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FastFeedback questions: A new teaching method

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Summary

In Australian Universities, based on a study from 1992-2014, the Feedback item has been consistently poorly rated by students. In addition, Biochemistry is a complex STEM subject which many students find difficult and was considered the hardest subject according to a recent study by Antigua medical school in USA. In this work, a new and interactive teaching method, FastFeedback Questions (FFQs), has been devised. FFQs is a rapid formative feedback method that involves embedding carefully crafted focus questions alongside PowerPoint slides (outside the slide field). The PPT is then projected as usual, but not in slide show mode, so the areas outside the main slide window are visible to the students. Prior to the lecture students receive a version without the answers. During the face-to-face lecture, the lecturer goes through the answers in an interactive way by requesting that students answer the FFQs, which can be verified immediately from the PPT slide. The focus questions not only increase students' understanding of the slides, they also model good answers. FFQs were delivered to the students of third year clinical biochemistry at Curtin University. Number of students in this study, $n = 311$. The final exam marks support the use of FFQs as there is an overall improvement of the student average grade by $\approx 10\%$ from $\approx 63\%$ in 2010-2014 (no FFQs) to $\approx 72.6\%$ in 2015-2017 (FFQs). FFQs have also gained the accolade of the students as their feedback was on average $\approx 97\%$ compared to $\approx 80.5\%$ for the Faculty and University.

Keywords: New teaching method, engagement, rapid formative assessment, feedback.

Introduction

Sciences, Technology, Engineering and Math (STEM) disciplines are complex, with students having to comprehend and remember concepts and techniques within a mass of detailed content. The Australian Government is placing increased emphasis on STEM disciplines to improve productivity and innovation [1]. If these goals are to be achieved, STEM subjects need to explore new approaches to learning and teaching which engage students and support their understanding of the complex concepts and techniques that form the basis of these disciplines. How then can teachers deepen students' understanding and assist them to identify the key concepts, mechanisms and processes they must master? To make learning more efficient, teachers need to clarify and share learning goals and criteria for success, as well as engineer effective classroom discussions and questions [2,3]. Biochemistry is a complex STEM subject which many students find difficult [4,5]. A recent study on a cohort of medical school students at Antigua University reported that most students consider first semester of Biochemistry to be the hardest class they have ever taken. Even competent students can become confused by questions and diagrams on biological systems and the chemical interactions that occur. Many researchers have been trying to solve this problem using PeerWise, multiple peer assessment facilities and similar web-based systems [6-8], but the problem is still in place. For example, PeerWise is an online learning system where students are encouraged to create, answer and explain questions within their peer group. In so doing, they become familiar with the course content. PeerWise has gained the accolade of students and some lecturers. However, the quality and level of difficulty of the questions are limited to students' knowledge, understanding and capacity. The students need to understand the topic before making questions.

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3 Feedback from lecturers to students is an important and integral part of teaching and learning. However, it is
4 generally poorly done. According to Sadler (2009), feedback is an essential component of good teaching that
5 can reduce the gap between where the student is and where they are meant to be and make this endpoint
6 very transparent. Traditionally feedback arrives too late for students to take action to address problems, does
7 not encourage dialogue between learners and teachers, nor does it help students develop the capacity to
8 identify the appropriate standards required of them [10]. Baik et al (2015) provided an analysis of trends over
9 a twenty year period in the attitudes and experiences of first year students in Australian universities [9]. The
10 finding of the study was interesting and shocking as they found that the item of Feedback is consistently poorly
11 rated by students.
12

13 The feedback approach central to this application, however, does this and models current theories of feedback
14 [2,11]. According to Boud, D. (2016), when formative feedback occurs it is typically limited to laboratory
15 reports and tutorial exercises and, as such, means there is a reasonable delay in students measuring their
16 comprehension [2]. Consequently, students often fail to identify their knowledge gaps until it is too late: well
17 into the semester and/or when they receive their exam results. Feedback can also focus attention on the
18 processes needed to accomplish a task, provide information about misunderstandings and provide motivation
19 [3]. One mechanism to achieve this is rapid formative assessment which occurs during the lesson when short-
20 cycle formative feedback is delivered; it assists teachers and students to make decisions about where to invest
21 time and/or when to move forward [12]. Unfortunately, rapid formative assessment and feedback does not
22 occur often and, when it does, tends to be limited to Multiple Choice Questions (MCQs) delivered using
23 technologies [13,14]. Due to the poor track record in giving feedback, there is now a concerted effort to
24 encourage academics to improve in this area. Consequently, student ratings of their teaching/learning
25 experiences, particularly in the area of feedback, are taken very seriously by the Higher Education Sector, even
26 to the point of affecting promotion.
27

28 In summary, we have two main problems to tackle:

- 29
30 a) How to motivate students and engage them in the educational process?
31
32 b) How to improve the Feedback rated by the students?
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34 I believe that the primary challenge is to motivate the students and engage them in the educational process.
35 As a result, we can expect to see better understanding and marks and, in turn, that will reflect positively on
36 student Feedback given to the university regarding their lecturers (eVALUate).

