Reflecting on & Discussing the Philosophy & Practice of Teaching

In this issue, colleagues reflect on the effectiveness of various learning activities put in place to deepen their students’ knowledge and understanding of course content (within and beyond the existing curriculum), and to build their capacity for critical analysis and self-regulated learning.

For students taking his module on industrial organization, Dr Ko Chiu Yu (Dept of Economics) developed a comprehensive formative feedback mechanism to help enhance the academic quality of the written reports for their research projects. His article charts the implementation of this feedback mechanism over two academic years and its subsequent refinement, where students received formative feedback from both the instructor and their peers at early and intermediate stages of the research project. Dr Ko also discusses how he scaffolded the feedback process, the challenges involved in doing so, and students’ responses regarding the effectiveness of instructor and peer feedback strategies. In her article, Dr Tan Kai Soo (Dentistry) discusses the rationale behind the introduction of a 7-day bridging programme for residents taking the Masters of Dental Surgery (MDS) programme, namely to deepen their knowledge of oral microbiology, immunology and molecular biology. She describes the implementation of the programme in its first academic year, the gaps uncovered during the post-programme evaluation survey, and the refinements put in place to enhance the bridging programme’s effectiveness in meeting the key learning outcomes of the MDS programme.
Meanwhile, Dr Kevin Yap (Dept of Pharmacy) chronicles the process involved in developing a virtual patient record (VPR) mobile application which simulates an electronic health records (EHR) system. The VPR app aims to educate pharmacy students on how to retrieve patient health information from EHRs during their pharmacy practice. He also reflects on students’ perceptions of the app’s effectiveness as a tool to support their learning, and how he plans to refine its existing features.

Finally, Dr Satyen Gautam (Dept of Chemical & Biomolecular Engineering) and his colleagues discuss the various aspects of industry involvement in the capstone design project for chemical engineering students and the learning benefits to be gained, including how it gives students exposure to expert knowledge and performance which would give them insights into how “a real practitioner behaves in a real situation” (Herrington & Herrington, 2006, p.5).

Reference
USING FORMATIVE FEEDBACK, PEER REVIEW, AND ONLINE VIDEO-RECORDED PRESENTATIONS TO ENHANCE STUDENTS’ RESEARCH REPORTS

KO Chiu Yu
Department of Economics

Recommended Citation:

This article describes how timely formative feedback was provided to students reading the elective module EC5322R/EC5322 “Industrial Organization” at various milestones in their research projects. The provision of timely formative feedback was used as an intervention to enhance their reports of such projects. Formative feedback was provided by the instructor and peers following a peer review of students’ online video-recorded presentations. The intervention was carried out over two rounds of teaching EC5322R/EC5322, with some fine-tuning of the approach after the first round. Some preliminary findings from the pilot study is also shared.

Background
EC5322 “Industrial Organization” is listed as both a graduate elective and an undergraduate module, EC5322R, which is open to undergraduate students pursuing an Honours Degree in Economics. The purpose of this module is for students to be able to understand and make in-depth analysis of various theoretical issues related to modern industrial organization. The module aims to enable students to develop their own economic models to explain real-world phenomena, and communicate these models well in both oral and written form. Hence, 70% of the module’s assessment is based on an independent research project, while the remaining 30% is based on the final exam.

Challenges encountered
In my first year of teaching EC5322R/EC5322 (n=15), students were asked to present their problems in class before submitting their written reports. However, the main problem we discovered about this instructional strategy was that in the course of doing their projects, many students were too focussed on the technical details and failed to see the “big picture”, that is, understanding the key economic that underpin a lot of this real-world phenomena. For example, when students attempted to apply the economic models discussed in class to explain the outcome of
particular markets, some of them failed to appreciate that while the assumptions from different models may seem innocuous when taken separately, they may not be plausible when applied wholesale in certain markets. Had they received timely feedback on the preliminary work they had done for their projects and refined it accordingly, they would have written papers of better quality.

**Interventions introduced: First cycle of interventions**

As a result, in the second year, I refined the initial instructional strategy by replacing the in-class presentation with an online video recorded presentation. We felt that incorporating peer review through online video recorded presentations would benefit students’ learning in a few ways. First, it would facilitate timely feedback and enable closer monitoring of students’ progress throughout the project. According to Nicol and Macfarlane-Dick (2006), providing timely feedback is one of the strategies that could be adopted to give quality feedback to students (p. 210). Secondly, through peer feedback, “students learn a great deal by explaining their ideas to others and by participating in activities in which they can learn from their peers” (Boud, 2001, p. 3). Another motivating factor was that the online mode would alleviate logistic problems. For instance, if each student were to do a 10-minute classroom presentation of their project, it could take several weeks of classroom time even for such a small class. With online video recorded presentations, we could set aside more time for in-class post-presentation debriefs and discussions. Finally, submission of multiple drafts would be hard to apply in this case as building economic models would require iterative development. When it comes to building a good economic model, one should follow the advice found in a phrase attributed to Albert Einstein: “Make everything as simple as possible, but not simpler.” A good economic model requires abstraction of complicated real-world problems into a few key assumptions. They should not only be simple enough to be tractable for analysis but also flexible enough to accommodate different possible extensions. Refining an economic model usually takes much more time than developing the first prototype.

The quality of the written reports appeared to improve with this modification to the instructional strategy. This could be due to students’ participation in the online discussions following each presentation, which generated constructive comments. In fact, one student’s paper was so well-written that it was later developed into an integrated honours thesis, and that particular student went on to achieve a double first-class honours.

Moreover, as the post-presentation discussions generated constructive comments that helped improve their written reports, I asked students to comment on their classmates’ presentations using the forum function of the website on which the presentation videos had been uploaded. Although we incentivised the peer evaluation by making it count towards 5% of their final grade, it was observed that the comments collected were less thoughtful and constructive than expected. One possible reason could be that students may encounter difficulty in evaluating a working idea from the video presentation without a written draft.

