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Evaluating Student Engagement and Learning Outcomes Through E-learning in Biomedical Sciences
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**In short…..**

1. **Aim:** To evaluate the effectiveness of e-learning formative activities in a biomedical science course.

2. **Embark and Clarify:** The MELT framework was adapted to determine whether the research significantly increased knowledge and engagement.

3. **Analyse and Synthesise:** Significant increase in mean summative assessment score and final grade.

4. **Evaluate and Reflect:** E-learning resources are an option for all educators and promote student engagement.

Introduction

• The ability to interpret clinical cases in haematopathology (blood disorders) is a vital skill for pathology students to learn.

• However, curriculum design has been influenced by the reduction in the number of face-to-face contact and the decrease in teaching staff.

• Utilizing alternative teaching methods provides an opportunity to maintain quality teaching standards and satisfy pedagogical change that is evidence based.
• There has been a growth in blended learning and e-learning.

• New teaching and learning methods can be accessed and experienced in a variety of ways through technology.

• Online tools have superseded paper-based activities.

• The Millennial learner (born 1982-2004) has grown up in a technologically driven environment with a routine involvement with e-learning.

Aims

• (i) Investigate a Model of Engaged Learning and Teaching (MELT) criteria that could be used as a platform for student engagement with e-learning.

• (ii) Determine the effectiveness of formative assessment to assess knowledge and skills in haematopathology with and without immediate online feedback prior to summative assessment.

• (iii) Assess whether a new e-learning approach improves final grades through empirical research.
Need was recognised to:
(i) incorporate formative assessment that provided timely and relevant support to assist in improved learning outcomes prior to the summative assessment
(ii) increase the opportunities for repetition and interactivity for the learner.

A model of engaged learning and teaching (CRS) framework was adapted to fit the context to design and apply curriculum structure to engage students and enhance teaching in this area.
<table>
<thead>
<tr>
<th>Facet of Skill Development</th>
<th>Student Role</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initiative</td>
<td>Establishes a professional role: Scientist.</td>
</tr>
<tr>
<td>Use of Technology</td>
<td>Resources &amp; technology to generate information: e-learning modules.</td>
</tr>
<tr>
<td>Learning &amp; Evaluating</td>
<td>Evaluates performance, sets goals, establish life-long learning: applies clinical learning and skills, interactive and on-going learning.</td>
</tr>
<tr>
<td>Self Management</td>
<td>Reflective practice: sets goals to improve and focus learning, application to work placement.</td>
</tr>
<tr>
<td>Problem Solving</td>
<td>Synthesises and analyses clinical contexts: real case based studies.</td>
</tr>
<tr>
<td>Communication</td>
<td>Communicates understanding: assessment &amp; team work in a clinical setting.</td>
</tr>
</tbody>
</table>

CRS Development Framework adapted from University of Adelaide by Assoc. Prof. Cathy Snelling and Assoc. Prof. Sophie Karanicolas
Organise & Manage

Task 1

Formative 1A
In-class tutorial

Summative 1B
Case study assignment

Compulsory laboratories

Task 2

Formative 2A
E-learning module

Summative 2B
Case study exam

Feedback

Verbal from Tutor
In class only
One attempt/class

Marking Rubric
10 days post submission
One attempt

Online
Instant feedback
Multiple attempts

Grade (%)
Score only
One attempt
Find, Generate & Reflect

Haematology Case Study - 39 yr old female

What are the most likely diagnoses?
Low Hb, Hct and RBC indicate anaemia.
The Hb result determines if the anaemia is mild, moderate or marked, in this case it is marked.
MCV refers to red cell volume, it is reduced e.g. microcytic.
MCH refers to the pallor of the red cell, it is reduced e.g. hypochromic.
The Retic ABS is within reference range suggesting decreased or ineffective RBC production. Therefore it would be a marked microcytic hypochromic anaemia, likely caused by decreased or ineffective RBC production in the bone marrow.
To learn more about the signs and symptoms of iron deficiency and thalassaemia click here.

Great job! You have been able to work out the most likely diagnoses for this case study.

Now think about what parameters from the full blood count indicated the type of anaemia that was likely in this patient.

After you have thought about a response, click on the Biomedical Scientist to read their explanation.

E-Learning Tutor
What did students actually do?

- Online haematology modules
- Developed in Smart Sparrow: Immediate feedback & analytics

Well done!
You labelled the correct cells.
Analyse & Synthesise

Paper-based

E-learning

![Bar chart](chart.png)

- **Task 1**
  - Completed: [Bar]
  - Did not complete: [Bar]

- **Task 2**
  - Completed: [Bar]
  - Did not complete: [Bar]
Evaluate & Reflect

During the game, information about the topic is given, and student inquiry guides learning. By having access to advanced technology teaching spaces and group touch screen participation exercises, students discuss questions amongst themselves before sharing their answers in real-time, on the huge touch screen, for the whole class to evaluate and discuss.

Rebecca influenced class participation by allowing students to work as a team to handle case studies in the tutorial. These case studies were online, and as a team, we worked through them together in class as well as by ourselves at home, which then would have personalised marking. This was an important way of learning and allowing us to better our responses and knowledge each time we partook in a case study.

Throughout the semester our group would have various tasks, such as annotating digital blood films and answering timed quizzes, that were then displayed on the big screen alongside each other. This provided an engaging and competitive means of learning – with your work at the scrutiny of your peers, you were driven to be the best performing group.
Communicate & Apply

Science is fun, engaging and applicable to my profession

Science is boring
Engagement

The design of an interactive and adaptive e-learning module should:

• Provide comprehensive learning objectives
• Stimulate attention, engagement and motivation to continue the module
• Contain knowledge that reduces cognitive load
• Be an efficient use of time
• Give the ability to complete and repeat the module anywhere/anytime
• Offer a positive interactive experience
• Demonstrate good aesthetics of the interface and user-friendly design
• Provide instant feedback and evaluation
• Have adaptable self-led learning with a choice of learning pathway
• Provide immediate analytics for improved usability and learning modification
• Have an application of the module to ‘real world’ scenarios.
Conclusion

• Formative assessment has a positive impact on student learning.

• Evidence suggests students want more e-learning lessons which corresponds with letting the students tell us how to teach\(^1\).

• Further research is needed into the development of e-learning modules to assist learning using adopted MELT frameworks.

Acknowledgements

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Published module can be viewed online for adoption by other users at https://www.best.edu.au