RHPF Central REGIONAL HUB PROJECT FUND AKO AOTEAROA

Response to scenario-based resources in a First Year Human Bioscience University Course

Jim Clarke, Michelle McCulley, Isabelle Lys[1], Terry Stewart, and John Milne
Massey University, [1]Charles Darwin University

7 November 2012

AKO AOTEAROA NATIONAL CENTRE FOR TERTIARY TEACHING EXCELLENCE

MASSEY UNIVERSITY TE KUNENGA KI PŪREHUROA UNIVERSITY OF NEW ZEALAND

AKO AOTEAROA NATIONAL CENTRE FOR TERTIARY TEACHING EXCELLENCE

An Ako Aotearoa publication.
This project output has been funded by Ako Aotearoa through the Regional Hub Project Fund.

Response to scenario-based resources in a First Year Human Bioscience University Course

Project Team: Jim Clarke, Michelle McCulley, Isabelle Lys[1], Terry Stewart, John Milne
Massey University, [1] Charles Darwin University

Contents

Response to scenario-based resources in a First Year Human Bioscience University Course

Project Team: Jim Clarke, Michelle McCulley, Isabelle Lys[i], Terry Stewart, John Milne
Massey University, [i]Charles Darwin University

Executive Summary

This report discusses the main findings from a pilot project that looked at student responses to scenario-based resources. These were used as an additional resource for the topic of endocrinology in a first year human bioscience university course. Many students studying the course as part of their degree in Nursing or Health Science are inexperienced science students with little or no previous knowledge in human bioscience

Scenario-based learning has been reported as a successful strategy for teaching science in the meaningful context of everyday life scenarios. This has been shown to positively affect the engagement of the student. As a result, an additional scenario-based resource was provided to help improve student understanding and increase pass rates which had been declining in recent years despite the introduction of other interventions such as online revision tests and fortnightly tutorials.

Scenario-based resources were provided to two cohorts of students for the topic of endocrinology. The two cohorts were those taking the course as a summer school distance course and those taking the course as a first year first semester on campus course.

The project sought to answer two key questions:

- Does the use of supplementary material presented as a scenario enhance student knowledge, understanding and performance in first year human bioscience students?
- Do students show a preference for this style of supplemental material?

Student response was measured by means of a student questionnaire and analysing student preference and performance on the topic of endocrinology in their final examination.

The scenario resource appeared not to have influenced student preference and performance in their final examination. The number of students selecting the endocrine based questions declined in both cohorts with one cohort also showing a decrease in performance and the other an increase in performance. However, these findings may reflect a number of other uncontrollable variables. The scenario resource was viewed positively by those students using it and was seen as a useful supplement to student learning.

Introduction and Background

Scenario-based learning presents students with knowledge in a context that can be relevant and as a result be more easily understood. This is supported by Kindley (2002) who when defining the phrase “Scenario-based learning” argues that knowledge cannot be known and fully understood independent of its context (1). When scientific knowledge is placed into

contexts that are relevant students become more engaged. Students entering university study have been shown to benefit from this approach(2).
Scenarios may be presented as components within case based or problem-based learning exercises (3). Within a scenario, storytelling can also be important. Stories allow learners to encapsulate information through an experiential (as opposed to abstracted) approach. Plots, contextualized situations and real life problems focus the attention of the learner and aid in inquiry, decision making and learning (4). As a result the knowledge being taught takes on relevance and a meaning that increases the motivation to learn (5).

In the human bioscience course the lecturers have tried a number of approaches that aim to raise the achievement of students (6). For example, lecturers introduced weekly online tests in 2008 which had little impact on the pass rates (6). Fortnightly tutorials were introduced in 2009. Teaching science in a meaningful context and relating this to everyday life scenarios positively affects the engagement of the student (2). As a result in 2010-2011 interactive scenarios were developed and tried. It was expected that real life scenarios would provide students with a learning tool to gain complex knowledge that can be more easily understood, remembered and applied. Real life as against scenarios related to a specialty area of study e.g. nursing, sports science were selected as the course is a generic one across a number of degrees and because it had been reported by Parkinson et al (2) that students are more likely to become disengaged where material is not related to their specific interests.