**Interventions introduced: Second cycle of interventions**

Therefore, in my third year of teaching EC5322R/EC5322, I refined the instructional strategy further by including an additional online video recorded presentation to allow students to provide feedback in the early stages of their projects. A 3-page written proposal was also included to facilitate the peer review process for the second online video-recorded presentation. Based on my subjective evaluation (as well as feedback from colleagues and students who compared the submissions with those from previous cohorts), the quality of the peer reviews, written reports, and in-class presentations all improved significantly with this further modification. Informal interaction with students and a survey confirmed the success of this experiment. The following sections detail the implementation of these additional learning activities.
Project Milestones Provided for Students

The revised instructional strategy, with its additional learning activities, was divided into three key phases over the semester:

- **The screening phase.** To kick-start the assignment, students were asked to share initial ideas of their respective independent research projects via 5-minute online video-recorded presentations in Week 5. The post-presentation discussions I had with the class were useful in helping to filter out less promising ideas and for me to provide input to improve the more promising ones. Prior to these discussions, students were given guidelines on how to evaluate their peers’ work. To complete the peer evaluation, they are required to answer qualitative questions in a form created on Google Docs.

- **The feedback phase.** Based on the feedback received from their peers, each student would prepare and submit a short written proposal (3 pages) in Week 8, in which they had to formulate the research question. This was followed by a second extended online video-recorded presentation (10 minutes) in Week 9 which focussed on their methodologies, and a peer review in Week 10.

- **The reporting phase.** Finally, students presented their results during the last two classes before submitting their final reports in Week 13.

Thus, there were five tasks within the three phases where students could receive critical and constructive feedback before submitting their written reports. Table 1 lists the project milestones for the research project. The tasks were arranged within these phases to scaffold their learning; it also gave them ample time to revise their ideas, or even switch to other topics. To implement such an elaborate feedback mechanism, I gave out a clear roadmap during the first class with detailed guidelines for each part of the assessment.

Table 1.
Project Milestones for the Research Project

<table>
<thead>
<tr>
<th>Phase</th>
<th>Week</th>
<th>Tasks Evaluated</th>
<th>Marks (% of final grade)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Screening</td>
<td>5</td>
<td>5-minute online video recorded presentation (with peer review)</td>
<td>5</td>
</tr>
<tr>
<td>Feedback</td>
<td>8</td>
<td>3-page proposal</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>9</td>
<td>10-minute online video recorded presentation</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>Peer Review (of 3-page proposal and online video recorded presentation)</td>
<td>10</td>
</tr>
<tr>
<td>Reporting</td>
<td>12</td>
<td>15-minute in-class presentation</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>13</td>
<td>20-page written report</td>
<td>20</td>
</tr>
</tbody>
</table>
Screening phase: 5-minute online video recorded presentation

During this initial phase, students were given a list of topics to explore. These topics had been attempted by previous cohorts and were useful in helping the current batch decide whether they were able and willing to conduct original academic research within 13 weeks.

What was the rationale for including the screening phase? I felt that it mentally prepared the students as they embarked on the research project, which was crucial for a successful paper. It minimised their tendency to procrastinate, an easy trap to fall into unless they really enjoyed working on their projects. Since the willingness to do research was hard to write down as a prerequisite, the screening phase allowed them to do a self-check at an early stage of the project. However, I did emphasise that they were free to explore topics beyond the list, especially since the class composition differs from year to year.

In Week 5, each student would upload a 5-minute presentation of their chosen research topic to Youtube, which allowed for easy viewing and file-sharing during the peer-review component of the project. Students could also choose to put their videos on a restricted channel to ensure their presentations were not searchable online. While students were free to choose their presentation styles, they were also given minute-by-minute guidelines on how to structure their presentations. In the guidelines, it was recommended that they spend one minute each to do the following in their presentation: describe their research idea in non-technical terms, justify its importance, spell out deficiencies in previous research, explain what can be done, and summarise the expected outcomes. Having students record their presentations reduced their anxieties over presenting their preliminary ideas. To further relieve students of this pressure, they were awarded full marks for their effort in completing this first online video recorded presentation. Each student would subsequently receive my feedback via email with emphasis on the feasibility of the ideas they proposed. After this screening phase, three students shifted their research focus or changed research topics.

Feedback phase: 10-minute online video recorded presentation, research proposal and peer review

As part of the milestone for the project, each student was to submit a 3-page research proposal in Week 8. In the proposal, they had to highlight the importance of their proposed research question, conduct a thorough literature review, and describe the methodology. The page limit was set to ensure students produce a concise report. This would not only compel them to think more deeply about the outcomes they wanted to achieve for this research project, it would also help reduce the number of pages to comb through for the subsequent peer review. It was interesting to note that students strictly adhere to the criteria listed for the proposal. In fact, two students sent me an email to request a topic change, even though my approval was actually not required.

In Week 9, each student submitted a second 10-minute online video recorded presentation in which they gave further elaboration of their analysis. One important purpose of the second presentation was for students to provide verbal and graphical illustrations, especially given that a formal mathematical model may not be ready at this stage. Once the entire class had submitted their presentations and proposals, each student evaluated the presentations of two randomly assigned classmates in Week 10. For the peer review, I issued a standardised feedback form for students to record their qualitative comments on potential deficiencies as well as suggestions for improvement. The comments were then posted online to inspire further discussion. I emailed my input to each student only after the entire class had completed the peer review. During this phase, only one student switched topics.
**Reporting phase: In-class presentation and written report**

Students presented their research findings via 15-minute in-class presentations in Weeks 12 and 13. We incentivised the post-presentation discussions by getting students to provide qualitative feedback to their peers individually, with evaluation forms provided. The feedback formed part of the overall assessment. We hoped that this would encourage active class participation amongst students and garner higher quality feedback. A surprising thing we observed was that having to do the two online video-recorded presentations may have substantially improved their time-management skills. Most of students from the current cohort were able to complete their presentations within the time limit, unlike those from the previous two years.