37 In this work, I am presenting "FastFeedback Questions" (FFQs), a new and rapid formative feedback method,
38 with the aim of solving the above problems. The method is an engaging approach that provides clarity on
39 student progress and communicates the criteria for success. This methodology is in line with Yorke's report as
40 he reported that "an important determinant of the effectiveness of formative assessment is the quality of the
41 feedback received by learners" [11].
42

43 The rationale used by the FFQs is summarized in the following four steps:

44
45 Step 1: Improving student understanding of the subject.

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47 Step 2: The student is more engaged in the education process.

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49 Step 3: The student is more likely to get better marks.

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51 Step 4: The student is more likely to provide positive Feedback on the subject/lecturer.
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53
54 The new method has been used over three years in third year Clinical Biochemistry at Curtin University. Since
55 this is a new method, the first part of this manuscript has been assigned to explain the method in detail.
56 Firstly, two examples of PPT slides containing the embedded FFQs will be presented and the reasoning behind
57

the choice of these specific questions will be explained. Secondly, evaluation of the efficiency and success of the new method will be determined by:

- a) The student final exam results
- b) The feedback of the student (eVALUate)
- c) Anecdotally from the student comments on the new teaching method

Thirdly, from a lecturer's point-of-view, the limitations and recommendations of the new method will be presented.

How do FastFeedback Questions work?

FFQs involve embedding carefully crafted focus questions alongside PowerPoint slides outside the main PPT slide field. The PPT is then presented, but not in slide show mode so the FFQs are visible to students. According to a thorough search made by the librarians at Curtin University, nobody has used this PPT area before. We have demonstrated in this work that this PPT area is very useful and has advantages over using the notes area underneath the main PPT slide as shown in Fig. 1., Fig 2a&b and Fig 3a&b show a print screen of PPT slides in use. Notice that they are not in slide show mode. The spaces used for the FFQs outside the main PPT slide have the following privilege over the notes' area.

They:

- Are much bigger in size than the notes area, which allows you to write more information without compromising the space of the main PPT slide
- Can be used at the left, right, top or underneath the main PPT slide (more choices) compared to only underneath the main PPT slide for the notes area
- Can be used to insert anything (e.g. text box, Figures, shapes, etc) compared to only text for the notes area.
- Can be used to insert a text box next to any information you need to focus on inside the main PPT slide.
- Can use arrows to correlate between the information in the main slide and the question/info outside the main PPT slide as shown in Fig 2a&b.
- Can use texts in different fonts, colours and sizes, unlike in the notes area.

Insert Figure 1

Figure 1. Schematic diagram of FFQs embedded alongside a PowerPoint slide outside the PPT main slide field, not in slide show mode. The main PPT slide contains the information and outside the PPT slide at both sides (left and right), FFQs can be embedded.

As shown in Fig. 1, outside the PPT main slide, different types of questions to help the students to understand the slide and to guide them on where to focus were embedded. FFQs can use various styles and types of questions such as true or false, fill in the gap, choose the best answer, define, comment on and compare between. The slides often contain chemical processes, diagrams and videos to cater for different styles of student learning. An average of three questions per slide is ideal. Prior to the lecture students receive a version without the answers, which are then delivered in the lecture and this is why they are called "FastFeedback Questions".

In brief, FFQs are used to:

- Alert / guide the student to the important key-information in each slide
- Simplify complex topics (simple language and descriptive questions)

- Check the student's understanding
- Prepare the student for the exam

Methods

Two PPT slides using FFQs taken from a face-to-face lecture on thyroid hormones are presented in this section. In the first example, FFQs were used to direct the student where to focus when faced with an overwhelming amount of information. In the second example, FFQs were embedded to help the student to understand a complex mechanism and to be able to recall it.

The efficiency of FFQs were evaluated through the student final marks and eVALUate as follows:

I. Student final marks

The student final results of third year clinical biochemistry, Principles and Practices of Clinical Biochemistry, MEDI3006, in 2015 - 2017 when FFQs were used have been compared against that of the previous five years, 2010-2014, when FFQs weren't used. Number of students in this study, $n = 311$. A T-test has been performed and the mean and coefficient of variance % (CV%) were also calculated.

II. eVALUate (item for Feedback)

eVALUate is an online system used by Curtin University for gathering and reporting student feedback on their learning experiences. The survey is anonymous and the student chooses for each item one of the following answers: strongly agree, agree, disagree, strongly disagree or unable to judge. The eVALUate Unit Summary Report (USR) shows the percentage agreement (that is, the percentage of students who agreed or strongly agreed) with the eleven discrete items. Among these eleven items, we are going to focus on the item of "Feedback" as it is problematic to most lecturers especially when they are teaching complex subjects like clinical biochemistry [9]. The result of the 'Feedback' item in eVALUate for the MEDI3006 class was compared to the average result of this item in the Faculty of Health Sciences and that of the University in that year.