This project looked at the use of scenarios and sought to answer two key questions:

- Does the use of supplementary material presenting content in context by way of a scenario enhance student knowledge, understanding and performance in first year human bioscience students?
- Do students show a preference for this style of supplemental material?

Scenarios often build on what the students already know showing the application of knowledge (7). However, many of the first year students in this course had little previously taught science knowledge. For this reason, rather than being the core subject knowledge students had to learn for endocrinology, scenarios are used as an additional resource, presenting this knowledge in context. Students also had lectures and tutorials on endocrinology.

Methods and Rationale

Scenarios were developed for the endocrinology topic because students seemed to struggle with this course topic. Students achieved lower marks in the final exam for endocrinology when compared to other topics (Table 1). In addition, fewer students chose the endocrinology questions (Figure 1)

Table 1. Average Mark Out of Ten Gained For Topics in Final Exam

Year	Cell	Renal	Reproduction	Cardiovascular	Endocrine
2009	7.5	6.4	6.6	6.3	6.1
2010	7.2	6.9	5.6	5.8	5.1

Endocrinology is an important part of homeostasis (which is how the body keeps itself environmentally balanced for optimum function). Homeostasis is introduced to students in week one of the course and then revisited, as appropriate, as each body system is taught.

Towards the end of the course the endocrinology topic is consolidated in three one hour lectures. It is during this time, the student is introduced to the additional online scenario-based resource known as 'Joe's Life'.
'Joe's Life' is a series of scenarios involving four main characters, experiencing everyday events related to the endocrine system that are explained in every day terms and supported by scientific explanation. Students are asked a series of questions for which there is immediate feedback as they progress through the scenario. Scenarios shown in Appendix 1 reflect the inexperience of science knowledge of some students and provide the starting point to the scenarios. Student's experiential knowledge related to hydration is then developed into the concept of feedback systems (Appendix 2). Feedback systems are the basis on which the endocrine system works. The knowledge most students have re blood glucose and insulin is then used to show the common components of a feedback system and to provide students with confidence in their own knowledge. This allows the introduction of the concept of negative feedback where a stimulus such as high blood glucose is reversed (lowered) to normal blood glucose. Not all feedback systems are negative, some require the stimulus to be enhanced and again using the everyday knowledge positive feedback systems can be introduced and explained. Further scenarios involve introducing students to the application of new knowledge built on the introductory knowledge, for example the importance of the hypothalamus and pituitary gland to the endocrine system. In addition students are encouraged, as they work their way through the scenarios, to copy their answers and paste them into a document file that when completed will provide a summary for that piece of learning (Appendix 3).

The effectiveness of presenting the scenario to supplement student learning was measured by looking at the student use of the scenario, by analysing the selection bias and performance of the student in the final examination for endocrinology questions and by obtaining student feedback on their experience with an online questionnaire after the final examination had been sat.

The final examination consists of fifty compulsory multiple choice questions, a selection of five from eight questions with a short answer format and six from ten questions requiring a paragraph answer. There is also a compulsory short essay. All the learning outcomes for the course including endocrinology are covered in each of the sections. Analysis of student performance was based on the endocrine short answer and paragraph sections of the examination.

Two cohorts of students trialled the scenario: 65 summer school distance students in 2010 and 281 campus students in 2011. Confidentiality did not allow for the identification of individual students and as a result the analysis of selection bias and performance of the student in the final examination for endocrinology questions is across the whole cohort and not just those using the additional scenario resource.

Results

In the summer school cohort 31 of the 65 enrolled students looked at Joe's Life and in the semester 1 cohort 138 of the 281 enrolled students looked at Joe's Life (Table 2). This is approximately 50% of the cohort.