Based on the feedback received from their peers after the second online video-recorded presentations, students finalised and submitted their 20-page written reports at the end of Week 13.

**Findings and Discussion**

At the end of the research project, I conducted an informal survey to collect students’ feedback about the whole process. Ten out of a total of sixteen students in the class responded.

**Quantitative feedback**

According to the quantitative feedback collected, 100% of the respondents found that comments from myself or their classmates were useful in helping them improve their research project. On a scale from 1 to 5 (best), overall usefulness of the learning activities received an average score 4.6. More details are shown in Table 2.

<table>
<thead>
<tr>
<th>Tasks Evaluated</th>
<th>Average Score 1 to 5 (Best)</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>5-minute online video recorded presentation</td>
<td>4.3</td>
<td>0.99</td>
</tr>
<tr>
<td>3-page drafts</td>
<td>4.7</td>
<td>0.48</td>
</tr>
<tr>
<td>10-minute online video recorded presentation</td>
<td>4.2</td>
<td>0.67</td>
</tr>
<tr>
<td>Peer Review</td>
<td>4.2</td>
<td>0.92</td>
</tr>
<tr>
<td>15-minute in-class presentation</td>
<td>4.5</td>
<td>0.62</td>
</tr>
<tr>
<td>Overall assessment</td>
<td>4.6</td>
<td>0.52</td>
</tr>
</tbody>
</table>

In terms of the 20-page written reports submitted, I found most of them to be of high quality. The survey results also indicated that students were happy with the quality of their papers, with 50% of the respondents planning to further develop their written reports into research articles.
Qualitative feedback

The majority of qualitative comments were positive but there were two suggestions worth mentioning.

First, one student expressed disappointment over the peer review, noting that “comments from [the] professor are useful, but comments from one of two peers may not be so useful because some peers may have not taken peer review work seriously.” I believe that this might be due to the fact that students might be lacking in experience when it comes to critically analysing research projects. To minimise such occurrences in the future, I may provide students with guidelines and examples of good peer feedback, or even explore other peer feedback formats such as voice feedback. In addition, I may consider getting future cohorts to write short reflection journal entries about their learning experiences throughout the process. Such documentation would serve as a good source of data in helping me to further refine and develop the learning activities.

Second, some students suggested that the second online video-recorded presentation could be conducted earlier in the semester to ensure that “[they] have more time to adjust the model according to the comments from others.” One way to do this would be to have students submit both the 3-page proposal and the online video-recorded presentation in the same week to allow more time for them to provide peer feedback.

Conclusion

One of the biggest challenges I faced when it came to teaching students to conduct original research in EC5322R/EC5322 was helping them to overcome the tendency to procrastinate. Most of the time, they had poor time management skills and had the tendency to underestimate the time required to complete the analysis. It was observed that some spent several weeks on gathering information and looking for a topic, which left them with very little time to complete their paper. In fact, some believed that they could complete their project by cramming all their tasks in the last few weeks! Also, while the conventional approach of using interim presentations and submission of drafts can help students set project milestones, they are not ideal for research projects such as the ones for EC5322R/EC5322, which require frequent feedback. This is because for such projects which require iterative development, it is very difficult to transform a budding research idea into a full-fledged research project without taking multiple detours. This is the case even for established researchers. Although the current learning activities implemented in EC5322R/EC5322 seem to be helpful in providing some form of scaffolding to students in carrying out their projects, it would be crucial, as a complementary measure, to include additional rounds of feedback in future and even different channels of feedback.

Meanwhile, online video recorded presentations have several advantages over the submission of drafts and interim in-class presentations. First, they do not occupy any classroom time since students can watch them outside of curriculum hours. As such, multiple online video-recorded presentations can be used as a mode to scaffold students’ learning through peer feedback. Second, students may feel more at ease presenting their ideas online instead of speaking in front of the whole class. Third, students can evaluate their own presentations and improve their exposition through multiple recordings. Fourth, online video-recorded presentations allow students time to think through their responses before sending in their feedback. Fifth, the online platform ensures that the exchange of ideas and comments between peers is not constrained by time limits, which it would be if the presentations were conducted in the classroom. Finally, going through two rounds of online video-recorded presentations means that
students learn how to manage their time more efficiently in a presentation; they would have had more practice learning how to plan their presentations within the time limit. Thus, based on the preliminary findings of the pilot study, it seems that the use of formative feedback through peer review leveraging on online video-recorded presentations enhances the quality of students’ written research reports.

References


About the Author

Dr Ko Chiu Yu teaches EC4344 “Financial Market Microstructure” and EC5322/EC5322R “Industrial Organization”. He subscribes to the philosophy that effective learning requires understanding of multiple facets in both depth and breadth. He also believes that giving students continuous feedback during the course is crucial as it means they learn from their mistakes, which consolidates the knowledge they have acquired and gives them the motivation to explore further and deeper.
INTRODUCING A 7-DAY BRIDGING PROGRAMME TO DEEPEN DENTAL RESIDENTS’ LEARNING OF ORAL MICROBIOLOGY, IMMUNOLOGY, AND MOLECULAR BIOLOGY

TAN Kai Soo
Faculty of Dentistry

Recommended Citation:

Background
In the Faculty of Dentistry at the National University of Singapore, the residency programmes are designed to provide specialty training for its postgraduate students in the various clinical disciplines. The curriculum includes a combination of clinical training, didactics which include basic oral sciences, and a research project. This emphasis on the integration of clinical dentistry with oral sciences is particularly apparent in the disciplines of endodontics and periodontics, which are dental specialties pertaining to the treatment of dental pulp and gum problems respectively.

Diseases of the dental pulp and gums arise primarily from bacterial infections and are the result of subsequent inflammation. As such, the principles and techniques of oral microbiology, immunology and molecular biology are widely used in current dental research literature to analyse the roles and mechanisms of oral bacteria and immune response in root canal and gum infections. Ideally, residents who complete the Master of Dental Surgery (MDS) programme should have sufficient knowledge of oral microbiology, immunology, and molecular biology to effectively critique advanced dental research literature. With this knowledge, they would be more effective in analysing and solving problems in clinical settings.

