EDUC6103 Action Learning Project

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Title: Enhancing accuracy and confidence in knowledge in undergraduate pharmacy students

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***"When you know a thing, to hold on to that you know it. And when you do not know a thing, to allow that you do not know it. This is knowledge"* Confucius 500BC**

Abstract

Knowledge is more than just information. Knowledge is justified true belief. Knowledge in the pharmacy profession is futile, unless it is acted on. Action on knowledge requires confidence in that knowledge. Within the third year undergraduate quality use of medicines pharmacy course we previously have not sought to allow students to identify their confidence in knowledge or improve their confidence in knowledge. To remedy this I introduced certainty based assessment multiple choice questions (CBA MCQs) into the course. These CBA MCQs involved complex question requiring critical thinking and requiring multiple submissions by students. In this report I present the results of these CBA MCQs which suggest that they may increase students' confidence in correct knowledge without increasing confidence in incorrect knowledge.

Introduction /Literature review

The question I have chosen to address in my action learning project is how can accuracy and confidence in knowledge be enhanced in undergraduate pharmacy students.

To be effective as a pharmacist, accurate knowledge of drugs is essential, but not sufficient. Knowledge is more than just possession of correct information. A lucky guess is not knowledge. Knowledge is generally accepted as justified true belief (Ichikawa 2014). In this course confidence in knowledge is inherently tied up with justification of knowledge such as evidence for that knowledge from textbooks, resources or clinical trials.

Poor confidence in knowledge in undergraduate pharmacy students has been shown to be correlated with lack of confidence in clinical decision making in pharmacists (Frankel, and Austin 2013). Frankel and Austin (2013) also argue that pharmacists who lack confidence also fail to feel responsible for their patients. Kampmeyer (2015) goes a little further and argues that confidence in knowledge is a necessary component in order to engender action on that knowledge.

Pharmacy is a profession where knowledge needs to be applied immediately. Customers walk in and expect immediate advice. As such confidence in knowledge is important pragmatically (Miles et al 2007, and Dory et al 2010).

Making students aware of their lack of confidence in knowledge may also inspire students to seeking clarification of information (Kampmeyer 2015).

BOX 1:PHRM3012 AND PHRM4011

PHRM3012 is a third year core course in the Bachelor of Pharmacy program focusing on infectious disease and cancer. In 2016, 254 students were enrolled in the course which is delivered via three hours lectures and two hours of tutorials per week. Over 50% of PHRM3012 students are of non-english speaking background.

PHRM4011: is a is a 4th year core course in the Bachelor of Pharmacy program. PHRM4011 requires students to demonstrate knowledge, and confidence in knowledge by making recommendations to general practitioners as part of a medication review process. As such it is considered a capstone course and students often struggle to obtain the confidence required to make recommendations in this course

Another concern is students who have a high level of confidence in knowledge but knowledge is inaccurate. Any innovation that improved confidence in knowledge in this course would also need to ensure it did not increase confidence in inaccurate knowledge.

The importance of confidence of knowledge has not previously been addressed in the pharmacy program. As such I chose this action learning question to address this problem.

Action Learning Question: How can accuracy and confidence in knowledge be enhanced in undergraduate pharmacy students?

Intervention outline

The intervention was multifaceted. It consisted of changes to lectures, multiple choice quiz questions (MCQs) and placements. This was chosen because multifaceted educational interventions which are constructively aligned lead to greater information retention and deeper learning in students (Black and William 1998). The biggest change in this was in the MCQs and as such this will be the focus of my evaluation/report, however I will briefly describe the changes to lectures and placements as well as the MCQs.

Lectures

Lecture content was amended to take a more constructivist approach to learning that with a focus on acquisition of applied knowledge learned through an interactive approach to learning through the use of UQpoll and other interactive methods. The use of audience response software like UQpoll facilitates more accurate learning than traditional didactic lectures, and allows immediate feedback to lecturers which allows them to address misconceptions immediately (Ayres 2015, Mulligan and Kirkpatrick 2000. In the first lecture I role modeled the process of becoming more confident in knowledge by walking the students through my process of answering a Certainty Based Assessment Multiple Choice Question (CBA MCQ).

Community Pharmacy Placements

The students were required to complete a week long community pharmacy placement in week 9. As part of their assessment of this we asked them to reflect on five prescription dispensings /customer interactions and discuss their confidence in knowledge around the clinical topic involved. The students were asked to:

Certainty Based Assessment Multiple Choice Questions - Literature

MCQs have been criticized by many for not adequately assessing critical thinking (Al-Kadri 2012). However in a course the size that I am teaching which is under-resourced, MCQs have the large advantage of being less time consuming to develop and mark.

Norcini et al (1985) and McCoubrie (2004) argue MCQs are a validated method of assessment in health sciences such as pharmacy, and that criticisms that MCQs do not test critical thinking can be (at least partially) addressed by appropriate MCQ design. Certainty based assessment with complex case based questions are one way to address these criticisms (Gardner-Medwin 2007).

CBA MCQs are MCQs where as well as answering A,B,C,D, or E you also indicate your level or certainty or confidence (See Appendix 1). This aims to address both the accuracy and confidence of students' knowledge.

Certainty based assessment has been shown to (Gardner-Medwin 2007, Cook 2010):

1. Encourage self/assessment, reflection, and justification of 'knowledge', promoting active, constructivist learning.
    - Approximately half of students who undertake CBA MCQ agree that as a result of CBA MCQs they think more before answering clinical questions in practice (Luetsch, unpublished work)
2. Motivate and challenge students by identifying uncertainty which stimulates desire for future learning.
3. Promote the principle of acknowledging uncertainty as a virtue, thus encouraging less careless practice.
4. Better inform teachers of the depth of understanding of students in real time.

    - Analysis of student responses in CBA delineates students who guessed an answer correctly or whether they answered correctly and confidently. This allows teachers to address muddy points (where students guessed correctly) or misconceptions (where students answered incorrectly and confidently) and thereby facilitate a solid scaffold of knowledge before progressing (Gardner-Medwin and Curtin 2007).

Certainty Based Assessment Multiple Choice Questions – My intervention

Five Online CBA MCQs were deployed before the lectures that students have previously struggled to understand (mostly infectious diseases lectures). Students were informed that they must complete these prior to the lectures to obtain marks, however they will be reopened after the lecture, for one week after relevant lectures, and students must review their answers. Even if students did not want to change their answers they were required to resubmit in order to achieve marks. This was a forcing function to encourage them to review their knowledge and in particular to review their knowledge where their confidence levels were low. Discussion with peers was encouraged (see below).

The CBA MCQs in PHRM3012 (see Appendix 1) were carefully designed to test higher level thinking and probe confidence in knowledge.

Proponents of CBA MCQs advocate using negative marking to discourage confident yet inaccurate answers (Gardner-Medwin and Curtin 2007). This contravenes UQ Policy, and would be a large change in mindset for students (and staff) in this program. As such I chose not to use negative marking and thus my action learning project differs from published work on CBA MCQs in this regard. Instead I gave students a mock outcome for the patient in the MCQ where they had made a decision. The outcome they received was determined by the correctness and their confidence in their answer. (see appendix 1).