Table 2. Student Use of the Scenario Software

Visits to Joe's Life	Summer School 2010 Number of Students	Semester 1 2011 Number of Students
1	28	65
2	3	42
3	0	16
4	0	11
5	0	2
6	0	2

The number of students returning for subsequent visits was low. The summer school cohort has a 'compressed' semester in terms of weeks of study which appears to have limited their time for using additional resources. In the semester 1 cohort, a little over 50% visited twice or more and 4 students visited the site more than four times. This may be a result of semester 1 students being mostly full time students who at the end of a semester will have other assignment deadlines to meet and would be thinking about final examination revision.

The use of an additional resource for learning endocrinology may not have been seen by many students as a high priority for their success. The provision of a course mark to students completing the additional resource and presenting their summary may have been a way of increasing participation.

Both cohorts showed a decline in the number of students selecting endocrinology questions after the introduction of the scenarios (Figure 1). In addition the Summer School cohort showed a decrease in their average mark achieved where as the semester 1 cohort showed an increase in average mark achieved (Figure 2).

Figure 1. Number of Students Selecting the Endocrinology Question in the Final Exam

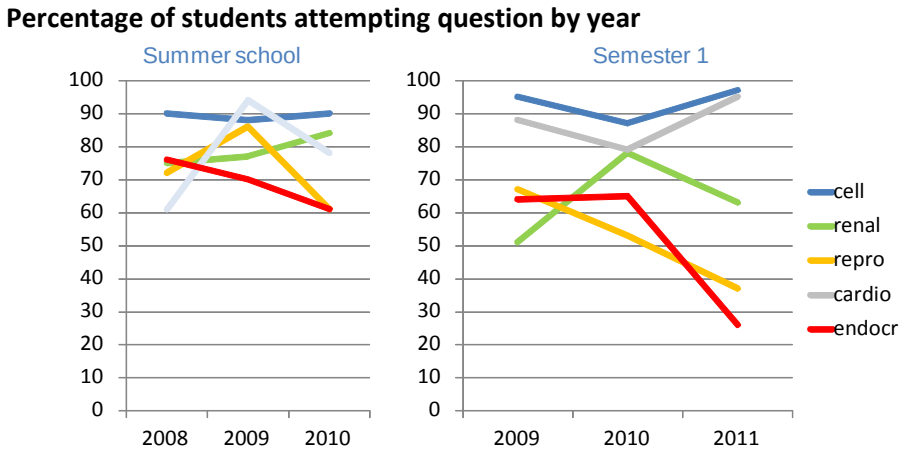
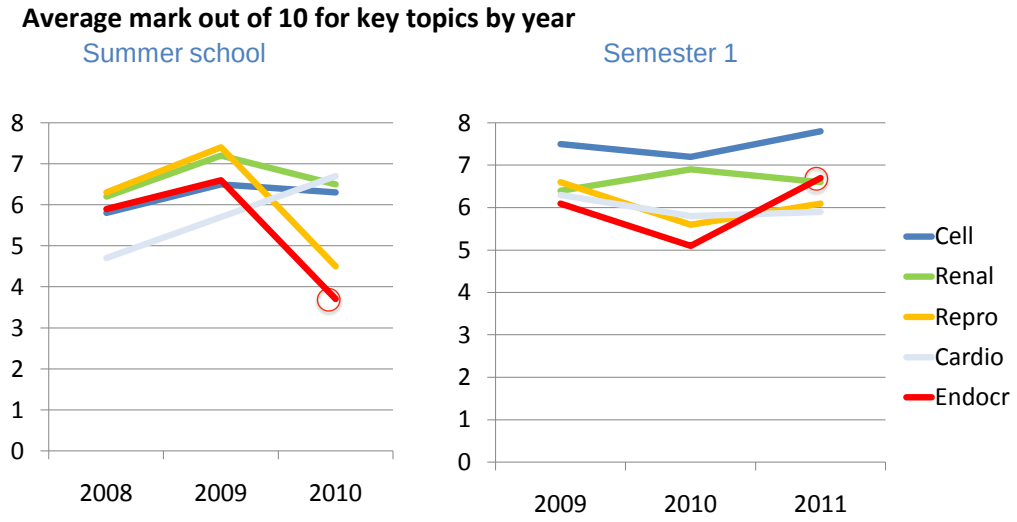