Pre-existing Curriculum
Prior to the introduction of the bridging programme, there was a lack of a structured curriculum to comprehensively address oral microbiology, immunology and molecular biology for residents taking the MDS programme. It has been noted that residents tend to have only a superficial knowledge and understanding of these topics as they were not covered in great depth in the undergraduate dental
curriculum. Hence, a common challenge educators encounter in teaching the MDS programme is that residents struggle to understand and critique dental literature effectively due to this knowledge gap in the oral sciences.

**Introduction of the 7-day Bridging Programme to Residents**

With reference to Bloom's taxonomy of learning domains (Krathwohl, 2002), the MDS programme was designed mainly to address the cognitive domain, in particular to equip residents with a deeper knowledge and understanding of the aetiology of these diseases. In the process, they experience a progression of learning from acquisition of core knowledge to understanding and application to the respective discipline. The educational philosophy behind this course is to provide the residents with a good foundation in these concepts, such that they become confident enough to critique and evaluate research, which would enable them to be more effective in solving treatment challenges they encounter with patients. They should also be able to effectively seek out and analyse currently available knowledge from the existing literature, and evaluate the validity and applicability of what they find. The ultimate goal is to develop residents to become dynamic clinicians who can create and innovate novel strategies for patient care.

Hence, in order to fill the knowledge gap in the pre-existing MDS curriculum and deepen residents’ knowledge and understanding of oral microbiology, immunology and molecular biology, an intensive 7-day bridging programme consisting of full-day seminars and hands-on workshops was introduced in Academic Year (AY) 2012. The bridging programme aims to enable students to achieve the following:

i. Apply the knowledge of oral microbiology, immunology and molecular biology covered during the seminars to execute the exercises during the hands-on workshops.

ii. Appraise advantages and limitations of experimental techniques to answer specific research questions.

iii. Design and execute experimental protocols for their MDS research dissertation.

iv. Relate key principles learnt during the bridging programme to evaluate and critique current literature relating to their clinical practice.

The rationale for incorporating a hands-on workshop component was to allow residents to appreciate the advantages and limitations of research techniques, instead of merely equipping them with proficiency in laboratory techniques. It was hoped that gaining such competencies would enable them to evaluate data and conclusions in the literature, and compare the different methodologies in experimental design. For example, they should be able to recognise that different bacteria have different growth rates, culture conditions and nutritional requirements; hence, changes in experimental conditions such as media, supplements and culture incubation period can yield different data and conclusions in a paper.

**Approach**

The bridging programme has been held annually for Year 2 endodontics and periodontics residents since its inaugural launch in AY2012. A total of 8 residents participated in the first run of this bridging programme in AY2012. Each day consisted of a 2-hour seminar session comprising didactic lectures followed by question and answer sessions, and a 6-hour hands-on workshop session in the laboratory (see Table 1).
Table 1. 
**Topics Covered During the 7-day Bridging Programme**

<table>
<thead>
<tr>
<th>Topics for the Seminars</th>
<th>Topics for the Hands-on Workshops</th>
</tr>
</thead>
<tbody>
<tr>
<td>• A Review of Basic Microbiology</td>
<td>• Microbiology Techniques</td>
</tr>
<tr>
<td>• Bacterial Virulence</td>
<td>• Anaerobic Culture</td>
</tr>
<tr>
<td>• Host-Pathogen Interactions in Oral Infections</td>
<td>• Polymerase Chain Reaction</td>
</tr>
<tr>
<td>• Host Response</td>
<td>• Molecular and Biochemical Methods to Identify Oral Bacterial Isolates</td>
</tr>
<tr>
<td>• Endodontic Microbiology</td>
<td>• Antimicrobial Susceptibility Testing</td>
</tr>
<tr>
<td>• Periodontal Microbiology</td>
<td>• Immunoassays</td>
</tr>
<tr>
<td>• Applications of Molecular Biology in Dentistry</td>
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</tbody>
</table>

A 20-page instructional handout was also prepared to guide the residents through the laboratory work. The concepts taught during the seminars were further demonstrated during the hands-on workshop sessions. For instance, one of the seminar topics covered host response\(^1\), while in the workshop, the residents carried out various immunoassays\(^2\) to detect cytokines typically produced during inflammation.

**Challenges Encountered**

The main challenge encountered while planning the bridging programme was designing the syllabus and deciding the content to be covered in the seminar and workshop sessions. The topics to be included in this programme would need to bridge the gap between what was taught in the microbiology and immunology, periodontology and endodontology modules offered in the dental undergraduate curriculum, and the in-depth knowledge residents require to better understand the advanced literature in their specialties. To determine the starting level of knowledge the residents already possess and identify topics that would require more in-depth instruction, reviews of related dental undergraduate modules were carried out in consultation with colleagues teaching the topics. The subject matter was carefully scaffolded to enhance residents’ learning. For example, immunology concepts were presented to the residents through illustrations of the disease process in a sequential manner.

At the beginning of the bridging programme, some of the residents came in with the preconceived notion that being clinicians, learning these scientific concepts would not be applicable to them, thus affecting their level of participation and engagement. As such, special effort was made to always relate the concepts taught with relevant examples which highlight their clinical significance while giving the residents an appreciation of the experimental process. The hands-on activities were also geared towards engaging the residents’ curiosity, for example, by having them identify oral bacteria from plaque samples freshly collected by the residents themselves.

Another challenge involved the practicalities of planning and allocating available equipment, laboratory space, and resources to carry out the workshop sessions. The workshops were conducted in a working oral microbiology research laboratory, and the schedule for the bridging programme had to be carefully planned to accommodate the workshops without interrupting the routine work of other laboratory users. The laboratory also faced working space constraints due to the fact that it is not a dedicated teaching laboratory. To ensure the smooth execution of the workshops, all experiments had to be optimised and tested prior to the commencement of the bridging programme.
Evaluating the Impact of the Bridging Programme in its First Year

We evaluated the effectiveness of this course by conducting a survey in which we collected and analysed student feedback. The survey consisted of a quantitative component where the residents indicated the usefulness of the seminars and workshops on a 5-point scale, ranging from “very positive” to “very negative”, and a qualitative component which consisted of 3 short questions where they indicated what they liked or disliked about the programme, as well as suggestions for further improvements.

