RESEARCH

A Qualitative Study on the Perception of Australian and Malaysian Academic Teaching Staff in an Undergraduate B.Pharm Program on Case-based Learning

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ABSTRACT

Objectives: To determine the perceptions of lecturers towards case-based learning (CBL), and to elicit their feedback and opinion regarding the design of CBL sessions within the pharmacy curricula.

Methods: One-on-one interviews were conducted with 10 academic staff members involved in teaching an undergraduate B.Pharm program. All sessions were audio-recorded and field notes were compiled. Recordings were then transcribed, and a qualitative thematic analysis of responses was performed.

Results: Four key themes were identified: (1) Perceived benefits of CBL; (2) Challenges in implementing CBL within the curricula; (3) Characteristics of effective and engaging CBL; and (4) Relevance and implementation of CBL within the curriculum.

Conclusions: While benefits of CBL identified included application to students' future roles as pharmacists, there were also challenges such as the design of cases as well as time constraints. Respondents also underlined the need for skilled facilitators, and the importance of working in small groups. In order to ensure effective implementation of CBL sessions, careful attention should thus be paid to selecting facilitators and providing the appropriate training on how to facilitate the sessions within the allotted time, as well as with regard to designing cases.

Keywords: case-based learning; pharmacy education; undergraduate education; facilitators; problem-based learning

INTRODUCTION

Teaching and training of future health professionals have evolved in an atmosphere of increasing demand on graduate and course quality. Not only are educators aware that passive acquisition and reproduction of examination-directed information from traditionally one-way, didactic teaching fails to nurture students,[1] curriculum time is also limited for exposure of students to a growing knowledge base.[2,3] Thus to maintain accountability to society and advance the profession, the paradigm in pharmacy education has shifted from traditional input-based teaching to a greater focus on learner outcomes.[4]

Contemporary practice demands that graduates have the capacity to respond to evolving professional challenges, collaborate effectively within interprofessional teams, and develop further through lifelong learning to enhance patient and population outcomes.[5,6] To this end, the International Pharmaceutical Federation recommends that active-learning (AL) strategies be employed in higher education.[7] The most utilized strategy among pharmacy schools in the United States is problem-based learning (PBL), which includes case-based learning (CBL),[1] and is increasingly being adopted around the world.

Both PBL and CBL bear advantages over didactic teaching, such as students being actively engaged and focused on higher-order learning.[8] However, apart from being relatively resource- and staff-intensive, the lack of faculty control and structure may account for some hesitancy to adopt PBL in pharmacy schools.[9] Indeed in a curricular shift from PBL to CBL involving second and third year students in a medical course, students preferred the latter, claiming it provided more opportunities for the application of clinical skills.[10]

From the point of view of learners, CBL is essentially student-centred because of the many benefits reported, such as enabling a deep and AL state to occur,[11,12] developing clinical competencies and professional attributes for future practice,[13,14] fostering communication skills and teamwork,[15] and motivating independent learning.[12] While PBL can be described as a type of open inquiry in relying on issues and learning points to be generated from the case by students, with minimal facilitator interference or need for prior knowledge,[16] CBL is more structured in having guidance from a

content-expert as students analyse a situation in small groups - using prior gained knowledge and other sources – followed by presentation of possible solutions to the class.[10,17]

The role of the facilitator in CBL has been identified by students to be paramount in optimizing learning gains. In a pilot study by Jacob et al, pharmacy students perceived that facilitators should be engaging, and actively participate as part of a dynamic process where feedback is constantly provided.[18] Indeed the role of the facilitator – such as in managing group dynamics, balance of participation, and breadth of discussions – has been found to have an impact on satisfaction among healthcare students.[19] However, while lecturers appreciate CBL for its benefits on student learning and interaction with students,[20,21] implementation can be challenging compared to didactic teaching. In an undergraduate surgical curriculum where CBL was implemented with little success, faculty members found facilitation skills challenging, and felt like novices instead of experts in their role.[22] However, perspectives of lecturers on CBL in undergraduate pharmacy have yet to be explicitly and qualitatively explored in literature.