Figure 2. Performance of Students Who Selected the Endocrinology Question in the Final Exam



The response rate to the student questionnaire was low for semester 1 (Table 3). For summer school students the return rate was 33%, similar to that expected for such a survey. Most of the students who returned questionnaires had used the scenario (Table 3).

Table 3. Student Questionnaire Response

Intake	Percentage of Students Returning Questionnaire	Percentage of Students using Scenario
Summer School 2010	33% (17/51)	59% (10/17)
Semester 1 2011	13% (35/278)	66% (23/35)

The responses of students using the scenarios can be summarised as the scenarios being easy to use, provided enjoyable and effective learning and 86% of those who responded to the survey would like similar scenarios to be available for other topics within the course.

The students liked the following things about the scenarios.

- **Gave me real life examples which always helps me learn and remember concepts**
- **Humour, ability to go back and change answers, read an explanation about answer**
- **It was enjoyable and taught at the same time. You could compare your answers easily to the proper answers**
- **The real life examples and the way that science concepts were explained in simpler language**
- **I really found this helpful and I really hope you create more of these**

Scenario-based content delivery as an additional resource in a first year human bioscience university course appears to provide a useful addition to these students' learning.

One student suggested a preference for scenarios being used as a revision tool and to build on what they already knew rather than the scenario being used as an additional resource:

- **think they should give more information about the topic and THEN ask the questions to see how much you remember from the teaching**

Students disliked the following:

- **Always having to type something in a box even if you did not know the answer**
- **A little bit long winded**
- **Being technologically challenged, I couldn't figure out how to cut and paste into word so had to write everything down, it was very time consuming**
- **I have slow internet, I got fed up waiting**
- **Too wordy to type stuff in**

Discussion

The student feedback suggested further improvements in the design of these scenarios. The feedback also reflects a number of important issues and assumptions made by academics regarding the use of online learning resources. There are still a number of students who are 'technologically challenged' and we cannot assume that all students will be able to initially cope with online learning. The provision of an optional short course on online learning may provide the required skills. Secondly, not all students have access to a broadband internet connection at this time and therefore these students may be disadvantaged in their learning particularly if online was the primary means of delivery.

In the final examination there was a decline in the number of students selecting endocrinology questions after the introduction of the scenarios (Figure 1). The Summer School cohort showed a decrease in their average mark achieved whereas the semester 1 cohort showed an increase in average mark achieved (Figure 2). The decreased trend in the student selection of questions appears to be against what could be expected when an additional learning resource is provided. Performance in answering the endocrinology question is opposite for the two cohorts. The summer school students showed a marked decline in their performance whilst the semester 1 students showed a moderate increase in their performance. Clearly, using the resource only once as was the case for half of those responding is not sufficient to enhance learning and success for an examination. To decide on the usefulness of the additional scenario resource using the measures selected, further cohorts could be studied and it is essential that a method of identifying scenario users and non-users for analysis of performance be employed. Future studies need to use a methodology that allows this discrimination. However, thought must first be given to the results as presented and a number of uncontrollable variables identified.

During the course of the study there were a number of significant uncontrollable variables that could have affected the results of the study. These included two of the three original academic staff participating in the delivery of the human bioscience course and project left the university and a new academic member joining the project. The semester 1 cohort of which 50% of the students are Bachelor of Nursing students had their entry criteria changed for 2011. Entry to the nursing degree now required a year 13 science paper, decreasing the number of inexperienced science students in the cohort. Could this change explain an increase in the performance of those answering the endocrinology question in this cohort?