All 8 residents who participated in the first run of the bridging programme in AY2012 responded to the feedback exercise. The quantitative feedback they provided for all 7 seminar sessions and 6 workshop topics was “very positive”. The presentation style of the seminars was found to be “clear and succinct”, with “good and sufficient content”, and allowed “easy understanding of complicated concepts”. In terms of qualitative feedback, they found the seminar topics to be “beneficial” and “not taught before elsewhere”. According to the residents, the hands-on session allowed them to “appreciate the methods used in literature and enhanced understanding”. The workshop sessions were also regarded to be “a very important complement to the seminars”. A particularly useful suggestion to improve the bridging programme was “to incorporate a literature discussion session” which would help the educators and residents consolidate the content covered during the seminars and workshop sessions.

Incorporating Journal Club Sessions

Based on feedback from the first cohort, subsequent iterations of the bridging programme were modified to include a Journal Club session, where participants read and discussed carefully selected journal articles on topics related to the course. This was important for relating what was discussed during the Journal Club with the intended learning outcomes of the MDS programme, in particular training participants to critique current literature. However, this had to be done within the given time constraints. To accommodate this new component, the introductory seminar sessions on “A Review of Basic Microbiology” and “Bacterial Virulence” were condensed from AY2013 onwards. The quantitative feedback (n=16) for the Journal Club session since its introduction has ranged from “positive” (19%) to “very positive” (81%). The following qualitative feedback, obtained from the AY2013-2015 resident cohorts who participated in the bridging programme, reflects what has been achieved using the combined approach of seminars, workshops and the Journal Club sessions.

• “The lectures are carried out systemically to gradually allow us to digest and understand the topics.”

• “The seminars covered relevant topics that are useful towards our understanding of our specialty. Enhances our knowledge of the techniques that were used in research papers and allows us to translate this knowledge into our research thesis.”

• “The seminars were very informative and well-taught. Delivery is clear and topics covered enabled us to understand the papers better.”

• “Comprehensive teaching, relevance to clinical dentistry especially through articles discussed during [the] Journal Club”.

• “Journal club consolidated the content learnt. Workshops are useful to actually give a feel of what is going on.”

• “I enjoyed the hands on workshop on DNA methods because it helped me to appreciate the hard work and limitations of the methods. I also better understood the subsequent papers.”
Planning Ahead

Given the rapid pace of research, one of the main challenges to anticipate when it comes to running this 7-day bridging programme in future would be ensuring that the programme design and content are up-to-date in order to keep pace with changes in undergraduate and postgraduate dental curricula, new techniques and emerging research. Based on analysis of the student feedback, the majority of the residents who have attended the bridging programme so far have suggested that it could be offered earlier in their postgraduate curricula, for example during their first year. This is so that the residents can reap the programme’s learning benefits from the earliest possible stage. However, to successfully achieve the learning outcomes, the programme’s content will need to be customised accordingly to fit their baseline level of knowledge. Ultimately, it is hoped that through this bridging programme, postgraduate dental students reading the MDS programme would be equipped with the necessary skills to become dental clinicians who are able to understand, critique and make use of new knowledge for improved care for their patients.

Acknowledgements

The author would like to thank Associate Professor Lim Lum Peng, Ms Liew Shin Dee, and Mr Alan Soong for their valuable input.

Endnotes

1. According to Genco (1992), host responses, which are primarily directed to “defending the host against fulminating infections, also likely result in some of the local tissue destruction that we know as periodontal disease” (p. 338).

2. They refer to chemical tests used to “detect or quantify a specific substance, the analyte, in a blood or body fluid sample, using an immunological reaction” (Encyclopaedia of Surgery, n.d.).

References


About the Author

Dr Tan Kai Soo teaches oral biology, endodontic and periodontal microbiology, and molecular biology to undergraduate and postgraduate dental students. She has a keen interest in exploring new ways to enhance dental students’ learning of oral sciences, equipping them to be well-rounded dental practitioners.
STUDENTS’ PERCEPTIONS OF THE USE OF THE VIRTUAL PATIENT RECORD (VPR) APP FOR PHARMACY EDUCATION

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Department of Pharmacy

Recommended Citation:

Introduction

In 2009, the Obama administration passed the Health Information Technology for Economic and Clinical Health Act, committing up to $27 billion worth of incentive payments to clinicians and hospitals to encourage greater adoption and use of electronic health records (EHRs) (Blumenthal & Tavenner, 2010). Although the benefits of EHRs—increased completeness and accuracy of patient information, better clinical decision support and electronic prescribing, and greater medical practice efficiency—have been well-documented (Menachemi & Collum, 2011; Clay, 2012; HealthIT.gov, 2015), the adoption and acceptance of EHR technology in clinical pharmacy practice has been poor (Li, Land, Ray, & Chattopadhyaya, 2010). One reason could be that the implementation of EHRs disrupts the usual workflow processes in clinical environments, and many pharmacists had difficulty extracting relevant and accurate patient information from the EHR systems (Wang & Huang, 2012). This unfamiliarity with EHR systems could be attributed to the pharmacists not being trained to use the systems when they were students (Guile & Ahamed, 2011). During a review of the pharmacy practice curriculum conducted in the Department of Pharmacy in July 2012, the faculty felt that there was a need to expose students to the basic workings of an EHR system and the types of patient- and drug-related information it contains. Such exposure would address the learning gaps observed, and the information retrieved from the EHR system would be relevant for patient counselling and dispensing, which would ultimately ensure undergraduate pharmacy students make a smoother transition towards clinical practice. With smartphone technology gaining acceptance and increasingly being adopted by students, mobile applications (apps) could be a potentially viable and authentic learning platform for our pharmacy students to familiarise themselves with the workings of EHR systems. Although there are apps available in the Apple iTunes and Google Play stores which have been developed as educational tools for healthcare students, none of them contain EHR features (Mosa, Yoo, & Sheets, 2012; Handel, 2011).