Results and Discussion

Examples of FastFeedback Questions embedded outside the PPT slides

In this section, two PPT slides on thyroid hormones with embedded FFQs outside the main PPT slides were presented to show the role of FFQs in slide with potentially overwhelming content and complex mechanism. For publication purpose only, additional Tables were presented in this manuscripts (Table 1a, b and Table 2a, b) to show and discuss the FFQs in Fig. 2a, b and 3a, b., respectively.

Example 1: Where to focus when you have a slide with overwhelming information?

In this example, the main PPT slide as shown in Fig. 2a&b is overwhelming as it contains eighteen hormones and that is a bit scary to most students. The student needs to know where to focus rather than studying all the eighteen hormones. The student was guided to focus only on two hormones; on the starting thyroid hormone, pregnenolone, and on the most abundant hormone, DHEAS, and to know why they are important. To guide them on where to focus, some questions, Q1-Q4, were embedded outside the main PPT slide as in Fig. 2a and Table 1a (without the answer), and Fig. 2b and Table 1b (with the answer).

Insert Figure 2a

Figure 2a. Main PowerPoint slide showing the synthesis of different thyroid hormones in no slide show mode. PPT slide contains FFQs with no answers (pre-lecture).

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3 *Insert Table 1a*
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6 *Insert Figure 2b*
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10 **Figure 2b.** Main PowerPoint slide showing the synthesis of different thyroid hormones in no slide show mode.
11 PPT contains FFQs with answers, which is delivered during the lecture.

12 *Insert Table 1b*
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16 In Q1 and Q2, the student was asked to recall the starting hormone in the synthesis of all the thyroid
17 hormones. In Q1, the student was given five answers to choose from, whereas in Q2, he was given a true or
18 false answer question on the same hormone. In Q3 the student was given a true or false answer question on
19 the most abundant thyroid hormone. Similarly, Q4 was a 'Cloze' exercise where students were required to
20 complete the information about the most abundant hormone. The student by answering these four questions
21 will be able to recall these two hormones and will be able to focus on the important information in the slide
22 without being distracted or overwhelmed by other information.
23

24
25
26 **Example 2: How to understand a complex mechanism and be able to recall it.**

27 In this example, the main PPT slide as shown in Fig. 3a&b reveals a mechanism of secretion and regulation of
28 cortisol that most students find difficult to understand and recall. Different types of questions were embedded
29 outside the main PPT slide as in Fig. 3a and Table 1a to support understanding and recall.
30
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32
33 *Insert Figure 3a*
34
35

36 **Figure 3a.** Main PowerPoint slide is showing the mechanism of secretion and regulation of cortisol in no slide
37 show mode. PPT slide contains FFQs with no answers (pre-lecture).
38
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40 *Insert Table 2a*
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42

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44 *Insert Figure 3b*
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47 **Figure 3b.** Main PowerPoint slide is showing the mechanism of secretion and regulation of cortisol in no slide
48 show mode. PPT contains FFQs with answers, which is delivered during the lecture.
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52 *Insert Table 2b*
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As shown in Fig. 3a and Table 2a, the PPT slides with the questions (no answers) were given to the students (pre-lecture). During the lecture, the lecturer presents the same PPT slides not in slide show mode with the answer (Fig. 3b and Table 2b) so that the student can immediately check his answers (FastFeedback).

Q1 requires a longer written answer describing the mechanism. The cloze exercise that followed (Q2) provided a model answer for Q1. To further support recall, Q3-5 focused on the same information but using various forms of short answer questions. The repetition involved is known to strengthen recall [15].

Statistical analysis: mean, standard deviation and coefficient of variances

The students' final marks in third year of clinical biochemistry, MEDI3006, in 2015-2017 (FFQs) were compared against that of 2010-2014 (no FFQs). The mean, standard deviation and coefficient of variances were measured. The efficiency of the new method was evaluated qualitatively and quantitatively as follows.

Figure 4 shows the student final results of MEDI3006 from 2010-2014 (no FFQs) and 2015-2017 (FFQs). The mean has increased from $63.1 \pm 11\%$ (2010-2014, no FFQs) to $72.7 \pm 10\%$ (2015-2017, FFQs). Although the standard deviation was high, but the increase in the mean was consistent when FFQs were used in 2015-2017. It is worth noting that the CV% was 17.7% in 2010-2014, which has been reduced to 14.3% in 2015-2017, which corresponds to a better distribution of results. The consistent increase of the students' final marks in 2015-2017 could be related to the use of FFQs or due to having an academically stronger cohort of students in 2015-2017 compared to those in 2010-2014. To investigate that, the students' final marks in three other units in 2015-2017 were compared to that in 2012-2014 to check if there was a significant increase in the students' final marks similar to that found in MEDI3006 or not. The students' final marks in the other three units in 2015-2017 were very similar to that in 2012-2014 as the change in the mean was insignificant, -1.2% to +0.7%. According to this comparison, the only variable that made significant positive improvement in the students' marks in MEDI3006 was the use of FFQs. This statement was further explored by the results of the Feedback item in eVALUate and by the student's comment.

Insert Figure 4

Figure 4. Student final results of MEDI3006 in 2010-2014 (no FFQs) and in 2015-2017 (FFQs).