But this does not explain why there was a decline in the number of students from this cohort attempting the endocrinology question in the final exam but does suggest that only those confident in endocrinology answered the question. In addition a change in Government funding restricted the intake of the summer school cohort to a third of the expected number and since priority for entry was given to 'repeat students', this proportionally increased the number of 'repeat students' in the cohort.

Repeat students are those that have previously failed the paper and although motivated to pass and continue with their entry cohort onto the next year of study are often students at higher risk of failure. In addition the exam technique of repeat students is often more focussed on 'picking winners', questions and content they consider more likely to be in the examination based on previous examinations. 'Picking winners' may explain the increase in performance for the cardiovascular and cell questions which can be considered as more predictable in their content and therefore safer to learn and attempt. Whereas endocrinology, a topic taught throughout the course, offers the examiner a much broader range of possible questions which could be considered by the student as harder to predict and taking more time to revise. In addition, students consider some aspects of endocrinology and the questions asked more difficult than others. An initial analysis of the endocrinology questions asked seems to suggest that this influences not only the numbers of students attempting a question but the mark achieved.

Performance apart, the use of scenario-based learning as an additional tool appears to be one that is favoured by most students using it. Enjoyment of use however, appears not to be linked to performance. In the same way, enjoyment of other teaching methodologies may also not be linked to performance. Further research needs to be undertaken to establish links between enjoyment of learning methodologies and learning success.

It was considered by the researchers that to introduce the scenarios as the only resource for learning endocrinology for first year first semester inexperienced science students carried too higher risk in terms of the students required learning for this topic. In addition core knowledge of endocrinology such as the relationship between structure and function, for example between the hypothalamus, pituitary gland and other endocrine glands, was thought by those teaching the course not suitable for scenario-based learning for inexperienced science students. Such topics needed to be taught as core knowledge on which scenarios could be built. As a result scenarios became, for many students, very much an additional and optional resource. The number of students opting not to use the additional scenario-based learning resource clearly suggests that when a new learning tool is introduced as an additional resource careful consideration must be given to the number of other activities students may be involved in and where the use of this additional resource is likely to sit on the students list of priorities.

In developing such a resource consideration must be given to the student's comments regarding this type of learning being longwinded and those that are technologically challenged by the resources available to them or their knowledge in the use of these resources. One other informal comment made that is worth noting for those considering developing such resources is to use characters that are readily identifiable to the student cohort and to which they would be more attracted. Pete and Dudley are well known to one of the (older) authors but not apparently so to most of the students!

Conclusion

An additional scenario resource was used as a supplement to a first year human bioscience university course for inexperienced science students. The students using the resource perceive the scenario-based resource as a useful aid to enhance their learning and understanding. However, the provision of scenarios did not show an increase in student performance and preference in selecting final examination questions in endocrinology. There appears to be no significant correlation between examination results and the use of the additional scenario resource in the methodology used. The performance in the final examination could have been influenced by a number of significant uncontrollable variables.

Whilst there is little doubt that the use of scenarios as a teaching tool enhances learning, careful consideration needs to be given to a number of factors before adopting the type of scenario-based resource used in this study to supplement the learning of endocrinology to inexperienced science students. These factors include, any additional learning resource requires the student to spend additional time on the resource when it is likely they are already using this time for other priorities and to complete assessments required to pass other courses. Developing a scenario-based resource is very time consuming. Other methods of teaching using scenarios and increasing participation by students in the use of those scenarios may want to be considered first.

The final word on the usefulness of presenting of content in context by way of a scenario is that of the students who used it:

> **"I just did Joe's life and it was soooo good."**
> **Laura**
>
> **"I did 'Joe's Life' this morning – I loved it!! Will have to go back to it though as didn't quite manage to finish. It was so engaging!! I could explain to a colleague at work the whole process of weeing – he was most appreciative. Those type of exercises are great for manic people like myself who can read for half an hour before realising I am not taken in anything."**
> **Jude**

