INTRODUCTION

Blood glucose control is an excellent example of homeostasis in the human body. Students studying first year biomedical science, health science and exercise science are required to have a thorough understanding of this homeostatic control and a comprehension of the importance of the glucose tolerance test. Traditionally, practical sessions have performed glucose tolerance testing on students which has relied on students fasting correctly and learning how to use equipment effectively in a short time frame to obtain reliable results. Ethics is also now required to perform these experiments on students. Consequently we have implemented case-based scenarios on glucose tolerance (normal and abnormal) in practical sessions to enable active learning experiences for students using non-invasive techniques.

Flipping Blood Glucose Control

Students are introduced to the key concepts of the endocrine system in a face-to-face lecture in the unit CSA112 Anatomy and Physiology 1, however the details of the oral glucose tolerance test (OCTT) and how this clinical test can lead to the diagnosis of abnormalities like diabetes mellitus and impaired glucose tolerance is taught and discussed in active learning practical sessions.

Online introductory lecture + Website content + Online concept quiz + Online game
F2P Practical session: case based scenarios of normal glucose control
Semi-routine written quiz at conclusion of practical session

The practical session was fully utilised to engage students in active discussions around the case based scenarios. At the end of the practical session the students completed a written quiz which was a summative assessment in the unit and designed to test their key knowledge of the endocrine system and the application of their knowledge to blood glucose control.

Case Scenarios

A typical day in the life of a nursing student ‘Larissa’

1) Describe the role of glucose and insulin during Larissa’s day
2) How may Larissa’s blood glucose levels change as the exam approaches? In your answer, identify which hormones may be involved in the response.

Using information from endocrine system lectures and pre-class online material, students work through the case scenarios in groups and participate in active-class discussions. Students refer to Figure 10.5 to gain an understanding of the diagnosis of type 2 diabetes mellitus and apply their knowledge to the case scenario questions.

Case Scenarios

Blood Glucose (BG) levels from 26-year-old males during a Standard Glucose Tolerance Test

<table>
<thead>
<tr>
<th>Time (min)</th>
<th>BG level (mmol/L)</th>
<th>PUB</th>
<th>BG level (mmol/L)</th>
<th>PUB</th>
<th>BG level (mmol/L)</th>
<th>PUB</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 (Normal)</td>
<td>4.5</td>
<td></td>
<td>5.8</td>
<td></td>
<td>6.5</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>5.0</td>
<td>4.2</td>
<td>6.1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>40</td>
<td>9.9</td>
<td>10.1</td>
<td>8.2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>60</td>
<td>11.8</td>
<td>10.1</td>
<td>9.6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>80</td>
<td>13.8</td>
<td></td>
<td>10.1</td>
<td></td>
<td>10.8</td>
<td></td>
</tr>
<tr>
<td>100</td>
<td>13.9</td>
<td></td>
<td>8.5</td>
<td></td>
<td>10.5</td>
<td></td>
</tr>
<tr>
<td>120</td>
<td>13.5</td>
<td></td>
<td>5.4</td>
<td></td>
<td>9.6</td>
<td></td>
</tr>
</tbody>
</table>

1) Using the figure ranges provided in Figure 10.5, state whether each fasting glucose level for Pub and PUB are normal or abnormal.
2) For any of the subjects in Table 10.1 who displayed ‘abnormal’ blood glucose responses in glucose ingestion (refer to reference two-hour blood glucose level), state (simply) why the responses are abnormal with respect to blood glucose levels recorded.
3) Provide at least three possible reasons (physiological mechanisms) why the blood glucose response is abnormal for these subjects.
4) Define the term glucose tolerance.
5) One of the subjects in Table 10.1 has abnormal glucose tolerance but is not yet diabetic. Using Figure 10.5, describe the difference between the two pre-diabetic stages: ICT and IGT.
6) Using Figure 10.5, identify the diagnostic criteria for diabetes mellitus.
7) Using the diagnostic criteria in Figure 10.5, state whether Pub, Sam or Sevino show impaired glucose tolerance or diabetes mellitus.

Impact of Flipping

Does Flipping the Content enhance and enhance Student Learning?

This flipped strategy was introduced into the unit in 2015. In 2015, 53% of students accessed the online module prior to attending the face-to-face practical sessions. Implementation of this flipped design resulted in times observing active engagement in practical classes with respect to the case based scenarios and a 4.8% improvement in summative assessment performance, related to the face to face class, was observed in the 2015 student cohort. Students indicated that the online module, particularly the self-tests, assisted their understanding of the topic.

In 2016, 34% of students accessed the online module, of these 67% completed the formative quiz. In 2016, students who accessed the module scored an average of 74.2% in the summative assessment compared to 61.9% by those students who chose not to access any aspect of the online module. Overall, the students achieved an average score of 66.4% in the summative assessment item but students who accessed the formative online quiz averaged 78.2% in the summative assessment item.

Outcomes of Flipping the Endocrine System

Students indicated that the online module, particularly the self-tests, assisted their understanding of the topic and reasons reported active engagement of students in the face to face practical sessions. Flipping this aspect of the endocrine system effectively enabled students to apply foundation knowledge of blood glucose control. Importantly, student learning outcomes related to blood glucose homestasis were improved by adopting this flipped pedagogy.