Student feedback

Student feedback is an important index to monitor student satisfaction on the quality of teaching and materials delivered to them and it is also useful to give an idea on the lecturer's performance. Unfortunately, in Australian Universities, the Feedback item has been consistently poorly rated by students [9]. Fig. 5 shows the student feedback in 3rd year clinical biochemistry (MEDI3006) in 2016 and 2017 when FFQs were used. The results were compared against that of the Faculty and University in the same year. The Faculty and University feedback result were very comparable 80% - 81% in 2016 and 2017, respectively. In MEDI3006, the results were far better than that of the Faculty and University as it was 94% in 2016 (n=44 and 41% participation) and 100% in 2017 (n=29 and 55% participation), with an average of 97% compared to 81% in all other units delivered by the Faculty and University when FFQs weren't used. This outstanding increase of 13-20% over the Faculty and University could be due to satisfaction of the students with course content and use of FFQs. Another study was made on the item Feedback in unit MEDI3006 in 2010-2014 (no FFQs) compared to that in 2016-2017 (FFQs). A similar pattern was obtained as the results increased from 81.4% to 97%, respectively. These results demonstrate that units that have been considered hard and complex can be welcomed by the students when FFQs are used.

Insert Figure 5

Figure 5. Student feedback in 2016 and 2017 in MEDI3006 versus that of the Faculty and University. In 2016, n = 44 with 41% response rate (participation), in 2017, n = 29 with 55% response rate (participation).

eVALUate has an area where the student can write an anonymous comment on the unit, teaching materials, teaching method and the lecturer. The following comments were selected to demonstrate student satisfaction with the new method, FFQs:

- I like how it summarizes each PowerPoint slide
- It improved my understanding of the subject. Made the material easier to understand
- More effective than a bunch of questions at end of lectures
- I think they are very helpful. To be able to answer the questions requires understanding not just memorizing
- They are excellent tools at helping you to figure out what you need to learn, and what gaps are in your understanding
- I find it a very useful tool for studying. I also like how they allowed me to know what sort of questions I should expect in the exam
- More short answer question examples along with the multiple choice or at the end of the lectures
- Maybe make some of the feedback questions not very direct, so we may need to analyse the slides to get the correct answers.

The students' criticism/suggestions were very useful and helped the process of improving the quality of questions. For example, direct and indirect FFQs were used in the same slide to consolidate memorization and understanding, respectively.

Limitations and recommendations

FFQs have been shown to be a successful method in simplifying complex topics, improving the student results and feedback. However, some students may not get the most benefit of it if they don't know how to use it properly. For example, they may answer FFQs just before the exam and this destroys the whole principle of FFQs as FFQs should be answered immediately after each lecture and slide by slide not even lecture by lecture. Another limitation is the printing out of FFQs as this is not possible at the moment unless Microsoft/Mac/Google paid attention to this area and make it printable in the future. However, FFQs can still be printed next to the main PPT slide if you take a Print Screen copy while not in slide show mode.

The following are also factors that can affect FFQs:

- The difference between teachers in terms of:
 - Personality
 - Teaching style
 - Explanation expectations
 - Approach
 - Marking scheme severity
 - enthusiasm
- Different student cohorts
- Change in content
- Assessment changes

As recommendations to the lecturer, in order to make good questions you need to be aware of the following:

- Use simple and clear language

- Focus on key-information in each slide
- Explain / simplify / narrate the content of complex slide
- Use different styles of questions for the same information
- Provide the student with ideal answer(s)

The choice of the type of questions per each PPT slide is challenging. Questions should align with the purpose of the slide in terms of type and difficulty. For example, if the exam is a written one, it is highly recommended to ask FFQs that need writing and it is not enough to limit your FFQs to MCQs, fill in the gap or true or false. Similarly, the FFQs should train the students on how to think and what level of exam questions they should expect. In other words, the level of difficulty and creativity of the FFQs should align with the exam questions. Another suggestion is initially use the PPT in slide show mode, where the answers are hidden first, giving the students an opportunity to answer the questions themselves before the answers are revealed.

Conclusion and future research directions

FFQs are a rapid formative feedback method that involves embedding carefully crafted focus questions alongside PowerPoint slides (outside the main PPT slide field). The focus questions not only increase students' understanding of the slides but also model what good answers look like. The rationale for using FFQs was to: a) improve the students' understanding of the subject, b) engage the student more in the educational process, c) increase the likelihood of the student achieving a better mark, d) students are more likely to give a positive feedback on the subject and the lecturer. As a result, the mean final student mark has remarkably increased by 7.1-12.3%. The Feedback item was 13-20% higher than that of the faculty and University in 2016-2017. Therefore, I found FFQs rewarding not only to the students, but also to the lecturer. Another benefit that a lecturer may see while preparing FFQs, if the lecturer finds a slide that he/she can't make a question on it, this is more likely not a good slide and it is better to remove it. That will improve the lecturer's overall presentation. For future study, I plan to apply FFQs to other Science, Technology, Engineering and Maths (STEM) disciplines as this was a recommendation by peers and students. I believe the area next to the main PPT slide is not limited to educational purposes as in this manuscript and there is a room for researchers to discover.