From 2012 to 2016, there has been a fundamental change in how teaching in an undergraduate pharmacy program is implemented at a public Australian university that has a campus in Malaysia, from mostly didactic teaching strategies to a much greater emphasis on AL teaching strategies.[23] The current curriculum utilizes an integrative approach, where in many units (where a unit is normally a semester-long component, and four units are normally taught concurrently and comprise a semester of teaching), science-based topics and practice-based topics are covered within the one unit. The increase in AL in both large and small class teaching, has involved a greater focus on CBL. Since lecturers are currently and will be on the frontlines of designing and carrying out this teaching/learning method, the primary aim of this qualitative study is to determine the perceptions of lecturers towards CBL. A secondary objective is to elicit their feedback and opinion regarding the design of CBL sessions within the pharmacy curricula. A qualitative design was employed as it would allow respondents to fully express themselves and give responses outside the options provided on quantitative questionnaires.

METHOD

Qualitative one-on-one interview sessions were conducted. Purposive sampling was employed whereby academic staff who were involved in teaching undergraduate students enrolled in the Bachelor of Pharmacy program, regardless of whether or not they used CBL in their teaching, and had a good command of English; were approached either in person or via email to participate in the study. Letters of invitation along with explanatory statements were sent to prospective subjects via email. Interviewees were informed that their responses would be anonymized and audio-recorded. The interview guide (Appendix 1) was developed based on the study objectives, as well as a review of the literature. Face and content validation was done by experts in qualitative research, and academics involved in undergraduate pharmacy and medical teaching, who were not involved in the study. Interviews were conducted by DM and SAJ at a time convenient to the study participants, and were conducted in private to ensure confidentiality. Each session lasted between 30 minutes to one hour, and during the interview, field notes were also taken to capture key points. Participants were also requested to provide some demographic details via email.

Data transcription and analysis:

Recorded interviews were transcribed verbatim, and deidentified prior to analysis. Results were then imported into QSR International's NVivo 11 Software. All audio recordings and interviewer field notes were also imported into NVivo for comparison and analysis. Thematic analysis was performed on the transcripts by two researchers (SAJ and HDO), guided by Braun and Clarke's six phase approach to coding.[24] Any discrepancies were resolved by consensus. Quotations by respondents were edited on a limited basis to remove content that did not convey meaning (repeated words, stutters, etc), and to correct for grammar. An ellipsis mark was used to note removal of such extraneous content. Square brackets were used in quotations to supply words omitted by the speaker or to replace sensitive information where names were mentioned. The research protocol was reviewed and approved by the Monash University Human Research Ethics Committee (CF15/3459 - 2015001481).

RESULTS

A total of 10 academic teaching staff agreed to participate in the study. There was a slight female preponderance (60%) in the participants who were between 34-53 years of age. Two respondents

were from pharmacy practice, while the rest were science-based. Other demographic characteristics of respondents are presented in Table 1. Qualitative analysis revealed two themes each with regard to participants' perceptions of CBL, as well as CBL design; and these are summarized below and in Table 2.

Perception of CBL

The first theme was 'Perceived benefits of CBL, and under the subtheme 'Knowledge transfer', respondents felt that CBL helps in translating complex, technical, and abstract concepts into concrete or meaningful information; allowing students to engage with theories or concepts at a deeper level or from a different perspective. This was especially relevant in science and non-clinical subjects, which lecturers perceived as hard and somewhat inaccessible to students. Specifically as it pertained to highly scientific and technical definitions, respondents felt that by putting it in the context of a case, it helped students understand the definitions better. CBL was also perceived to be a way for students to check if they had all the correct information, and had understood the concepts discussed during lectures.

The application of knowledge and skills for a particular scenario were seen to enable simulation or thinking on a wider plane, as well as trigger higher-order skills to be employed such as critical thinking, problem-solving, logic, and reasoning. As noted, respondents believed that CBL enhances student learning due to the deeper analysis and discussion that it involved. Traditional lectures were thought to lead to superficial understanding and short-term memory retention, thus respondents felt that putting things in a clinical context by using examples in the form of cases would aid students in understanding and remembering what had been taught. This was also noted by science-based lecturers who found it helped students remember technical concepts and theories taught during class.