References

1. Kindley, R.W. (2002). Scenario-based E-Learning: A Step Beyond Traditional E-learning, ASDT online magazine – Learning Circuits, 3(5). Retrieved February 22nd, 2010 from http://astd.org/LC/2002/0502_kindley.htm

2. Parkinson, T.J., Hughes, H., Gardner, H.G., Suddaby, G.T., Gilling, M. and MacIntrye, B.R. (2011). Engaging Learners Effectively in Science, Technology and Engineering: The pathway from secondary to university education. Ako Aotearoa

3. Stewart, T. (2010). Constructing and Using Interactive Scenarios Retrieved 21 February, 2011, from http://www.massey.ac.nz/?sa9d00341g

4. Andrews, D.H., Hull, T.D., & Donahue, J.A. (2009). Storytelling as an instructional method: descriptions and research questions. Interdisciplinary Journal of Problem-based Learning, 3(2), Article 3. Retrieved May 30th, 2010 from http://docs.lib.purdue.edu/ijpbl/vol3/iss2/3/

5. Schank, R., Fano, A., Bell, B., & Jona, M. (1993). The design of goal-based scenarios. Journal of the Learning Sciences, 3(4), 305-345.

6. Clarke, Jim, Tielemans, Wilma & Hoong, Isabelle (2009). Do Weekly Online Revision Assessments Enhance First Year Student Pass Rates? In Meyer, Luanna H., Davidosn, Susan, Anderson, Helen, Johnston, Patricia M. & Rees, Malcolm (Eds.) *Tertiary Assessment & Higher Education Student Outcomes: Policy, Practice & Research (pp117-128).* Wellington, New Zealand: Ako Aotearoa.

7. Stewart, T.M. and Brown, M.E. (2009) To spray or not to spray? A scenario-based exercise for tertiary-level horticulture students *Proceedings ascilite Auckland 2009*