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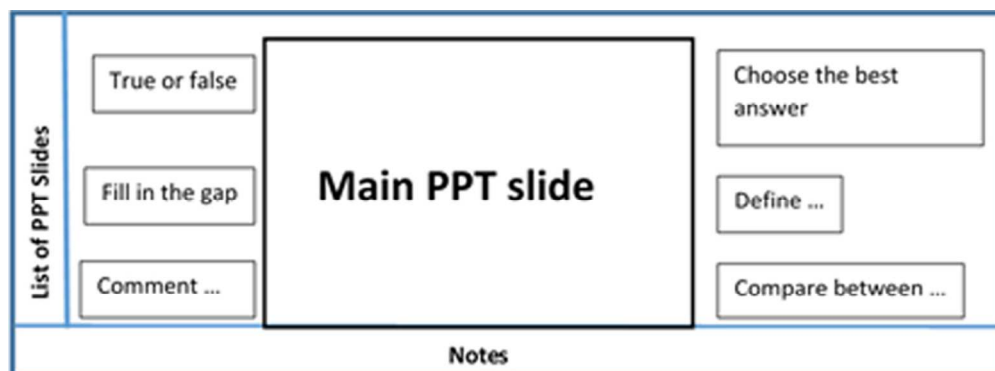


Figure 1. Schematic diagram of FFQs embedded alongside a PowerPoint slide outside the PPT main slide field, not in slide show mode. The main PPT slide contains the information and outside the main PPT slide at both sides (left and right), FFQs can be embedded.

75x28mm (300 x 300 DPI)

Peer Review

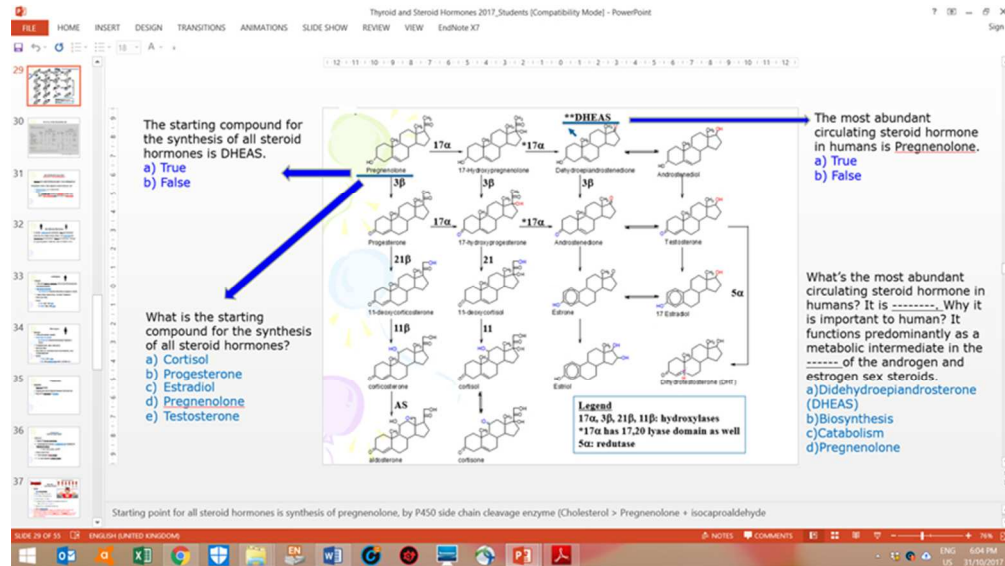


Figure 2a. Main PowerPoint slide showing the synthesis of different thyroid hormones in no slide show mode. PPT slide contains FFQs with no answers (pre-lecture).

70x39mm (300 x 300 DPI)

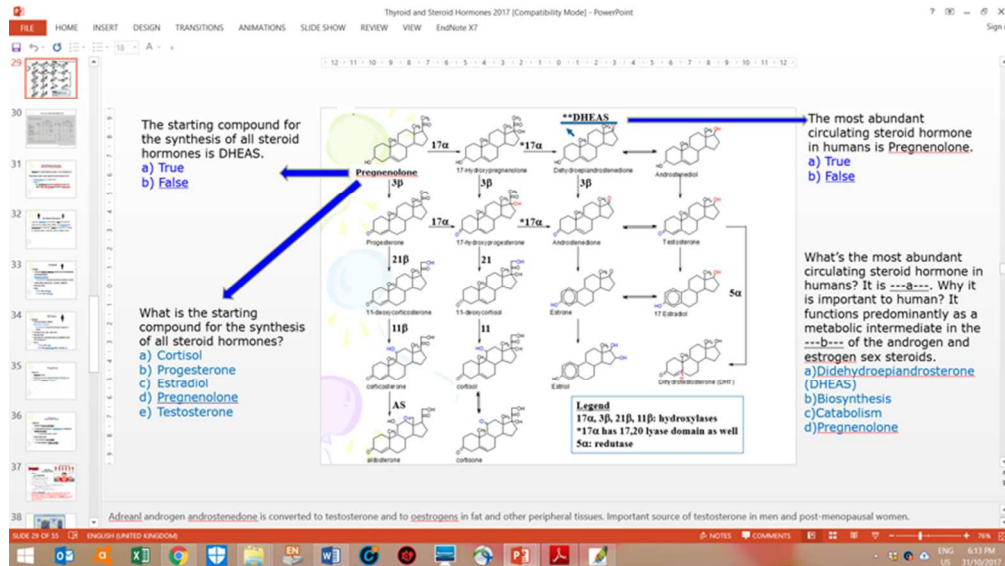


Figure 2b. Main PowerPoint slide showing the synthesis of different thyroid hormones in no slide show mode. PPT contains FFQs with answers, which is delivered during the lecture.