Research around CBA suggests that discussion forums are rarely used, and that this may be due to high number of steps to get into discussion boards or due to fear of humiliation if they are not anonymous (Schoendorfer & Emmett 2012). Because of these concerns in the literature Padlet was chosen. Padlet is a very simple discussion board that can be accessed with one click, requires no login, and is anonymous. The 3rd year students are also currently familiar with Padlet from a previous course. See https://padlet.com/karlwinckel/PHRM3012Quiz3 for an example

Initially I planned to give students feedback on:

1. Accurateness of answers
    - Further reading will be suggested if inaccurate answers given
    - Encouragement will be given if accurate and unconfident
2. Likely outcome (see appendix 1)
3. Their level of confidence compared to peers

As I reviewed the students results and Padlet discussions I realized that poor critical thinking and critical reasoning skills were often to blame. Thus a careful and comprehensive explanation of why an answer was incorrect or correct was focused on in my feedback rather that giving more information sources. Encouragement was given together with the likely outcome in the form of video feedback. The videos were developed by myself with a medical registrar at the Princess Alexandra Hospital. This was in the following form:

1. If inaccurate and confident - Students received a video of a doctor talking angrily to the camera about a patient hospitalized because of a pharmacist error
2. If accurate and unconfident - Students received a video of a doctor talking politely to the camera saying thank for advice but they will not change medicines
3. If accurate and confident - Students received a video of a doctor talking politely to the camera saying thank for advice, they will change medicines.

Formative assessment and feedback is essential for learners to develop self-assessment skills (Macfarlane-Dick and Nicol 2006) and encourage accurate learning (Black and William 1998, Al-Kadri et al 2012). Feedback on outcomes has been shown to improve performance of allied health professionals (Lambert 2001).

Students level of level of confidence compared to peers was posted as an announcement on blackboard (see figure 1)

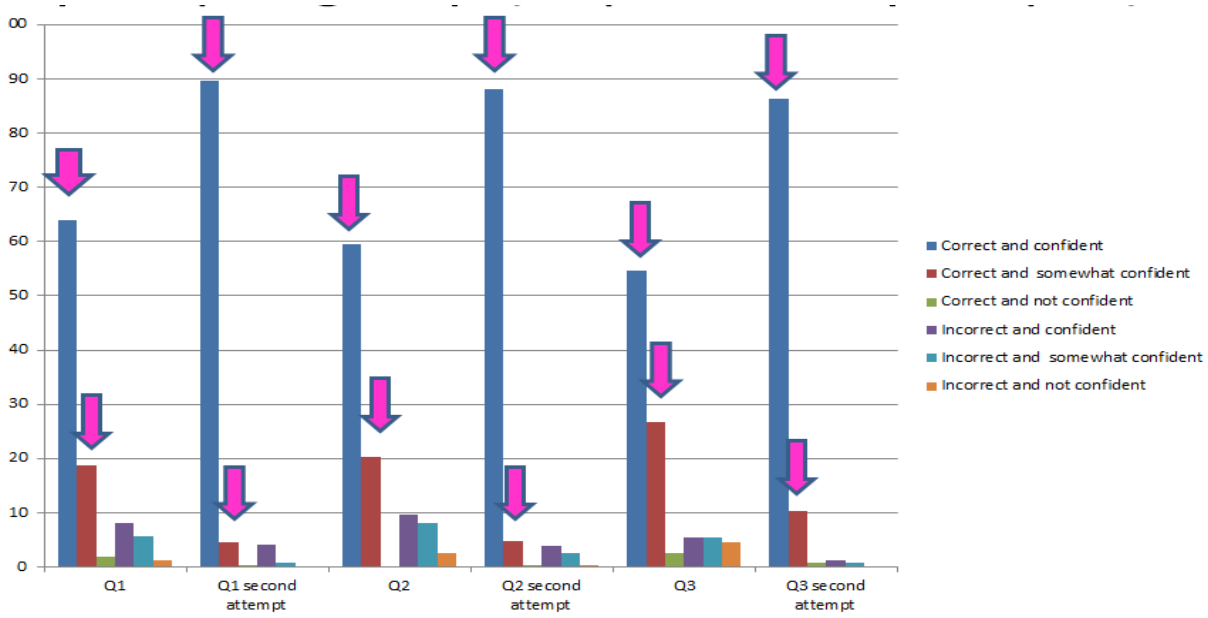


Figure 1: Feedback on confidence

This feedback was given at various intervals throughout the semester and aimed to show the students who were unconfident and correct how they compared to their peers, and encourage them to reflect on their lack of confidence.

This was an iterative process. I reviewed answers to each MCQs set (4-5 MCQs per set) for the cohort after each MCQ set had closed. Subsequent MCQ deployments addressed issues identified. For example critical / logical thinking was found to be lacking in Quiz 1 and so all Quiz 2 and 3 had a heavy focus on this.