The element of working in groups during CBL was noted as essential in helping students develop skills in terms of working as part of a team, as well as an appreciation of different perspectives when bringing together different elements of a case. This exposure to different thought processes and opinions was thought to contribute to their overall development. This also translated to students learning from their peers through these interactions, as it was believed that discussions with

friends would help improve their understanding of a particular topic. This was then thought to provide a platform for students to grade and assess one another as part of working in a group, for example by using a marking rubric; to ensure teammates were progressing well.

In terms of 'Application to future roles', respondents felt that given that students were not exposed to real-life situations during their pre-university days, contextualizing cases according to real-life scenarios would help students learn better as it enabled them to see how information they learned would be useful in their future roles as pharmacists. Respondents also felt it helped students understand that healthcare does not happen in a vacuum, and is influenced by other determinants of health such as social, ethical, and economic factors. 'Exposing' them to real-world situations through cases would also serve to mature and develop them overall. Through the analysis of real-life cases, this also allows for the consolidation of skill sets for specific professional competencies like counselling, and providing pharmaceutical care to patients.

The second theme encompassed the challenges in implementing CBL within the curricula, and under the subtheme 'Issues within the curriculum', respondents were of the opinion that setting up the CBL sessions would be fairly work-intensive. Existing modes of learning such as AL and online wikis, which would play a role in the mode of delivery of CBL sessions, also needed fine-tuning. CBL is also currently not part of the course or unit guide, and is therefore not formally timetabled. This has then led to issues of time-constraints to conduct these sessions within current lecture or tutorial sessions, in a curriculum that is already saturated.

With regard to 'Human factors', it was highlighted that one of the challenges would be not only in getting facilitators who were enthusiastic and engaging to run the sessions, but also training them to facilitate rather than just tutor. It was also pointed out that the success of implementing CBL was dependent on the attitude of students, who preferred to adopt passive roles during classes, and didn't seem to like AL. A further challenge was trying to get them to work in groups, rather than taking the information away to solve on their own.

Case-design was an important subtheme, with 70% of respondents of the opinion that designing cases would be the biggest challenge, requiring a lot of skills and time. Among the challenges noted specific to this was designing cases which were logical, realistic, challenging, and

for different situations to explain different concepts, without being too difficult; making it relevant and being able to articulate to students why it is relevant, and linking the cases to the course content as well as assessments. Cases were also constantly recycled, with accompanying questions often theoretical, which impeded learning. Science-based lecturers lamented the fact that not all topics could be converted into cases, such as physical and organic chemistry, which would work better through practical classes.

CBL Design

With regard to the theme 'Characteristics of Effective and Engaging CBL', respondents were unanimous in their opinion that the most important element to ensure effective CBL sessions was the design of good cases, with one suggesting the use of live patients and creating videos. The importance of first outlining learning objectives and the intended outcomes was imperative in deciding if cases were indeed suitable for respective sessions. Among the suggestions were that cases should be logical, directly related to the lecture series, and should be accompanied by insightful questions that actually make students think. While cases should be simple, it should not be too simple that students could have solved it on their own (for cases where students were expected to work in groups); but it also should not be too challenging that students feel they cannot contribute. Respondents also noted that there was an expectation by students that the cases should be connected to their assignments or assessments. One respondent suggested that cases should be dramatic in order to pique the interest of students, while others suggested that in order to be effective, the students should already have background knowledge of the case being discussed.

Another key characteristic noted for effective CBL sessions was for students to be actively involved, to engage in debates and discussions, justify decisions on management, and present information to the rest of the group. This would also assist facilitators in discerning whether students had a good grasp of the content. Students should also be active agents in their own learning as during lessons, students were often put on the spot. So to fully benefit from each session, it was important for them to come prepared with pre-reading, and be familiar with lecture materials.

Respondents felt it was equally important for feedback to be given to students. This was based on comments received from students who felt it helped guide them in knowing if they were

progressing well in terms of answering questions pertaining to the case. Group work was also stressed here as it encouraged students to work as a team, and support one another in solving a case. Respondents agreed that groups should be no larger than 4-5 students, as that could lead to only a few engaging actively in discussions, while others were either left out or did not see the need to participate. While most respondents felt that each session should be no longer than one hour to prevent students from becoming disengaged, one suggested that the timing should instead be based on the objectives of each session.