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The diagram illustrates the HPA axis regulation of cortisol. It shows the Hypothalamus, Anterior Pituitary, and Adrenal Cortex. The Hypothalamus releases CRH (Corticotropin Releasing Hormone), which stimulates the Anterior Pituitary to release ACTH (Adrenocorticotropic Hormone). ACTH then stimulates the Adrenal Cortex to release CORT (Cortisol). Negative feedback loops are shown from CORT back to the Hypothalamus and Anterior Pituitary. Triggers for CRH release include Emotional stress, Fear, Anxiety, apprehension, Injury, and Drive for Diurnal rhythm.

The adrenocortrophic hormone (ACTH) stimulates the adrenal cortex to synthesize Corticotrophin Releasing Hormone(CRH).
a) True
b) False

In case of injury, fear, or anxiety, the corticotrophin releasing hormone (CRH) is firstly synthesized in the ---- as a response to stress. CRH is positively stimulated the ----to synthesize the adrenocortrophic hormone (ACTH), which finally stimulates the ---- to synthesize the cortisol. However, this process is regulated by negative feedback when the hormone ---- is high in concentration.
a) Aldosterone
b) Adrenal cortex
c) Anterior pituitary gland
d) Cortisol
e) Hypothalamus

Discuss with a diagram the regulation of cortisol.

In case of injury, fear, or anxiety, the corticotrophin releasing hormone (CRH) is firstly synthesized in the hypothalamus.
a) True
b) False

Negative feedback inhibition occurs when cortisol concentration is high and it affects ----.
a) Adrenal cortex
b) Adrenal cortex and Anterior pituitary gland
c) Adrenal cortex and the hypothalamus
d) Hypothalamus and Anterior pituitary gland
e) Hypothalamus

The hypothalamus, anterior pituitary and adrenal cortex are regulating the secretion of steroid hormones.
ACTH stimulates synthesis of cortisol in zona fasciculata but also stimulates synthesis of adrenal androgens in the zona reticularis (p 743, (Iachavan)

Figure 3a. Main PowerPoint slide is showing the mechanism of secretion and regulation of cortisol in no slide show mode. PPT contains FFQs with no answers (pre-lecture).

70x39mm (300 x 300 DPI)

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The screenshot shows a PowerPoint slide titled "Regulation of Cortisol" within a presentation window. The slide features a central diagram of the HPA axis and several text boxes with multiple-choice questions (FFQs) and their answers.

Diagram: Regulation of Cortisol (HPA Axis)

- Hypothalamus:** Stimulated by "Emotional stress, Fear, Anxiety, apprehension" and "Injury". It secretes "Corticotropin Releasing Hormone (CRH)".
- Anterior Pituitary:** Stimulated by CRH. It secretes "Adrenocorticotropic Hormone (ACTH)".
- Adrenal Cortex:** Stimulated by ACTH. It secretes "CORT" (Cortisol).
- Feedback:** "CORT" exerts "Negative Feedback" on both the Hypothalamus and the Anterior Pituitary.
- Other Influences:** "Drive for Diurnal rhythm" also influences the Hypothalamus.

Text Boxes and Questions:

- Text Box 1:** "The adrenocortrophic hormone (ACTH) stimulates the adrenal cortex to synthesize Corticotrophin Releasing Hormone(CRH).
a) True
b) False" (Answer: b) False)
- Text Box 2:** "In case of injury, fear, or anxiety, the corticotrophin releasing hormone (CRH) is firstly synthesized in the ---e--- as a response to stress. CRH is positively stimulated the ---c--- to synthesize the adrenocortrophic hormone (ACTH), which finally stimulates the ---b--- to synthesize the cortisol. However, this process is regulated by negative feedback when the hormone ---d--- is high in concentration.
a) Aldosterone
b) Adrenal cortex
c) Anterior pituitary gland
d) Cortisol
e) Hypothalamus" (Answer: b) Adrenal cortex)
- Text Box 3:** "Discuss with a diagram the regulation of cortisol."
"In case of injury, fear, or anxiety, the corticotrophin releasing hormone (CRH) is firstly synthesized in the hypothalamus.
a) True
b) False" (Answer: a) True)
- Text Box 4:** "Negative feedback inhibition occurs when cortisol concentration is high and it affects --d--.
a) Adrenal cortex
b) Adrenal cortex and Anterior pituitary gland
c) Adrenal cortex and the hypothalamus
d) Hypothalamus and Anterior pituitary gland
e) Hypothalamus" (Answer: d) Hypothalamus and Anterior pituitary gland)

Footer: "The hypothalamus, anterior pituitary and adrenal cortex are regulating the secretion of steroid hormones. ACTH stimulates synthesis of cortisol in zona fasciculata but also stimulates synthesis of adrenal androgens in the zona reticularis (p 743, [Barrhavan])"

Figure 3b. Main PowerPoint slide is showing the mechanism of secretion and regulation of cortisol in no slide show mode. PPT contains FFQs with answers, which is delivered during the lecture.