This pilot study aims to determine the perceptions of a group of Year 4 (final year) pharmacy undergraduates on the usefulness of a virtual patient record (VPR) mobile app prototype, developed as a tool to support their learning. The VPR mobile app serves to educate students on the types of patient health information (PHI) available from EHRs to supplement their pharmacy practice curriculum.
Creating the VPR Mobile App Prototype

Features

The VPR mobile app prototype consists of two core features, the “Patient Health Records (PHR)” and “Case Questions”, as well as two supporting features, “Statutes” and “Useful Links” (see Figure 1). Fictional patient records containing the PHI were incorporated into the PHR feature. The types of PHI were categorised into “Social Data”, “Medical History”, “Prescription History”, and “Lab Data”, while the “Case Questions” feature contained clinical case scenarios. Web links to the governmental statutes of Singapore (e.g. the Medicines Act, the Poisons Act, and the Misuse of Drugs Act) were included in the “Statutes” feature. Meanwhile, web links to other professional websites (e.g. Singapore Pharmacy Council, Pharmaceutical Society of Singapore, and the Department of Pharmacy, NUS) were incorporated within the “Useful Links” feature.

Development process

The graphical user interface of the VPR mobile app prototype was conceptualised on storyboards using Microsoft PowerPoint 2013, from which an Android version of the app was created. Mock patient records created for training purposes were uploaded into a local backend database and integrated into the app’s PHR feature to simulate an EHR. The app was installed locally on two Samsung Galaxy Tab devices for the pilot study.

Study Design

The VPR mobile app prototype was used within a Year 4 undergraduate pharmacy practice module for 4 weeks from March to April 2013. Classes were held once every week where students had to participate in mock counselling sessions, where they engaged in one-to-one role play which mimicked real-life patient encounters. They then had to use the app to solve these clinical cases. Following the role play, students had to complete an online survey in which they had to indicate their perceptions of the app’s usefulness for pharmacy education, and its relevance as an EHR simulation tool. Overall usability of the VPR mobile app prototype was assessed based on a scale of 1 (“not useful at all”) to 10 (“extremely useful”). Additionally, qualitative feedback was sought on how the app could be improved. A total of 31 students were involved in the pilot study, and all of them participated in the survey.
Results

Students’ perceptions regarding the usefulness of the VPR mobile app for pharmacy education

The general response towards the VPR mobile app prototype was positive, with 100% of the respondents agreeing that it was easy to search for PHI relevant to the case questions. Most of them felt that the designs for the app’s features were understandable and self-explanatory (96.7%), and that the graphical user interface made it easy to navigate within the app (93.5%). 100% of the respondents found the PHR to be the app’s most useful feature, followed by “Case Questions” (83.9%), “Statutes” (57.1%), and “Useful Links” (48.4%). Overall, 28 students (90.3%) found the app useful as a teaching aid, and 87.1% of the respondents gave a rating of at least 7 out of 10 for the usefulness of the app as a teaching aid for pharmacy practice education.

Students’ suggestions on how the VPR mobile app can be refined and implemented in other pharmacy modules

A majority of the students indicated that the app had the most potential to be implemented in the following modules: pharmacology and pharmacotherapy (90.0%), pharmacy law (81.0%), health communications skills (74.0%), and pharmacokinetics (58.0%). Over half of the respondents also suggested that additional features be included in the app, such as revision and supplementary materials from lectures (61.3%), practice quizzes/questions, and lesson updates (54.8% each).

Discussion

In this study, the “Statutes” and “Useful Links” features were deemed less useful by respondents (compared to “PHR” and “Case Questions”), with respectively only 57.1% and 48.4% finding them useful. This could be because the respondents, who were Year 4 (final year) pharmacy students, had previously undergone several modules on pharmacy-related law and good clinical practices in their curriculum, and were more likely to refer to their lecture notes instead. Nevertheless, half of the respondents felt that “Statutes” and “Useful Links” were still useful features for the app. One of the respondents suggested that the app be implemented earlier in their Year 1 and Year 2 modules so as to introduce undergraduates to the concept of EHRs and how to apply the information they retrieve from this system to clinical practice. In fact, the respondent added that students should be familiar with the app before their hospital preceptorship attachments, which occur during the mid-term holidays in Year 3, by which time the app’s usefulness to pharmacy education would become more obvious to them.

In order to help students keep abreast of the latest medical-related news and developments, websites that provide relevant health- and medication-related information (e.g. Medscape), and useful materials for continuing professional education (e.g. American Society of Health-system Pharmacists and the Royal Pharmaceutical Society of Great Britain) will also be included in the “Useful Links” feature. This would make the app more useful and relevant in the pharmacy practice curriculum.

Limitations and Future Plans

The main limitation of the app was that it lacked a security login feature to prevent unauthorised access to the case questions, hence it was locally installed on two tablet devices owned and provided by the facilitator. This also limited the number of students to only a small group who could utilise the app at any time during the counselling sessions. In addition, only one source of data was obtained for this pilot study. Data collected from other sources, such as focus group interviews with students and video recordings of mock up counselling sessions, could better support the findings.
To overcome these limitations, future plans to enhance the VPR mobile app include incorporating a login function tagged to the institutional login identities of students and facilitators, as well as migrating its access to the mobile web. This enhancement would mean that the app can be tested on a larger sample of students in their earlier undergraduate years and in other pharmacy practice modules. Besides surveys, the facilitator may consider collecting additional user feedback data through focus group interviews to ascertain the usability of the app, as well as identify and address any potential reliability issues.

