds indicates the systolic blood pressure value and the subsequent disappearance denotes the diastolic blood pressure).

Evaluation of this practical formed part of a controlled study (discussed later) and the student feedback was once again, whole-heartedly positive. By being able to visualise the Korotkoff sounds the students were better able to understand the underlying physiology and improve their use of a stethoscope for auscultation.

Diagnosis using urinary dipsticks

This practical presented four mock patients each with 'urine' samples and asked the students to match the samples to the patients utilising urinary dipsticks. The students submitted their answers online and were given immediate feedback followed by an explanation of the underlying pathophysiology.

This practical was also very popular with the students and received universal praise. The students really appreciated the clinical relevance of this practical and integrating the physiology with clinical practice. The course lead felt the practical added an extra dimension to the course and brought together much of the bioscience content.

Following on from the success of the initial deployment two further practical sessions have been developed, which are due to be released to the students: recording the electrocardiogram and cardiopulmonary exercise testing.

Development and deployment issues

The first issue encountered was finding the time to create the substantial changes that were necessary. Each program required a significant time-commitment, which was unfeasible for the already over-stretched academics within the college. Therefore students were employed

to develop the content and the process took approximately 200 hours to create from conception to delivery.

There were advantages to utilising students, which included their availability and their first-hand insight into what students require in terms of guidance. However, the main disadvantage was their lack of expertise in the area, which had an impact on the levels of supervision and subsequent corrections that were involved.

Another issue encountered was attempting to create practical sessions that could be completed by the students within the imposed time-constraints, especially considering that all students work at different paces. This was addressed by incorporating a testing phase where students were enrolled for 'dry-runs' of the practical sessions. Following the feedback from these sessions much of the 'non-essential' learning was repackaged as additional information, which the students could access off-site within their own time.

This partly resolved the problem; however we still found that there was a large variability between the amounts of time that each group of students spent on the package and on a number of occasion's students had to be rushed through to complete the practical. This is an element that we are looking to address for future years.

Further reflections

Following the initial deployment, the updated practical sessions have now been integrated into courses within all the degrees available in the Faculty of Medicine at Imperial College and student feedback remains positive.

In reflection, a key reason for the success of these practicals has been the fact that they were developed utilising well established pedagogic principles. The practical design followed the cognitivist approach by offering a holistic structural framework. The learning outcomes were clearly signposted and the content was aligned to these; relevant formative assessment with feedback was included; the sessions built on principles developed within the course and referred to other teaching within the module. Moreover, all the information from the sessions was accessible to students afterwards.

The social constructive element was also present due to the fact that the students worked in groups and were taught relevant skills. Furthermore, the inclusion of patient cases added an element of situated learning.

Evaluation and publications

The blood pressure practical session was evaluated as part of a controlled study using both qualitative and quantitative data. The findings of the study were presented at the Physiological Society meeting in 2014 and published in abstract form (Joshi *et al,* Proc Physiol Soc 31, 2014). In brief: The interactive patient-based significantly improved student knowledge and engagement when compared to a traditional practical. The qualitative assessment using a visual analogue scale found the updated practical increased students' perceived knowledge by 72±1% (n= 227) compared to the traditional practical (61±2%, n= 208), whilst the students also felt significantly more engaged; 84±1% compared to 78±1% ($p< 0.001$). The quantitative data assessed knowledge gained by pre- and post-session single-best answer questions and also found a significantly higher increase in correct answers ($p<0.05$) following the updated practical.

Conclusion

A range of new patient-based, interactive, online practical sessions have been successfully incorporated into teaching programmes within the Faculty of Medicine at Imperial College London. These practical sessions were developed with the assistance of older students according to specific requirements and were very well-received by the younger students. The sessions were also found to significantly increase student knowledge and engagement when evaluated as part of a controlled study.