70x39mm (300 x 300 DPI)

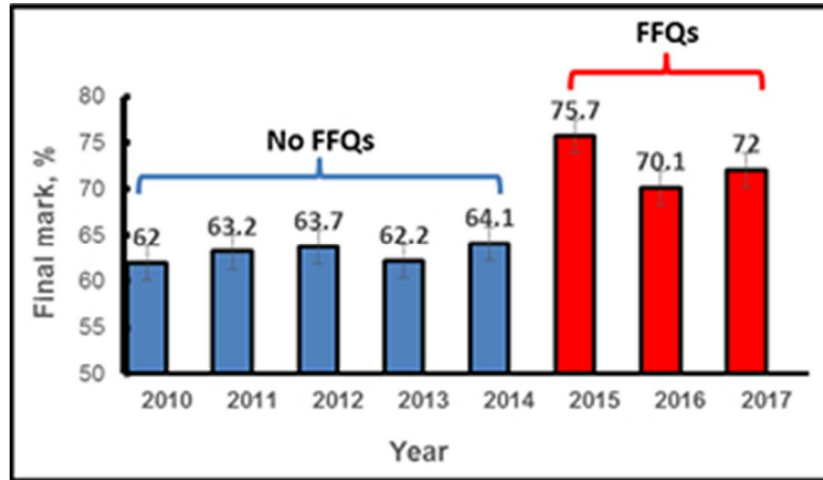


Figure. 4. Student final results of MEDI3006 in 2010-2014 (no FFQs) and in 2015-2017 (FFQs).

34x20mm (300 x 300 DPI)

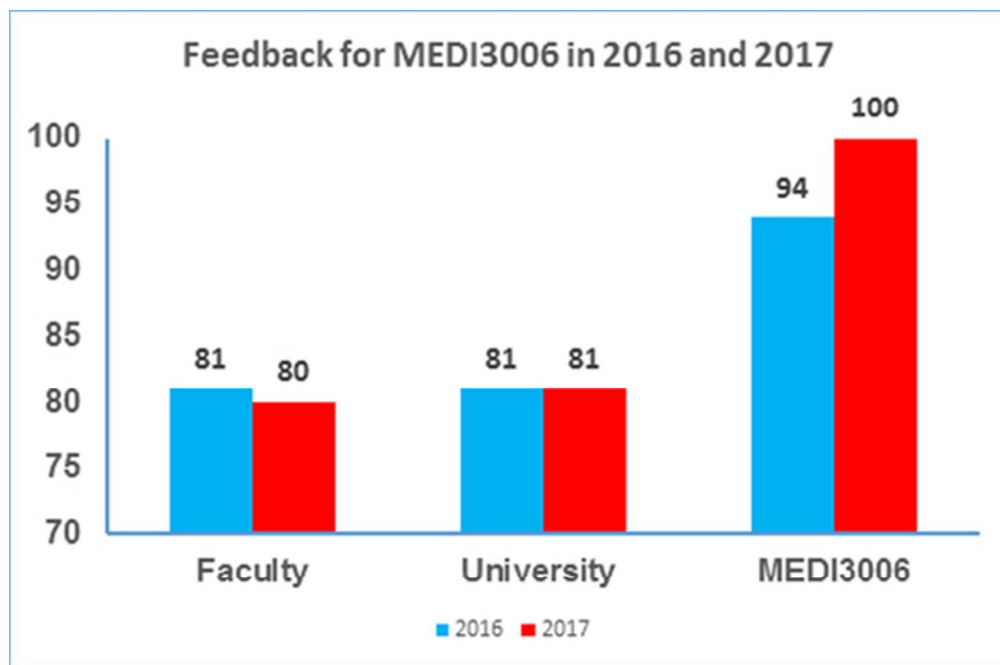


Figure 5. Student feedback in 2016 and 2017 in MEDI3006 versus that of the Faculty and University. In 2016, n = 44 with 41% response rate (participation), in 2017, n = 29 with 55% response rate (participation).

46x30mm (300 x 300 DPI)

Table 1a. Embedded questions with no answers at both sides outside the main PPT slide in Figure 2. Questions were given to the students (pre-lecture) without the answers.