All respondents stressed the importance of properly-trained facilitators in ensuring the success of CBL sessions, underlining the importance of going beyond teaching, and facilitating instead; which was perceived as being more difficult. Respondents noted that facilitators should not however adopt a passive role, and should instead be able to draw the students to the cases, as well as play a role in revising and translating the sessions to make it easier for students to comprehend the sessions. Most respondents prefer facilitators conducting the sessions to be content-experts, noting that content-experts would also be cognizant of the degree to which they should be involved in a session ie, when to guide the students, and when to step back. Respondents also felt that facilitators would require a fair bit of training, as despite being knowledgeable, a different set of skills is required in order to conduct and facilitate CBL sessions. Some noted that students are capable of asking questions beyond what is expected, and see expertise as helpful in this regard. To that end, they recommended that a guide be prepared for facilitators to help them prepare for these unexpected situations.

Under the second theme of 'Relevance and Implementation of CBL within the Curricula', 90% of respondents felt that CBL, while mandatory for clinical topics, was applicable to both clinical and science-based topics. There were however concerns as to whether a case would be able to stand alone for science-based topics, with respondents suggesting integration with other topics within integrated units, for example integrating pharmacology and chemistry with elements of management. Respondents were unanimous that CBL should be initiated in the first year of the pharmacy course, using a scaffolded approach that builds up in complexity as they progress through the course. In the same vein, detailed instructions and guidance should be provided to students upon implementation to

orientate students to expectations and intended outcomes, so that they have an awareness of what was expected of them, how to approach the session, and what resources they needed to look at. This would then encourage their involvement in the sessions.

The type of topics covered was dependant on the year of study, with respondents proposing that cases are tailored according to subjects being taught in the respective years. Indeed how a case is designed and the intended purpose for clinical topics differs from science-based topics. For instance in pharmacology, the emphasis is not so much on managing a patient or disease, as it is about drugs and its mechanisms of action. Another suggestion was to apply the same structure or format to facilitate learning in both science-based and therapeutic units across the years.

DISCUSSION

The aim of this study was to gain an insight into the perceptions of lecturers that teach into an undergraduate pharmacy curriculum regarding CBL, with a mind to utilise this information to better construct and run CBL classes. Respondents agreed that CBL is a useful means by which to apply knowledge and develop skills such as communication, problem-solving, and teamwork.[15]The majority of those interviewed also appreciated the relevance of CBL in the context of future roles of students as pharmacists. This is in agreement with the concept that CBL is a constructivist model that enhances problem-solving abilities, relates course material directly to practical outcomes,[25] and aids in the development of professional skills.[13,14]

It is also encouraging to note that all the science-based respondents currently use some format of CBL within their units, and are cognizant of the role of CBL in facilitating students' undestanding of technical scientific concepts. This is a departure from a 2011 survey which found that pharmacy practice staff were three times more likely to utilize AL strategies compared with science- and pharmaceutical-based staff.[2] This might signal the advent of more science-based faculty adapting CBL components within their units, given the importance of future pharmacists to apply their knowledge and think critically when managing patients - skills which are not effectively imparted through didactic-based teaching.[1]

Whilst CBL is more easily translatable to clinical-type subjects, there was a general perception that CBL helped to develop relevance of material, particularly in basic science-type

subjects such as chemistry and pharmacology. This is in agreement with a number of studies that have promoted the benefits of teaching basic science subjects in a CBL format.[15,25-27] In a toxicology elective whereby students met once a week for two hours to work on case-based problems for an hour, examination scores improved and it also provided a clinically-relevant experience where students actively engaged with the material.[27]

Science-based respondents have, however, lamented the fact that it was challenging to develop cases for science-based material, and that science-based subjects would not be able to stand alone without clinical topics when conducting CBL sessions. Thus it was proposed that there should be an integration of science and clinical material within cases. This was done in a study to teach osteoarthritis and rheumatoid arthritis to undergraduate pharmacy students, where students were required to apply their knowledge of all components to successfully manage the patient. At the end of the study, students displayed mastery over course material, and graded this format highly.[28]