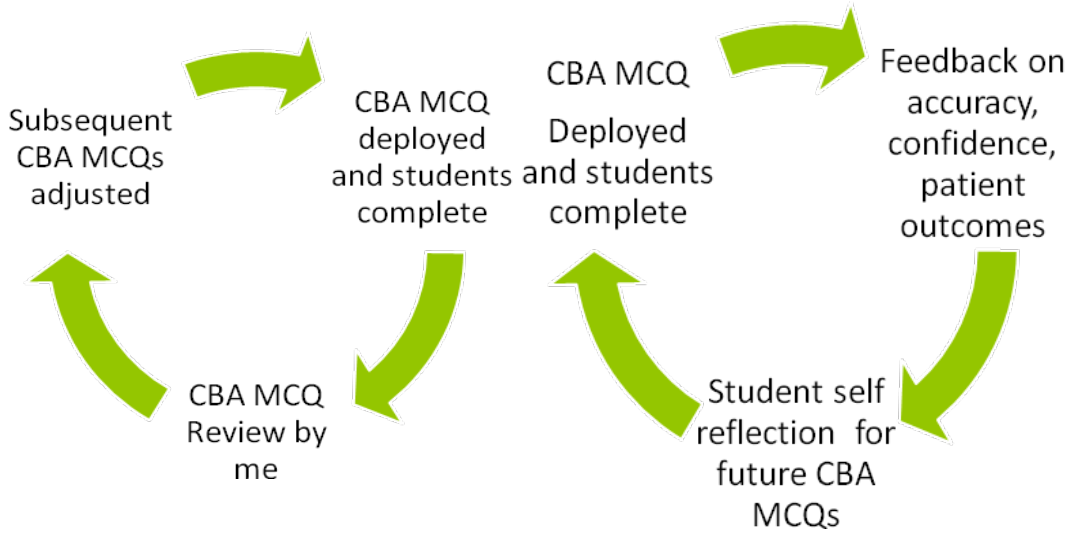
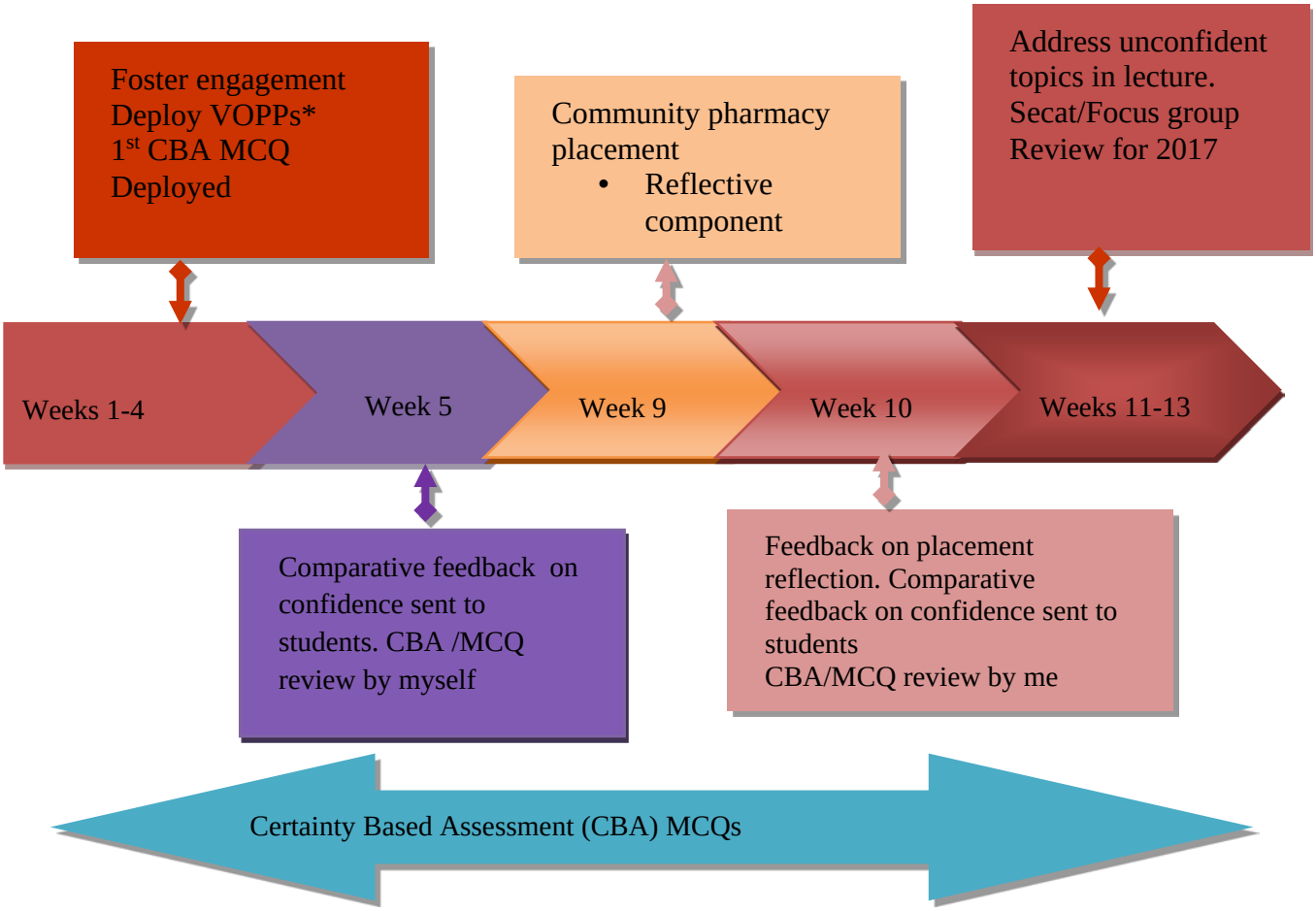


Figure 2: CBA MCQ review process (course coordinator point of view)

Figure 3: CBA MCQ review process (student point of view)

A Lecture was delivered in week 12 covering muddy points identified by Padlet comments or unconfident / incorrect CBA MCQ answers were delivered (see figure 4)



*VOPP=Voice Over PowerPoint

Figure 4: Timeline

Evaluation plan :ethics application, methodology , data collection, analysis

Evidence of effectiveness of teaching needs to be obtained from a range of sources which are contextually relevant (Hounsell 2009). My innovation will be evaluated using a seven step process. This will consist of both performance outcomes and perception outcomes from:

- Academics / Pharmacists in the workplace
    - They are well equipped to comment on whether confidence in knowledge is an appropriate course aim
- Students
    - They are well equipped to comment on whether course aims are achieved. what Hounsell (2009) calls a "learners eye view".
- Myself

Step 1: Focus Group Feedback

A focus group of students was interviewed at the end of semester (week 12). Students were probed around optimising confidence as a course aim, and on CBA MCQs as a method to achieve this aim.

A focus group of pharmacists and pharmacist employers will also be conducted (in November), focusing on thoughts around the course aims of optimising confidence in knowledge.

Step 2: Performance outcomes- analysis of exam

An analysis of end of semester exam question will be undertaken. Responses to exam questions on the topics discussed within the CBA MCQs will be compared between this cohort of students and last year's student cohort.

Step 3: Opportunistic Feedback

Anecdotal/opportunistic feedback from students was sought. Corridor and lunch area conversations were instigated inquiring about students thoughts regarding CBA MCQs. Conversations were de-identified and documented in an electronic diary.

Step 4: Survey

A blackboard survey was developed. The survey asked the same questions as the questions asked focus group (Step 1), but with a simple likert scale (see appendix 2). This allowed for validation of the focus group as a representative sample of the whole cohort.

Step 5: Self-reflection

I kept a self-reflective diary and completed this weekly. This was useful for both the specific content, as well as engendering a critical reflective mindset.

Step 6: Peer feedback

Feedback from my peers will be sought. Lecturers in PHRM3012, the course coordinator from PHRM4011, and pharmacists in the workplace will asked for honest opinion about the course aims, curriculum, structure, and delivery. I also had a critical friend who provided feedback.

Step 7: CBA MCQ results

CBA MCQ questions for the first four sets of questions were analysed for the overall cohort to determine if:

1. Students were more likely to be correct in the second attempt
2. Students were more likely to be correct and confident in the second attempt
3. Students with incorrect answers were more likely to be more confident in their incorrect answers in the second attempt.

Findings

Step 1 and 4 : Focus Group Feedback and Survey

Nine students attended a focus group meeting in week 12 of the semester. Verbatim transcripts were analysed using thematic coding using a general inductive approach (Thomas 2003).

110 out of 254 students completed the survey. Overall students appeared to appreciate the necessity of the course aim with regards to improving confidence in knowledge. However students were divided in opinion about whether asking about the confidence in knowledge achieved this. The results suggest that the CBA MCQs helped but perhaps it was not completely due to asking about confidence in all students. The critical thinking nature of these questions may have played a role with regards to this.