1	1. <u>Choose the best answer</u>
2	What is the starting compound for the synthesis of all steroid hormones?
3	a) Cortisol
4	b) Progesterone
5	c) Estradiol
6	d) Pregnenolone
7	e) Testosterone
8	2. <u>True or false</u>
9	The starting compound for the synthesis of all steroid hormones is DHEAS.
10	a) True
11	b) False
12	3. <u>True or false</u>
13	The most abundant circulating steroid hormone in humans is Pregnenolone.
14	a) True
15	b) False
16	4. <u>Fill in the gap</u>
17	What's the most abundant circulating steroid hormone in humans? It is -----.
18	Why it is important to human? It functions predominantly as a metabolic
19	intermediate in the ----- of the androgen and estrogen sex steroids.
20	a) Didehydroepiandrosterone (DHEAS)
21	b) Biosynthesis
22	c) Catabolism
23	d) Pregnenolone

Table 1b. Embedded questions with the answers at both sides outside the main PPT slide in Figure 2. The slides were shown to the students during the lecture.

<p>1. <u>Choose the best answer</u> What is the starting compound for the synthesis of all steroid hormones?</p> <p>a) Cortisol b) Progesterone c) Estradiol d) <u>Pregnenolone</u> e) Testosterone</p>
<p>2. <u>True or false</u> The starting compound for the synthesis of all steroid hormones is DHEAS.</p> <p>a) True b) <u>False</u></p>
<p>3. <u>True or false</u> The most abundant circulating steroid hormone in humans is Pregnenolone.</p> <p>a) True b) <u>False</u></p>
<p>4. <u>Fill in the gap</u> What's the most abundant circulating steroid hormone in humans? It is <u>---a---</u>. Why it is important to human? It functions predominantly as a metabolic intermediate in the <u>---b---</u> of the androgen and estrogen sex steroids.</p> <p>a) Didehydroepiandrosterone (DHEAS) b) Biosynthesis c) Catabolism d) Pregnenolone</p>

Table 2a. Embedded questions outside the main PPT slide of Figure 3. Questions were given to the students (pre-lecture) without the answers.

1	1. <u>Long answer</u>
2	Discus how cortisol is secreted and regulated.
3	2. <u>Fill in the gap</u>
4	In case of injury, fear, or anxiety, the corticotrophin releasing hormone (CRH) is
5	firstly synthesized in the _____as a response to stress. CRH positively stimulates the ____
6	_to synthesize the adrenocortropic hormone (ACTH), which finally stimulates the _____
7	_to synthesize the cortisol. However, this process is regulated by negative feedback
8	when the hormone _____is high in concentration.
9	a) Aldosterone
10	b) Adrenal cortex
11	c) Anterior pituitary gland
12	d) Cortisol
13	e) Hypothalamus
14	3. <u>True or false</u>
15	In case of injury, fear, or anxiety, the corticotrophin releasing hormone (CRH) is
16	firstly synthesized in the hypothalamus.
17	a) True
18	b) False
19	4. <u>True or false</u>
20	The adrenocortropic hormone (ACTH) stimulates the adrenal cortex to synthesize
21	Corticotrophin Releasing Hormone (CRH).
22	a) True
23	b) False
24	5. <u>Choose the best answer</u>
25	Negative feedback inhibition occurs when cortisol concentration is high and it affects
26	_____.
27	a) Adrenal cortex
28	b) Adrenal cortex and Anterior pituitary gland
29	c) Adrenal cortex and the hypothalamus
30	d) Hypothalamus and Anterior pituitary gland
31	e) Hypothalamus

Table 2b. Embedded questions outside the main PPT slide of Figure 3 with the answers. The slides with the answers were shown to the students during the lecture.

1	1. <u>Long answer</u>
2	The answer to this question is the same as that as in fill in the gaps (Q2). The
3	students can be asked the same question in a different way.
4	
5	2. <u>Fill in the gaps</u>
6	In case of injury, fear, or anxiety, the corticotrophin releasing hormone (CRH) is
7	firstly synthesized in the <u>---e---</u> as a response to stress. CRH positively stimulates the
8	<u>-c---</u> to synthesize the adrenocortrophic hormone (ACTH), which finally stimulates the
9	<u>---b---</u> to synthesize the cortisol. However, this process is regulated by negative
10	feedback when the hormone <u>-d---</u> is high in concentration.
11	a) Aldosterone
12	b) Adrenal cortex
13	c) Anterior pituitary gland
14	d) Cortisol
15	e) Hypothalamus
16	
17	3. <u>True or false</u>
18	In case of injury, fear, or anxiety, the corticotrophin releasing hormone (CRH) is
19	firstly synthesized in the hypothalamus.
20	
21	c) <u>True</u>
22	d) <u>False</u>
23	
24	4. <u>True or false</u>
25	The adrenocortrophic hormone (ACTH) stimulates the adrenal cortex to synthesize
26	Corticotrophin Releasing Hormone (CRH).
27	
28	c) <u>True</u>
29	d) <u>False</u>
30	
31	5. <u>Choose the best answer</u>
32	Negative feedback inhibition occurs when cortisol concentration is high and it affects
33	<u>----d-----</u> .
34	a) Adrenal cortex
35	b) Adrenal cortex and Anterior pituitary gland
36	c) Adrenal cortex and the hypothalamus
37	d) Hypothalamus and Anterior pituitary gland
38	e) Hypothalamus
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