Future developments of the VPR mobile app will also consider its use on a variety of platforms, including Android, the Apple iOS (operating system) and the newer Microsoft Windows 10 platform. Another possible refinement would be to migrate the app’s features to a cross platform-based medium, such as the mobile web as mentioned earlier, to cater to the general student population and address the issue of students’ unfamiliarity with the app. Besides the advantage of the mobile web version having a uniform look and feel (which can have a positive impact on students’ usability experience), it is also easier to maintain and sync any updates to the app across all platforms. This would yield savings on logistics and manpower. In addition, students can access the app from the browsers on their mobile devices without having to download and install the app onto their smartphones.

**Conclusion**

Technological advances and innovations in the educational arena are changing the landscape of pharmacy education. The lack of EHR-related intended learning outcomes in our pharmacy curriculum presents itself as a potential aspect of pharmacy education which we can improve, and there is a need to look into the feasibility of including them in our course curriculum. With a student population that is increasingly tech-savvy, there is great potential for educators to utilise mobile apps as learning tools for pharmacy students. The high student feedback ratings given for the VPR mobile app’s usefulness as a teaching aid for practice education in this pilot study suggest that it has been successfully implemented as a tool which gives pharmacy students much-needed exposure to the workings of an EHR and the types of PHI that are relevant when dealing with clinical patient encounters. An opportunity also exists for the Department of Pharmacy to leverage on this app and explore how it can be used in other modules to enrich students’ learning experiences. Although there is still room for improving some features of the app, I hope in subsequent semesters to incorporate its use in the early segments of the undergraduate pharmacy practice curriculum, so as to ease the transition process of our graduating pharmacists to becoming healthcare professionals.

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Endnote

1. As mock patient records were created for training purposes and uploaded into the app’s PHR feature to simulate an EHR system, it eliminated any security concerns regarding access to confidential patient data. Furthermore, the app was isolated from the hospital’s EHR records and did not tap into any real patient records. As such, the app can be used for pharmacy education without any risk of compromising patient privacy and confidentiality.

References


About the Author

Dr. Kevin Yap is a cyber-pharmacist and an interdisciplinary researcher at the Dept of Pharmacy. He strongly believes in a blended form of learning for students which combines digital education and authentic learning environments. His educational research interests focus on e-learning and e-assessments, mobile and games-based learning, and how such technologies can enhance students’ learning and build up their domain-related knowledge and skills. He has led several initiatives in promoting the use of technology in pharmacy education through using the university’s e-assessment platform, initiating a YouTube channel, and creating a virtual pharmacy game for clinical practice and skills training.
AUGMENTING THE CHEMICAL ENGINEERING CAPSTONE DESIGN PROJECT EXPERIENCE THROUGH INDUSTRY INVOLVEMENT

Department of Chemical & Biomolecular Engineering

Introduction

Many universities and colleges across the world recognise the capstone design project as an effective vehicle to round out the undergraduate education in chemical engineering (Kentish & Shallcross, 2006). The objective of the design project is to provide students with a valuable opportunity to do the following: apply their technical knowledge, build on professional skills (e.g. communication, decision-making, and teamwork), and enhance their analytical, critical and creative thinking abilities. In the Department of Chemical and Biomolecular Engineering (ChBE) at the National University of Singapore (NUS), all chemical engineering undergraduates are required to take and complete the capstone design project as part of the core curriculum module. This module has a strong technical and professional component, with students having to review and evaluate process alternatives, simulate and optimise the chosen process using Aspen HYSYS\textsuperscript{1} and/or Matlab packages, size process units/equipment, conduct safety, health and environmental studies, and perform economic analysis. Details of the design project structure and implementation methodology at ChBE, NUS can be found in our previous article (Bansal et al., 2012).

The scope and format of the design project is based on the expected learning outcomes and objectives (outlined in the earlier paragraph) which are in line with the Department’s vision to produce dynamic, innovative and ethical engineers with a strong engineering foundation. The module emphasises the development of soft, hard and ethical skills of undergraduates with the intended result of producing graduates who are ready to pursue challenging engineering careers. To meet these aspirations, the teaching and learning practices in ChBE are constantly being evaluated and refined; these include enhanced industry involvement in the capstone design project. This paper discusses various aspects of industry involvement in the design project over the past two academic years (AY2013/14 and AY2014/15) and their implications—from industry personnel being invited to be guest speakers and external advisors for the project, to students going on plant visits.

\textsuperscript{1} Aspen HYSYS is a registered trademark of AspenTech, Inc.
Industry Involvement in the Chemical Engineering Design Project

Industry personnel as guest speakers

Industry talks have long been recognised as an effective pedagogical tool (Wolfe & College, 2006). Inviting experienced engineers as guest speakers provide elements of an authentic learning environment (Donovan, Bransford, & Pellegrino, 1999; Herrington & Herrington, 2006), and help to enrich the students’ overall learning experience in several ways. The guest speakers provide relevant up-to-date industry-specific information. They also share real-world experiences and give students valuable insights into their respective fields of practice. Every year, practising engineers from Singapore’s numerous chemical process industries are invited to present technical talks on a range of topics related to the design project. Six or more industry talks were arranged during each of the two academic years mentioned; details of these talks can be found in Figures 1 and 2. These talks, each lasting between one and one-and-a-half hours and prepared in consultation with ChBE’s faculty advisors, serve to bridge the gap between classroom education and industrial experience, as well as provide students valued exposure to industry perspectives and engineering practices. According to Herrington and Herrington (2006), such talks give students access to expert knowledge and performance that would provide “a model of how a real practitioner behaves in a real situation” (p. 5). For the benefit of students unable to attend, the talks were webcast and made available on the Integrated Virtual Learning Environment (IVLE).