The focus group feedback identified six consistent themes. Themes identified were:

1. Complexity/Critical thinking

The focus group expressed the view that understanding rather than rote learning was encouraged in the CBA MCQs. The group attributed this to the content of the CBA MCQs rather than the requirement to state your confidence level or the ability to resubmit answers.

Four students in the focus group expressed the view that whilst critical thinking was a good aim, the nature of a MCQ made this difficult as they could not ask the patient for more information.

The majority of the group expressed variations around a concern that they had not been adequately trained to think critically in this way. Content in this course was also discussed as contradicting content in other courses. Some of the students identified that this was not

universally problematic as it challenged their preconceived views. This showed an encouraging maturity in critical thinking.

Students suggested tutorial time to develop critical thinking skills, and more training on how to make decisions despite conflicting information in differing resources. Two students in the focus group discussed the fact that the questions required them to read around the content area significantly. The focus group had ambivalent feelings around this. It was felt to be too time consuming yet at the same time positive because of extra information learnt whilst searching around the topic.

The use of the discussion board was also identified as helping with this critical thinking. Draper (2009) concurs with this, arguing that peer discussion is a more effective way to create critical thinking than discussion with teachers as you respect your peers enough to think they could be right, but you are not at all sure whether they are right, whereas teachers elicit unthinking acceptance.

Overall the students appreciated the opportunity think critically about cases, and held the view that this was preparing them well for fourth year,

"I enjoyed them as they were not just about regurgitating facts, it made you really think"

2. Confidence

The focus group unanimously agreed that confidence in knowledge was an important aim of the course and this matched the survey results (see figure 5).

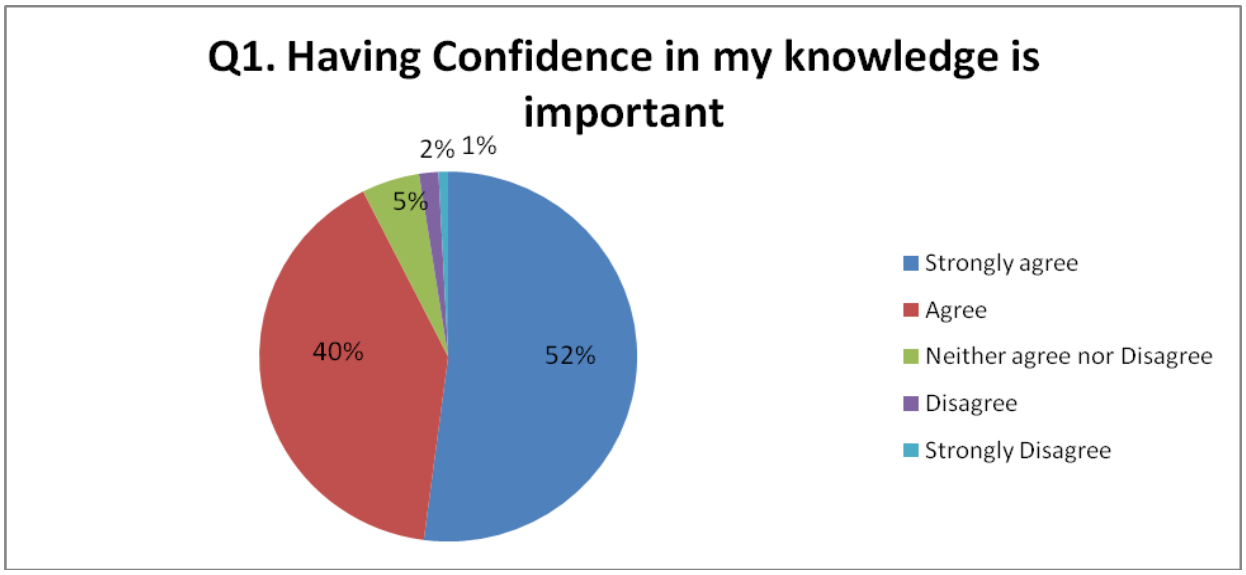


Figure 5: Survey question number 1 (n=114 students)

The focus group had mixed views around asking about confidence however this did not seem to correlate strongly with survey results (see figure 6).

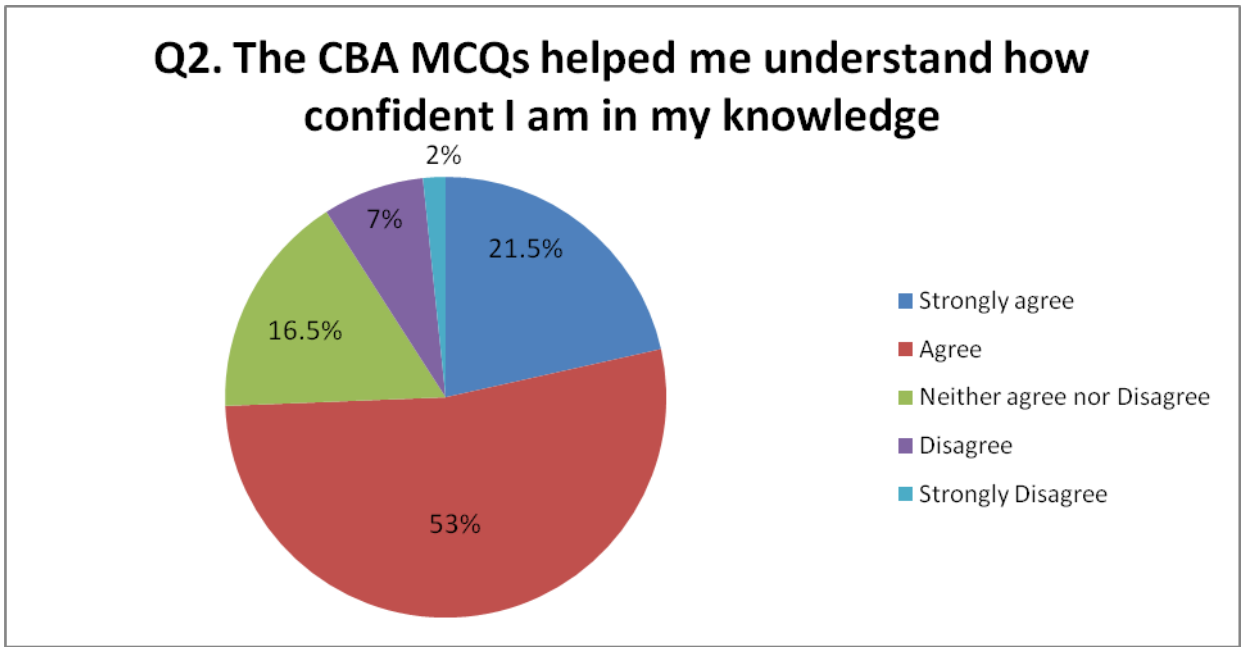


Figure 6: Survey question number 2 (n=114 students)

Overall the CBA MCQs were felt to increase confidence in knowledge in both the survey and focus groups (se figure 7). However merely asking about confidence in knowledge was not felt to lead to cause this change. The complexity of the CBA MCQS was felt to be the driving factor for this. There was diversity in survey results regarding this question (see figure 8).