Educators should also make an allowance for the fact that any one format or pedagogy might not suit all units. Indeed, science-based learning might require different methods of thinking and processes of learning which might then require a different method of teaching; and while integration of material might work, it might also be useful to simply use different AL pedagogies for science material and for practice material. One such pedagogy is the Process Oriented Guided Inquiry Learning (POGIL), which uses guided inquiry and has been found to increase students' problem-solving, critical-thinking, and communication skills. Students work in small groups, are assigned different roles, and are guided by a facilitator. However, it focuses more on specific concepts in learning and the development of process skills, which may find it more useful in science-based topics.[29,30] There is also a move to hybridize different pedagogies in order to optimize the benefits of each.[29] Thus in programs that strongly emphasize both science and clinical skills, adapting a hybrid of CBL and POGIL might be worth exploring.

It was identified that conducting sessions in groups can assist in developing teamwork skills, appreciating varying perspectives regarding a particular problem, and improving one's understanding of a topic.[20] Most higher education pedagogies subscribe to the concept of social constructivism, which implies that the process of building knowledge is aided through cooperative social

interactions.[29] Thus working in groups facilitates this, and closely mirrors the real world situation, assisting students in building interprofessional relationships.[31] This was reflected in a study involving students in a PharmD program who were tasked with working in small groups to communicate with 'patients' and design appropriate treatment and follow-up plans. Students felt the format provided significant opportunities to improve their verbal and written communication skills, problem-solving skills, as well as their ability to work as a team.[32] Although one of the challenges to group work highlighted by respondents was reticence on the part of students, students have rated working in groups favorably, claiming it gave them greater satisfaction, and that they valued being an active part of a group and sharing information.[19,33]

Another important aspect of group work is peer assessment, which allows for evaluation of non-content skills not usually assessed in traditional forms of assessment.[34] Students have expressed the view that peer assessments helped develop their confidence, motivation, critical thinking, and team building skills; made them more reflective, analytical, and self-aware,[31] and provided another avenue for feedback that is so highly sought-after by students. [31,3536] Facilitators have also noted that intergroup peer assessment was effective in getting students more actively involved, and in piquing their interest. Students themselves commented that they valued the feedback received from peers as it was different from that received from facilitators, and was more relatable as their peers had researched the same information as the students they were assessing.[31] Students also felt it was easier to accept criticism from their peers as opposed to their facilitators.[37] Peer-assessment has however led to students over-marking their peers.[38] Students also feel peer-assessment is challenging and time-consuming,[39] thus it should be utilized in moderation and with proper guidance.

Respondents were unanimous in that facilitators should assume an active role and be able to direct discussions, thus functioning as part of the group instead of as an observer. These discussions would serve to assist students' understanding of their expectations and standards, as well as to correct any misunderstandings.[37] Indeed the role of facilitators was seen as vital in encouraging group organization and equal contribution from members,[19] and was key to effective AL sessions.[18,40-44] In the traditional system, feedback from facilitators was largely unidirectional, with facilitators telling students what they did right or wrong, and the students using this information to make the necessary

corrections.[37] This is in contrast to the principles of CBL, which subscribes to the philosophy of students as self-regulated learners. Along with this change in teaching, there should also be a shift in the way feedback is given, or rather, the role that feedback plays. Indeed, the method of feedback in the current pedagogy has evolved as it is within an avenue where students are actively structuring their own knowledge and skill, and should instead be used to empower students to self-regulate their learning. Thus feedback should be dialogical as opposed to transmission-centered, and students must interact actively with the feedback received, in order for it to be effective.[37]

In the traditional transmission-centered feedback, the onus is solely on facilitators, thereby increasing their workload. To overcome this, facilitators can leverage on peer assessment as an added source of feedback.[31] Facilitators should also empower students to be more self-regulated and develop their self-assessment skills, as this will lead to them being less dependent on teachers. Indeed it has been noted that students do generate their own feedback within CBL sessions,[37] thus the role of the facilitator is to simply enhance this skill. Some examples of ways to overcome the difficulty of providing feedback, due to time constraints and large class sizes, are by using classroom technologies to trigger peer discussion,[45,46] as well as one-minute papers in class, which allow for rapid feedback.[37]