Industry personnel as external advisors

Members of the industry could impact students’ learning experience by serving as external advisors for the capstone design project. As external advisors, they can support the “collaborative construction of knowledge” (Herrington & Herrington, 2006) by contributing significantly to the formulation of the engineering problem statement for the design project, sourcing for realistic data, advising students, and more. One of the primary requirements towards achieving the intended learning outcomes for the design project is the formulation of an open-ended engineering problem that is realistic and accurately reflects the constraints found in the industry. Though faculty advisors are responsible for preparing the problem statement, feedback from the members of the industry can be very helpful in ensuring that the proposed design project problem is industry-relevant and adequate in preparing students for their professional careers. Furthermore, the industry representative can contribute by interacting with students, participating in meetings, as well as sharing insights and practical experiences. Working along these lines, the Department of ChBE appointed Dr. Gavin Towler (Chief Technology Officer and Vice President of R&D, UOP) as external advisor for the design project in AY2013/14 and AY2014/15. Over the past two academic years, Dr. Towler has contributed in a variety of ways: reviewing the design project’s problem statement, delivering talks, participating in the team leaders’ meeting, and offering consultation to students. The design project and students involved have benefitted immensely from his expert suggestions and involvement.

Partnering industry to organise industrial visits

Another form of industry involvement in the capstone design project is through the plant visits for students. Visits to the industries, particularly to plants with manufacturing activities closely related to the design project problem, can help students broaden their learning experiences by helping them gain a better understanding of the overall process as well as by facilitating awareness of new technologies, good industrial practices, and safety issues. The visit to a related industry in the midst of working on the design project is particularly beneficial for students, even though many of them have to complete a 24-
week industrial attachment before doing the design project. For example, during Semester II of AY2013/14, students were assigned to work on the phenol manufacturing process using cumene as the feedstock. To help students acquaint themselves with the production process and obtain a closer view of the large-scale unit operations/equipment, we worked with our industry partners to organise a visit to Mitsui Phenols Singapore Pte Ltd. Students valued the visit to the plant as they gained a deeper insight into the process and had the opportunity to talk with the engineers, make queries, and clear doubts. In continuation of such efforts, an industry visit to Asia-Pacific Breweries Singapore was organised during Semester II of AY2014/15. More than 100 final year undergraduates participated in both visits.

**Student Response and Feedback**

On conclusion of the design project, an online survey was conducted via the IVLE to evaluate students’ perceptions and learning from having enhanced industry involvement in the design project. The anonymous survey collected both quantitative and qualitative feedback from students. A total of 105 and 200 students participated in the survey conducted in AY2013/14 and AY2014/15 respectively. The quantitative responses are summarised in Figures 1 and 2.

![Figure 1](image)

*Figure 1. Students’ quantitative responses to the survey questions (AY2013/14).*

**Quantitative feedback**

The student feedback results were highly encouraging, with a majority of the students in both academic years (>70%) finding the industrial talks and visit ‘helpful’ or ‘very helpful’. The positive feedback clearly indicates that students embraced the industry talks as well as the visits, and considered them to be valuable and practical learning resources with long-lasting learning benefits. As part of the survey, students were asked if there were other topics they felt should be included in future industry talks. Among the various topics suggested, the following appeared most frequently: economic analysis, design of absorption columns, and heat integration.
Qualitative feedback

The qualitative feedback also indicated a very positive student response to industry involvement in the design project. Some of the students’ comments on how such industry involvement had enriched their learning experience are shown below:

- “The industry talks and visit were very useful. They set the foundation and initiate the thinking process for students. They give us a yardstick to which we can compare our calculations to and ascertain if our calculations are meaningful on an industrial scale…”
- “The talks were pretty useful, especially the talk by Dr. Towler. They gave a good insight into the industrial practices.”
- “Talks were useful as they provided knowledge beyond those available in books and we could apply them in our design project.”
- “They are very useful, particularly the plant visit because it gave an opportunity [for us] to talk to the engineers who are involved in running the plant. We can thus become aware of what’s practically correct and what’s not.”

Conclusion

Farr et al. (2001) stated that “relevant, industry partnered design is an important part of the undergraduate education experience for tomorrow’s engineers” (p. 193). Our approach is a step in this direction. In view of students’ positive feedback and apparently enhanced performance, evident from the improved quality of the written reports submitted and students’ responses to questions during the oral presentations, we will continue to incorporate and strengthen industry involvement in the capstone design project. Given the industry’s expectations when it comes to the skills that entry-level engineers should possess, it is important to understand and identify the most effective means for preparing undergraduates to meet these expectations. The active involvement of industry personnel in the chemical engineering design project as formulators of the design project problem, guest speakers, external advisors, and hosts
for industrial visits can make a significant impact on students’ overall learning and preparation for their professional careers. We are grateful to the practicing engineers in the chemical process industries for their support and cooperation in the past, and look forward to the continued support in the future.

Endnotes

1. HYSYS is a powerful software tool which is commonly used for the simulation of chemical process plants including petroleum refineries and petrochemicals. It includes tools for estimation of physical properties and vapour-liquid phase equilibria, heat and material balances, and simulation of many types of chemical engineering equipment.

2. UOP, formerly known as Universal Oil Products, is a Honeywell company which develops and delivers technology to the petroleum refining, gas processing, petrochemical production, and major manufacturing industries.

3. Cumene is the common name for isopropylbenzene, an organic compound that is based on an aromatic hydrocarbon with an aliphatic substitution. It is used in the production of phenol, acetone and other derivatives.

4. We are grateful to Dr Gavin Towler (of Universal Oil Products), Ms. Lau Sue-Ann (of Sulzer Chem-Tech), Mr. Joseph William Eades (of Isaphan Group), Mr C.C.S. Reddy (of Singapore Refining Company), Mr. Satendra Singh (of Foster Wheeler), Mr. Raman Balajee (of Air Products), and Mr. L. Srinivasan (of Shell) for giving the industry talks.

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References


About the Author

Dr Satyen Gautam is the corresponding author for this article and part of the academic team coordinating the Design Project for Chemical Engineering students. He believes that education is a progressive journey of becoming better and that students learn best when they are in harmony with their learning environment. Also, learning becomes most efficient if it can appeal to students at both a personal and an intellectual level.