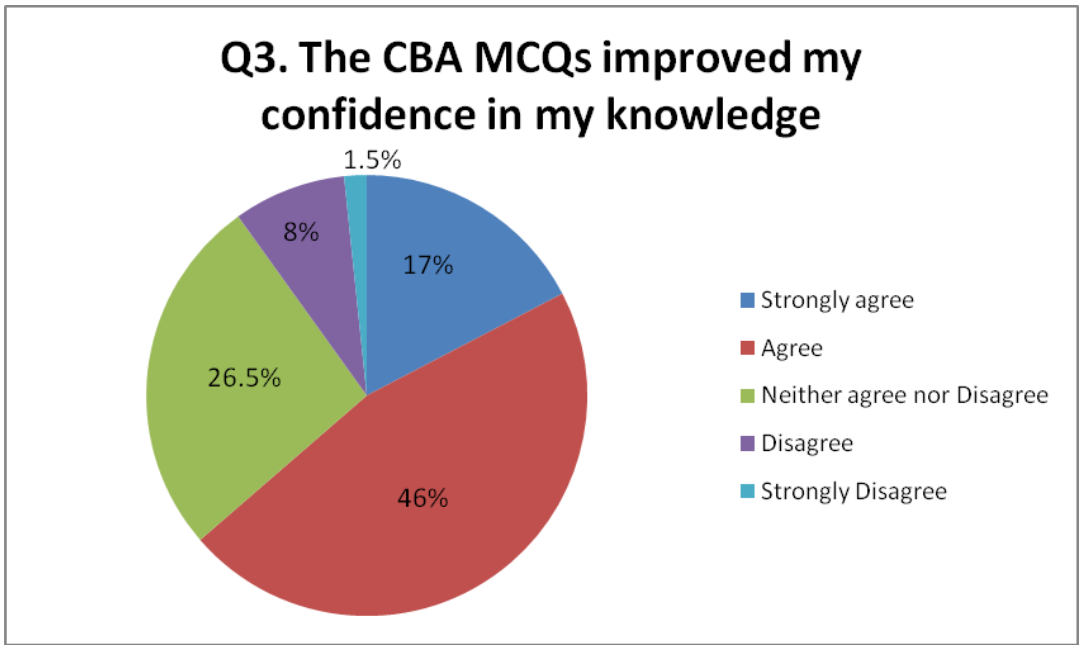


Figure 7: Survey question number 3 (n=114 students)

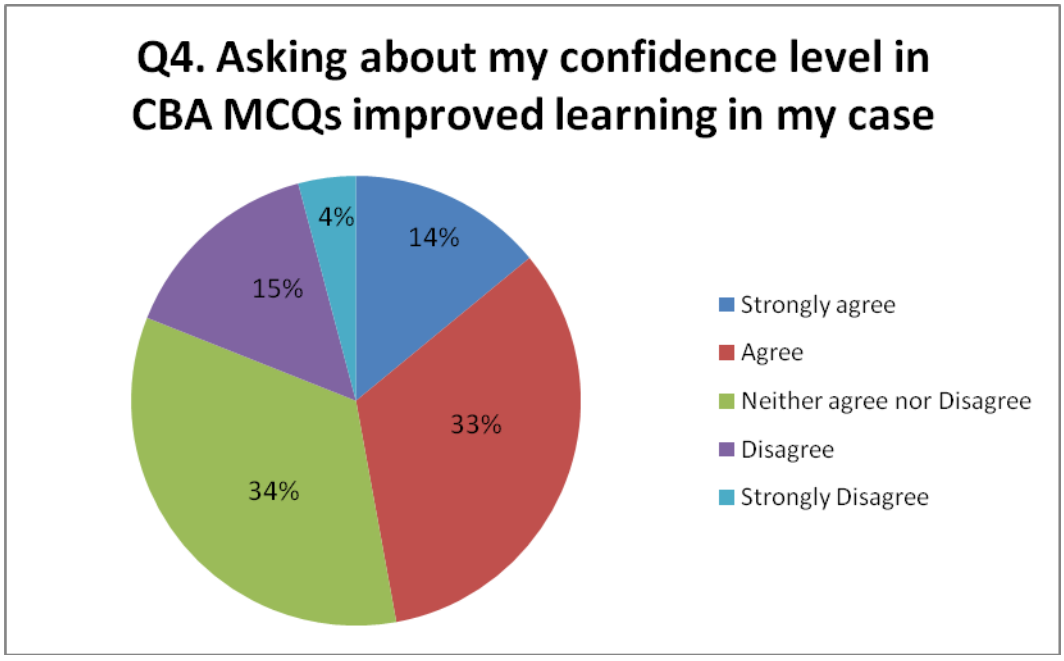


Figure 8: Survey question number 4 (n=114 students)

Hunt (1982) suggests that when participants are asked to indicate their level of confidence in MCQ answers they learn about 20% faster. Possible reasons the focus group may diverge from this literature is that they were a high achieving cohort of students in the focus group, who already questioned and reflected on their confidence in knowledge without needing to be specifically asked about this. That is they internalized this self assessing approach (Draper 2009). The results of the large group (survey results) are more supportive of Hunt's (1982) view (see figure 8).

Teaching content in a way that optimizes learning and thus confidence may be a more effective strategy than teaching about confidence in knowledge (MacFarlane 2004)

3. Communication, teamwork and socialisation

Effective teaching and learning develops personal and social skills and resources in learners (Ashwin 2015). Many of the focus group discussed the positive effect the complexity of the questions had on communication with their peers. The group used a range of communication modalities including face to face, Padlet, but mostly they used private facebook groups.

This critical discussion between students is in line with principles of active learning (Ramsden 2003). Howe, Tolmie and Rogers (1992) showed that students progress further than just obtaining factual knowledge from these interactions with their peers, because the effort to provide reasons for their views develops these views further.

4. Authenticity

The focus group also identified the "real world-ness" nature of the CBA MCQs and appreciated this. Students who could identify this were currently working in pharmacy. One focus group attendee stated that identifying your confidence in a MCQ at home is very different to identifying your confidence in a busy work environment.

5. Lack of sufficient feedback

Students in the focus group felt the feedback of the overall cohort was not beneficial for them. They wanted feedback on the number of questions they had answered correctly after the first attempt and before submitting the second attempt quiz. Providing students with more individualized feedback should encompass an approach of allowing students to play a role in developing their own strategies for improvement (Boud and Molloy 2013).

6. Time

The results of the survey question around this were mixed (see figure 9).The long time limits allowed were identified as leading to improved learning. Second attempt opportunities were appreciated by some, but a recurring theme was the time 'wasted' doing this.