Our respondents also stressed the need for facilitators to be content-experts. Previous studies have noted that students have commented that without content-experts, it was akin to the 'uninformed leading the ignorant', as there was nothing to discuss when facilitated by non-experts.[19,44] Indeed beyond being able to effectively direct discussions and recognize errors in comprehension, a content-expert would be cognizant of the appropriate time and degree as to which they should intervene in student learning, without compromising the tenets of self-regulated learning.[47]

Facilitators themselves have expressed the fact that not being content-experts affected their performance during AL sessions.[44] However due to budget constraints and staffing issues, getting content-experts may not always be possible. A solution to this could be the use of the Objective Structured Brainstorming Questions, a road map to guide non-experts in effectively directing discussion sessions and ensuring students explore cases in a comprehensive manner.[48] There is, however, some ambiguity with regard to the importance of content-experts, with some finding it more of a hindrance in self-regulated learning, commenting that content-experts would feel compelled out

of force of habit to lecture. [49]

Facilitators have lamented that a key issue in facilitation was a lack of knowing when to direct or when to facilitate in order to strike a balance between teaching students and guiding students to self-regulate.[47] This then aligns with the comment by our respondents as well as other authors on the need for facilitators to be appropriately trained.[18,44,49] This was identified as being important to ensure consistency across multiple classes being run by different facilitators, as well as adapting facilitators with the different set of skills required to facilitate CBL sessions.[50]

Some facilitators, however, are resilient to change as they are more familiar with the traditional roles of 'teachers'.[51] Of particular concern are the subversive facilitators who do not believe in the philosophy of CBL and AL, and who might subtly or overtly communicate to students that they are receiving lower-quality education.[49] Students themselves have noted that facilitators who did not support PBL performed worse.[44] Thus, facilitator training needs to involve a reflection on what or how they feel about the philosophy behind CBL and AL, to ensure that they are indeed aligned with the theory underpinning CBL.

There was an overall acknowledgement that writing real-life cases is time-consuming, and requires significant training in order to make the case at the right level in terms of difficulty in particular. An attempt to address how difficult cases should be for novice, intermediate, and advanced pharmacy students was developed by Spark et al by altering a case difficulty cube originally developed for business students.[52] This involved analysing cases based on three dimensions (analytical, conceptual, and presentation), and recommending case level difficulty based on these dimensions to be scaffolded through pharmacy courses.[53] There also seems to be difficulty in adopting CBL due to time constraints within the current curriculum, and one method of addressing this would be to use online CBL, where students have to attempt cases online in a group, and the results are then used by the facilitators to facilitate face-to-face discussions with students.[54] It was noted however, that it is naive to assume that AL can be introduced without first having to make structural changes to the curriculum.[55]

Limitations

Only two respondents were specialists in pharmacy practice, while others were science-based. However, this allowed an interesting perspective into CBL in terms of teaching into the pharmacy course. In addition, whilst the sample size of 10 was relatively low, the majority of respondents had over 10 years' experience in teaching undergraduate pharmacy students. The use of two interviewers increases the potential for interrater reliability issues, while thematic analysis was done by one of the researchers, which might have introduced bias in the analysis.

CONCLUSIONS

A number of key benefits of CBL were identified, including knowledge and skills' acquisition, and application to future roles. Challenges identified included time taken to design cases, and appropriate training of facilitators to deliver CBL effectively. In order to ensure effective implementation of CBL sessions, careful attention should thus be paid to selecting facilitators and providing appropriate training, as well as in designing the sessions itself, taking into account issues related to case design as well as time constraints. There should also be a shift not just in facilitators', but also students' perceptions of the role of facilitators.

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Table 1. Demographic Characteristics of Participants

Characteristics	**No. of respondents**
Age (mean ± SD)*	40.25 (4.86)
Number of years teaching undergraduate pharmacy*	
a) < 5 years	0
b) 5-10 years	1
c) > 10 years	8
Area of specialization in teaching*#	
a) Pharmacy practice	2
b) Pharmacology	4
c) Drug delivery	2
d) Molecular biology	1
e) Medicinal chemistry	2
Qualifications#	
a) B.Pharm	5
b) B.Sc	5
c) M.Sc	1
d) M.Clinical Pharm	1
e) M.Pharm	2
f) PhD	9

*One respondent declined to provide demographic details.

#Numbers might total more than 9/10 as respondents were allowed to select more than one option.

Table 2. Common Themes Identified and Example Responses

Study objectives	Theme	Sub-theme	Examples
1. Perception of CBL	1.1 Perceived benefits of CBL	1.1.1 Knowledge transfer	*"...membranes can be a little bit abstract for students, talking about ion channels, ion movement etc, and putting it into context in terms of what it means in the human body. Example: The case based study I came up with, to demonstrate some of the concepts I talked about in lectures was having someone feeling sick as a result of being poisoned with tetrodotoxin (TTX), a sodium channel blocker. It is one thing talking about TTX blocking sodium channels in a large lecture series and putting it in context and showing examples of what adding TTX would do to an action potential. But it is completely different to get students to think and apply their knowledge and critically think about what that would do to somebody, ie, the whole body, as opposed to a channel, thinking about systems, and thinking about the human body as a whole."* ***(Science-based #1, Australia)***
		1.1.2 Knowledge and skills' acquisition	*"...[in] thermodynamics I teach a lot of concepts and theory, it's just like reading definitions and trying to learn and then we...put in...problems, questions...and then they try to calculate things. That's all. It [is] all left in the paper, you know. It doesn't go in, into their brain, I would say because...after two weeks, three weeks of that period [of] learning, they will forget...they will not remember, even after semester... So...during the learning state itself if you can show...a few stories which [are] related to the concept, theory...then they can visualize, they can think further... that makes them to appreciate the topic as well as enhance the learning. And they will... not forget the topic easily."* **(Science-based #8, Malaysia)**

		1.1.3 Application to future roles	*"Students can see how… their communication skill and the clinical knowledge and management skill fit into looking at that scenario or the case that we ask them to look at...an example...[Mr X] came to get Nurofen (Ibuprofen) for his headaches and … when you check his history you found that he's taking something like Nexium (Esomeprazole) so what would you do? So… they need to identify the problem, they need to identify how they're going to manage it and how they're going to follow up....it's the delivery as well, so the way I did it was I asked the person to come down and one person be [Mr X] and one person be the pharmacist and one be the bystander, you know, looking at them; and take note of the conversation and how they're going to deal with this problem."* **(Pharmacy practice #2, Australia)**
	1.2 Challenges in implementing CBL within the curricula	1.2.1 Issues within the curriculum	"*...recently they have incorporated active learning and they (faculty education leaders) are encouraging us to input a lot of questions during the classes. But again the problem is we have limited number of lectures and limited number of contact hours...we have limited time if you want to implement CBL."* **(Science-based #7, Malaysia)**
		1.2.2 Human factors	"*But I guess it depends on whether students appreciate our approach. Whether they understand the reason we introduced CBL, whether they actively participate in the discussion, or discuss with their friends…to come up with the answers."* **(Science-based #2, Malaysia)**
		1.2.3 Case design	"*...we have got cases that we created but then the questions given to the students are very academic questions, very theoretical questions that they can easily get from the… lecture notes. So it defeats the purpose… because CBL is good to teach clinical reasoning."* **(Pharmacy practice #1, Malaysia)**
2. CBL Design	2.1 Characteristics of effective and engaging CBL	2.1.1 Case-design	"*I think for it to be effective it has to be something they understand. So, it has to be diseases and drugs and medicines that they've heard of and that they know a little bit about how they work...so again, it has to be relevant to them, they have to understand, they have to have heard of the things."* **(Science-based #6, Australia)**