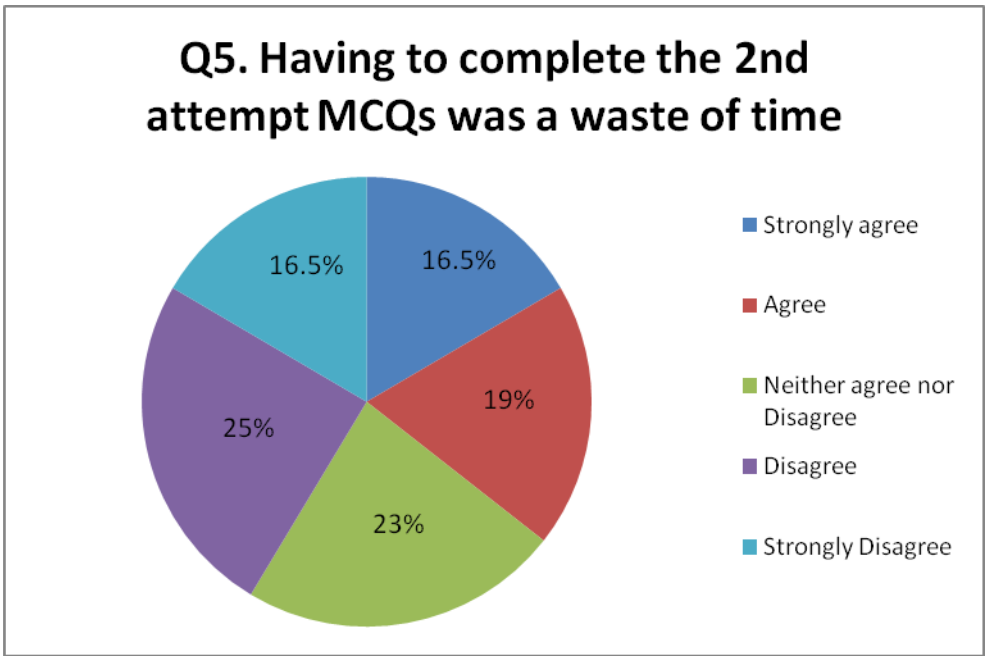


Figure 9: Survey question number 5 (n=114 students)

Step 3: Opportunistic Feedback

Opportunistic feedback from students was difficult to obtain as students interactions with me were heavily focused on asking questions around assessment. Opportunistic feedback from peers was more forthcoming though.

Academics were skeptical about the aim of improving confidence in knowledge. They suggested students were already too confident. This highlighted again the fact that I had not engaged staff and students enough before launching my intervention.

Step 5: Self-reflection

On reflection I realised quite early (week 1-4) that students seemed very unhappy around the requirement to resubmit a second attempt. In week 4-8 I noted that the level of constructive alignment within the course was nowhere near what I thought it was, and that I needed to produce a larger variety of video feedback as the students will find these repetitive. I was quite

surprised at this time that so many students answered the quiz questions correctly given the difficulty of these.

Looking back at my self reflection it is interesting to see that I had adequately predicted that students were not engaged in the process of resubmitting a second attempt for their CBA MCQs. In hindsight more time should have been spent fostering engagement at this point.

Step 6: Peer feedback

Fomalised peer feedback (in addition to observational feedback mentioned above) will be obtained in the form of a focus group in November.

Step 7: CBA MCQ results

The results from CBA MCQs are displayed if figures.10 and 11. The most striking difference is in the number of students who have changed their answers from correct and somewhat confident to correct and confident.

Reassuringly there did not seem to be an increase in confidence level of incorrect answers between the second and first attempts.

Taken together these results suggest that confidence was not increased irrespective of the correctness of the answer, which had been an original concern.