	2.1.2 Active involvement of students	"*...if you involve…students to…create that learning piece by using their…prior knowledge and understanding and… they're making the story together with the teacher and they…can express their opinions, they can argue, they can speak up for what they think is right or wrong, without having to be scared of what the teacher might think. So I think engaging is.. they're actively learning it and they're contributing to their own learning and also…when they participate in discussions...that's why I want them to talk about it and be opinionative...So I want them to ask questions and I want them to think and argue with me. If they're thinking and reflecting that means they're not just sitting there and not getting anything...if I can't see their response then I don't know how I'm going to know that it's effective or not, you know."* **(Pharmacy practice #2, Australia)**
	2.1.3 Feedback to students	*"...has to be some way of [providing feedback] – not the answer, but some way of, of providing recognition that you're on the right track, or that what you're thinking is appropriate under the circumstances."* **(Science-based #4, Australia)**
	2.1.4 Working in groups	*"... I was working on the nervous system one just before…it's a scenario where an individual suffers a subdural hematoma – that's not particularly important for a pharmacy student – but thinking about the consequences in terms of symptoms, and damage, and what sort of treatment options might be appropriate. And it's a way of…looking at physiology material that we're covering in physiology but we're using the human aspect of it. So in a sense it's not a realistic case, because they wouldn't be diagnosing someone, but it's a way of approaching those kinds of concepts from a different angle and they have to work together and just…work out what could be going wrong and why...But, it's a good example of where they have to work together to solve something..."***(Science-based #4, Australia)**
	2.1.5 Time factor	"*Yeah the time...actually depends on what you're looking out [for], and what you're working on…with the case… and*

		what outcome you want to achieve." **(Science-based #8, Malaysia)**
	2.1.6 Role of tutors/facilitators	"*The way that I run it is that I provide all the rules, structure, [and] organization of the class to the class beforehand. I invite the facilitators who are going to run the class to that introductory class as well, so that everyone is on the same page, I also send facilitators notes with answers to questions, I then also have a short meeting for them to ask questions. So there is a fair bit of work required upfront to train the facilitators."* **(Science-based #1, Australia)**
2.2 Relevance and implementation of CBL within the curricula	2.2.1 Relevance within the curricula	"*Well I use it mainly for clinical stuff but I think it is still useful to teach scientists how drug interactions are important and what they might do, they have to think of that sort of thing when they're looking at things like new medicines and new drug targets, they have to think of how they might affect other parts of the body."* **(Science-based #6, Australia)**
	2.2.1 Implementation within the curricula	"*I think it should start early... Not to say the first semester first year, but...should instil the flow, the learning flow from the beginning. I mean, if they have this kind of thing even in their A-level or college or even in their secondary education that would be…great…because learning - it's like child development. So the…earlier you start you know you are into this. It's difficult to change a person later."* **(Science-based #8, Malaysia)**
		"*…suppose… you are conducting for clinical-based then it should be in third year and final year. But like...medicinal chemistry and organic chemistry, physical pharmacy, the case-based studies which are related to these topics...we can conduct within that year also…whatever subjects they study in that year, it is better to conduct that (CBL) in that year."* **(Science-based #5, Malaysia)**

Appendix 1: Questions for Interview Session

1. What is Case-Based Learning (CBL)?

Definition/explanation of CBL provided at this point: *CBL uses "real life" problems that are mostly clinically-based to develop skills such as analytical thinking and reflective judgment. It often occurs in small groups in tutorials, but may also be done individually or in larger classes such as lectures. [Adapted from Kaddoura, Mahmoud A. (2011) "Critical Thinking Skills of Nursing Students in Lecture-Based Teaching and Case-Based Learning," International Journal for the Scholarship of Teaching and Learning: Vol. 5: No. 2, Article 20.*]

2. What is CBL useful for and why?
3. Do you feel CBL enhances student learning? If so why? If not why?
4. Do you think CBL is only useful for clinical topics or also for science-based and non-clinical topics? Kindly elaborate.
5. What are the key characteristics of effective and engaging CBL? Explain why you think these are critical characteristics?

   Additional prompt:

   a) Is it sufficient to use tutors that are trained or should the tutor/lecturer be the content-expert?
6. Have you used case-based learning yourself? If so, please describe your use of CBL and its key attributes including its integration in your course curriculum.
7. Give an example of a case-based learning scenario you know has worked really well in a context with which you are familiar.
8. If you have not used CBL yourself before, please outline in some detail how you would go about designing and developing CBL, and integrating it in your teaching
9. What are the challenges in implementing or conducting CBL sessions in the B.Pharm curriculum?
10. In what year should CBL be implemented?