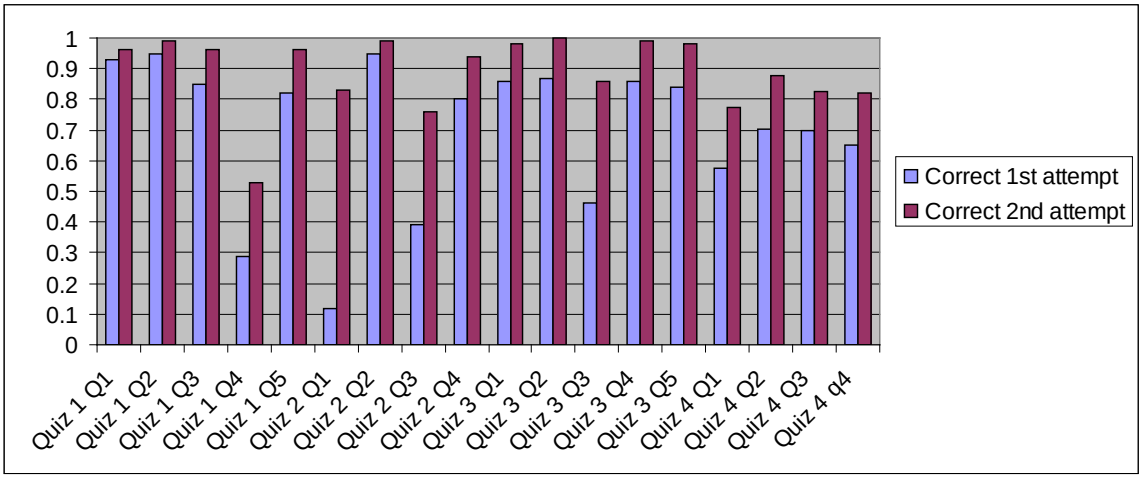


Figure 10: Correctness of individual quiz question in first and second attempts

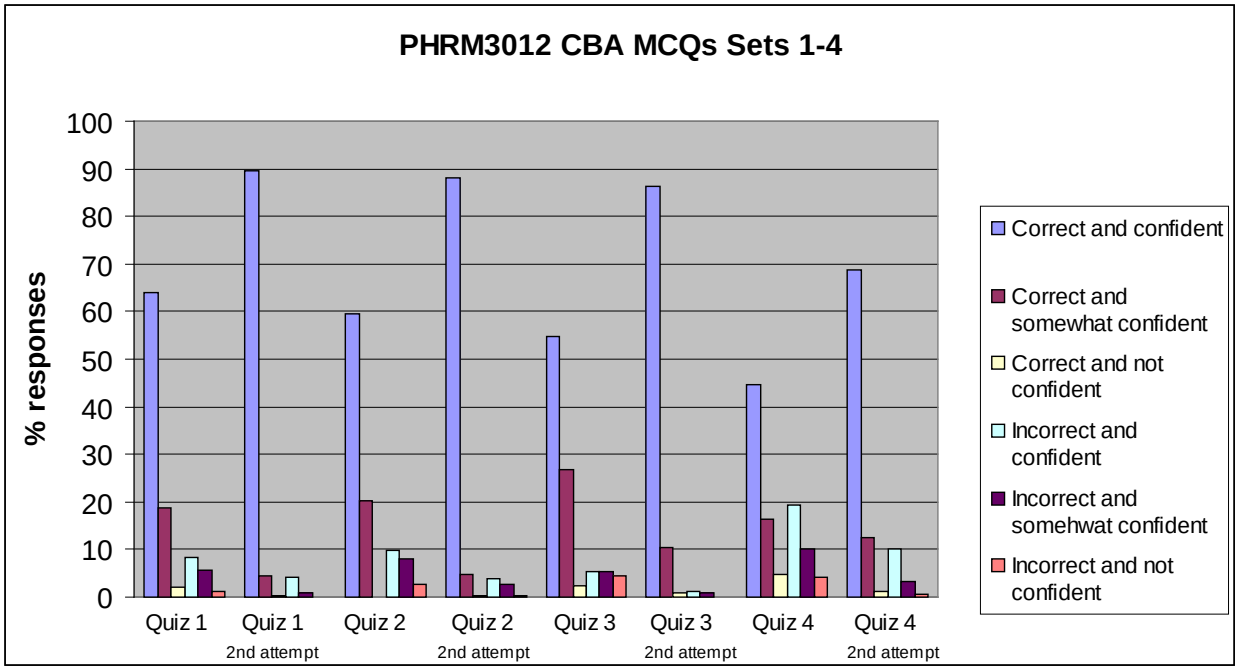


Figure 11: Confidence and correctness of sets of quiz questions in first and second attempts

Limitations

The data gathered throughout this study is focused on the perceptions of students around their confidence, rather than measurable improvements in their role as a pharmacist (which is the whole reason to improve confidence in knowledge).

There is a large potential for this data to be biased. There were only nine students volunteering to be part of the focus group, and the survey only captured approximately half of the cohort. As this became clear that I would fail to receive a good number of students enrolling for this I amended the planned survey questions (Step 4) to ensure they addressed a broader range of questions so that I could ensure the focus group was truly representative of the overall cohort, which after reviewing the results I believe it was. Utilisation of conjoint tutors for data collection was implemented to reduce this bias.

Unfortunately this report was due before the analysis of the exam could take place and this means that analysis of students performance was lacking. However this was partially addressed via Step 7, the CBA MCQ analysis.

As this was a multifactorial intervention it is difficult to attribute improvements in students' performance to the CBA MCQs, let alone an individual component of the CBA MCQs such as indicating confidence level.

Ethical considerations

This action learning project raised a number of ethical considerations. These were:

Fairness

Would students with a low self-esteem be given worse grades and therefore unduly punish them? What about students with cultural identities that encourage a lack of confidence?

Gardner- Medwin (2006) advocates that confidence level ought to contribute towards student's grade. However because of the concern around fairness the confidence level indicated did not contribute towards their grade. Students were made aware of this. On reflection if I intend to change this in the future I have learnt that this would require a large amount of work to ensure student and staff engagement.

Autonomy

Should students be required to complete the level of confidence in MCQs if this does not deliver them marks, or should it be voluntary? Students were prevented from progressing until they complete the level of confidence in the CBA MCQs. The feedback from students in the survey was that they were unhappy with this. As this was only a small commitment of time for the students to indicate their level of confidence respect for autonomy was overridden. I will review this decision for 2017 as the survey and focus group evaluation suggests that students who benefited most from this were the students who were engaged in the first place.

Non-maleficence and Privacy

Because students may feel embarrassed about their level of confidence, privacy was maintained by allowing students to complete the quizzes in their own time. No student was allowed to see another student's CBA MCQ results, unless they show the other student themselves. The use of the anonymous discussion board (Padlet) was a strategy aim to encourage students with English as a second language who were less likely to participate in discussions to engage and lead to upward social mobility (Ashwin 2015).

Bias

Students may have felt pressured to give good feedback to me, as I also work at a major hospital and am likely to interview many students for jobs after graduation. Conjoint tutors amalgamated and de-identify data for me. The focus group delivered by a conjoint tutor with experience in running focus groups instead of me. Students were also advised that any feedback given to me will have no impact on their personal career progression.

What did I learn

My original assumption was that I had a good feel for what was needed in my course and that researching the scholarship of teaching and learning was unnecessary I have learnt that engaging in the scholarship of teaching and learning is essential if I am to be a quality teacher. Good SECATs are not enough. Improving student performance and evaluating this is essential.

Whilst integrating and contextualizing employability and graduate attributes such as confidence in knowledge has been advocated by many (Ashwin 2015), I have also learnt that the fact that I believe confidence in knowledge to be a positive graduate attribute is an assumption that needs revisiting. As such I need to research the goals of my course more before researching the methods to achieve these goals. I have also learnt that literature exists around these questions of suitable goals, and that stakeholder opinion is useful, but often conflicting.

In doing this action learning project I have learnt that:

1. Complex MCQs can be a useful type of what Draper (2009) terms catalytic assessment and may lead to quality learning.
2. A lot of explanation around the importance of confidence is needed in order to ensure engagement by students and academics with regards to this
3. Academics and industry professionals have widely different opinions about required student attributes.
4. Self-awareness of confidence is a necessary but not sufficient component of increasing confidence.
5. If I expect students to know how to think critically then this needs to be taught. Role modeling in one lecture this is not enough.
6. Students learn more deeply from peer interactions rather than by being taught.

As a result of this project, I have committed to seeking feedback on all of my work not just my action learning project.

Critical Reflection on my learning and assumptions

There are four main points that I have reflected as a result of this innovation.

The first is that I have been a little ignorant of the need to engage stakeholders in my project despite this being advice early on from my EDUC6102, 6103 course coordinators. On reflection I need to have a more open mindset around methodology and accept advice a little quicker.

The second is that I base my beliefs about what knowledge skills and behaviours I should teach undergraduate students on the deficiencies in registered pharmacists I work with, not on agreed professional competencies. Whilst I do not think this is completely unreasonable it is certainly not robust, and I was not previously aware that I was doing this.

The third point that I have learnt that I tend to use power imbalances to my advantage. I have learnt that I do this subtlely and self-deceptively. This is something I am committed to self-identifying and reducing.

The fourth point is that I have learned that I have an assumption that I know students baseline knowledge (poor), motivation (lazy unless proven otherwise), and expectations of coursework (that it will be easy and non-intrusive to their lives). I have realised that this was not only unfair but incorrect.

Where to next

The results suggest that the complexity of questions is what challenged and stimulated the confidence in knowledge rather than asking students to indicate their confidence. As such the next iteration of this will include these complex MCQs in the written exam.

Engaging in evaluation on other students critical thinking on complex scenarios helps students to understand deficiencies on their own critical thinking (Sadler 1989). Because of this I am also planning to make the discussion around these complex questions more structured and require the students to present their answers to some of these CBA MCQs to their peers in tutorials. These tutorials will facilitate discussions with accompanying peer feedback that will foster development of self-evaluation strategies (Boud & Molloy 2013). Exemplars will be provided, and a world café style approach will be used. This will be formative only and early in the semester. Critical thinking will also be taught in the first tutorial and I will be discussing options to include this in previous courses with other course coordinators.

Self reflection

Criterion	Fail	Pass	High Pass
Clarity and relevance of question	The question and its relevance are unclear	The question and its relevance are identified	Clear, concise question, with its relevance made clear
Appropriateness of innovation, evaluation and ethical issues addressed	Incompletely described and/or inappropriate innovation or evaluation, with lack of ethical issues	Appropriate innovation and evaluation that address the question, with suitable ethical issues	Original, well-articulated innovation and evaluation that address the question, with clarity on ethical issues
Adequacy of reasons for innovation, evaluation and ethical issues, using literature	Inadequate reasons for innovation design, evaluation and/or ethical issues based on literature	Adequate reasons for innovation design, evaluation and ethical issues, using literature	Clear reasons for innovation design, evaluation and ethical issues, with sound use of relevant literature
Quality of analysis and discussion	Inadequate analysis with significant issues for the project overlooked	Sound analysis and issues clearly of significance to the project are identified	Evidence is critically analysed, with subtle or complex issues identified
Clarity of summary on learning from project	Summary of what was learned from the project is unclear or missing	Adequate summary of what was learned from the project	Clear summary of what was learned from the project
Quality of critical reflection on learning and development	Little or no critical reflection on learning and professional development	Adequate critical reflection on learning and professional development	Thoughtful critical reflection on learning and professional development

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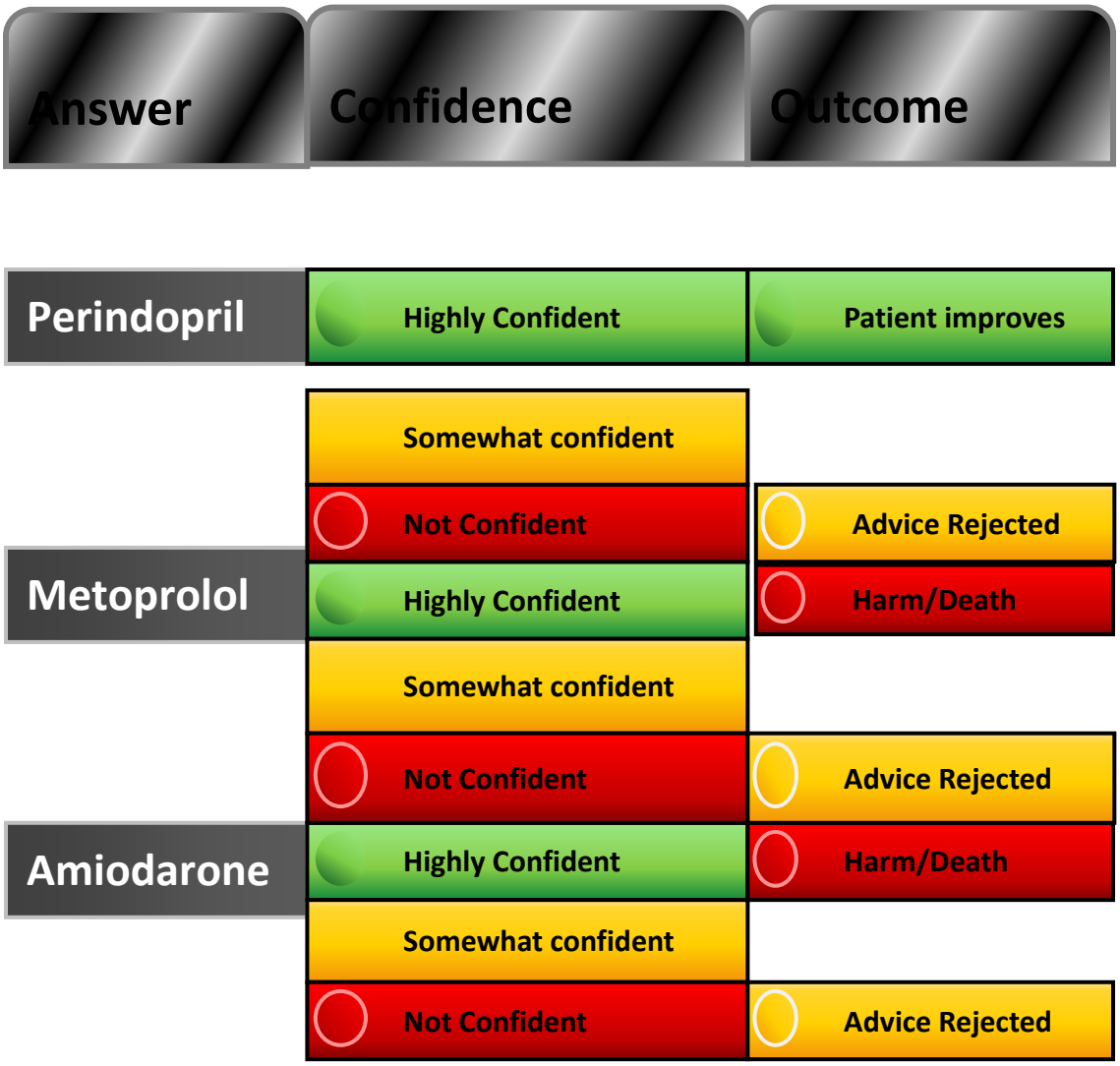
Appendix 1 Certainty Based Assessment Quiz Question Example

John is an 85 year old patient suffering from heart disease, severe kidney disease, and diabetes. He currently takes Atenolol 50mg daily, Aspirin 100mg daily, and Digoxin 250mcg daily. Which drug should be added to John's medication regime?



Appendix 2: Survey

QUESTION 1

Having confidence in my (correct) knowledge is important.

1. Strongly Agree 2. Agree 3. Neither Agree nor Disagree 4. Disagree 5. Strongly Disagree 6. Not Applicable

QUESTION 2

The multiple choice quiz questions in PHRM3012 helped me **understand** how confident I am in my knowledge around infectious diseases

1. Strongly Agree 2. Agree 3. Neither Agree nor Disagree 4. Disagree 5. Strongly Disagree 6. Not Applicable

QUESTION 3

The multiple choice quiz questions in PHRM3012 helped me **improve** how confident I am in my knowledge around infectious diseases

1. Strongly Agree 2. Agree 3. Neither Agree nor Disagree 4. Disagree 5. Strongly Disagree 6. Not Applicable

QUESTION 4

Asking about my confidence level in the multiple choice quiz questions in PHRM3012 led to **improved learning** in my case

1. Strongly Agree 2. Agree 3. Neither Agree nor Disagree 4. Disagree 5. Strongly Disagree 6. Not Applicable

QUESTION 5

Having to complete the second attempt Quiz Questions was a waste of time. We should just do these once.

1. Strongly Agree 2. Agree 3. Neither Agree nor Disagree 4. Disagree 5. Strongly Disagree 6. Not Applicable