Appendices

Appendix 1: Introduction Joe's Life

Figure 1: A question in Joe's life

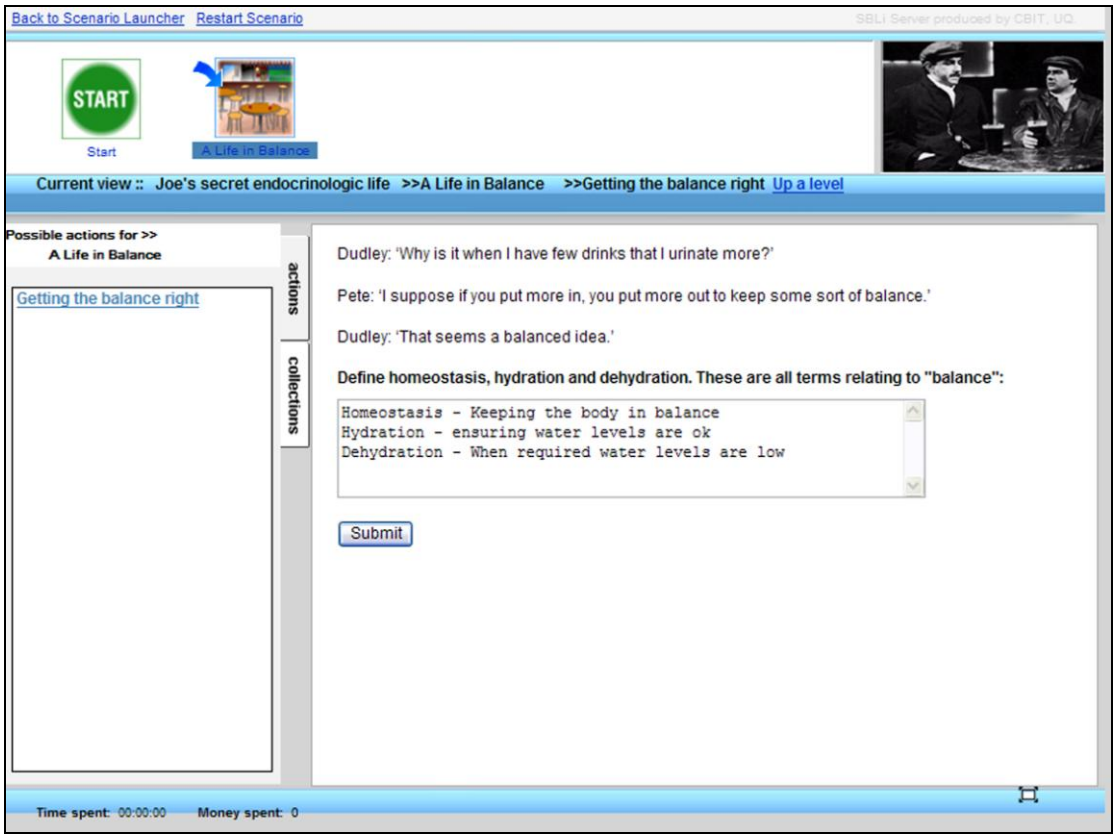
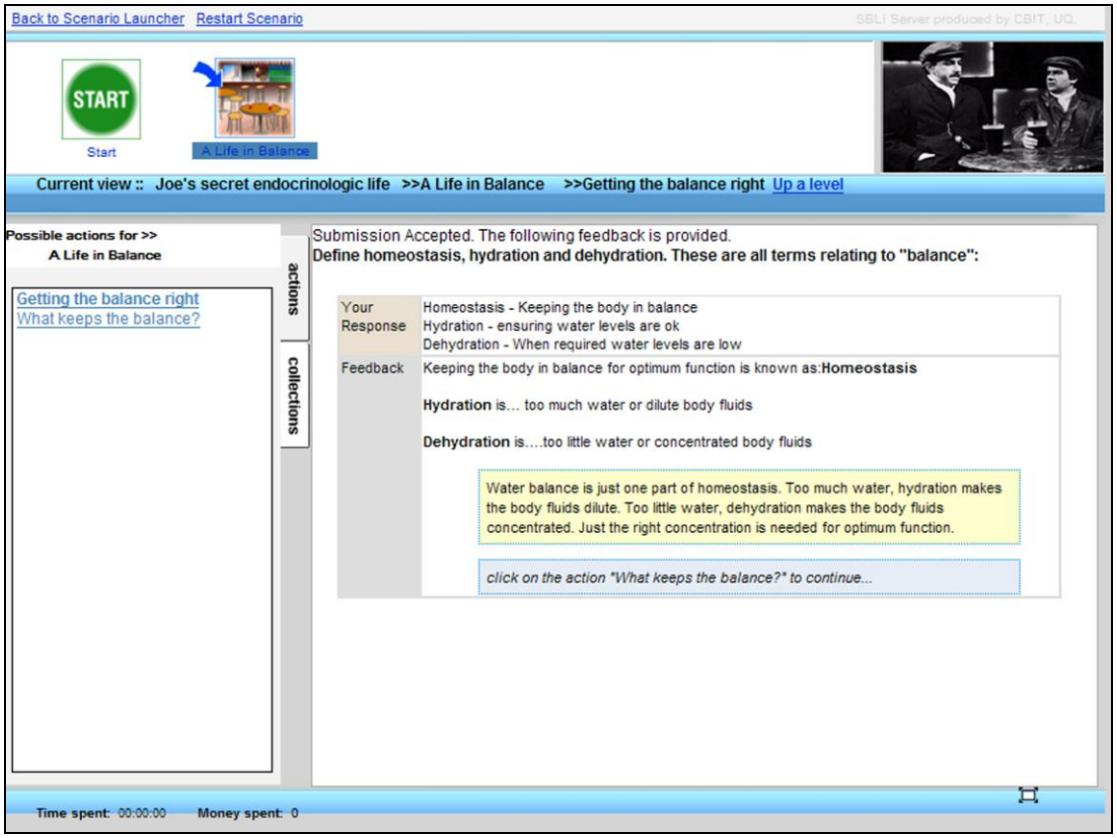
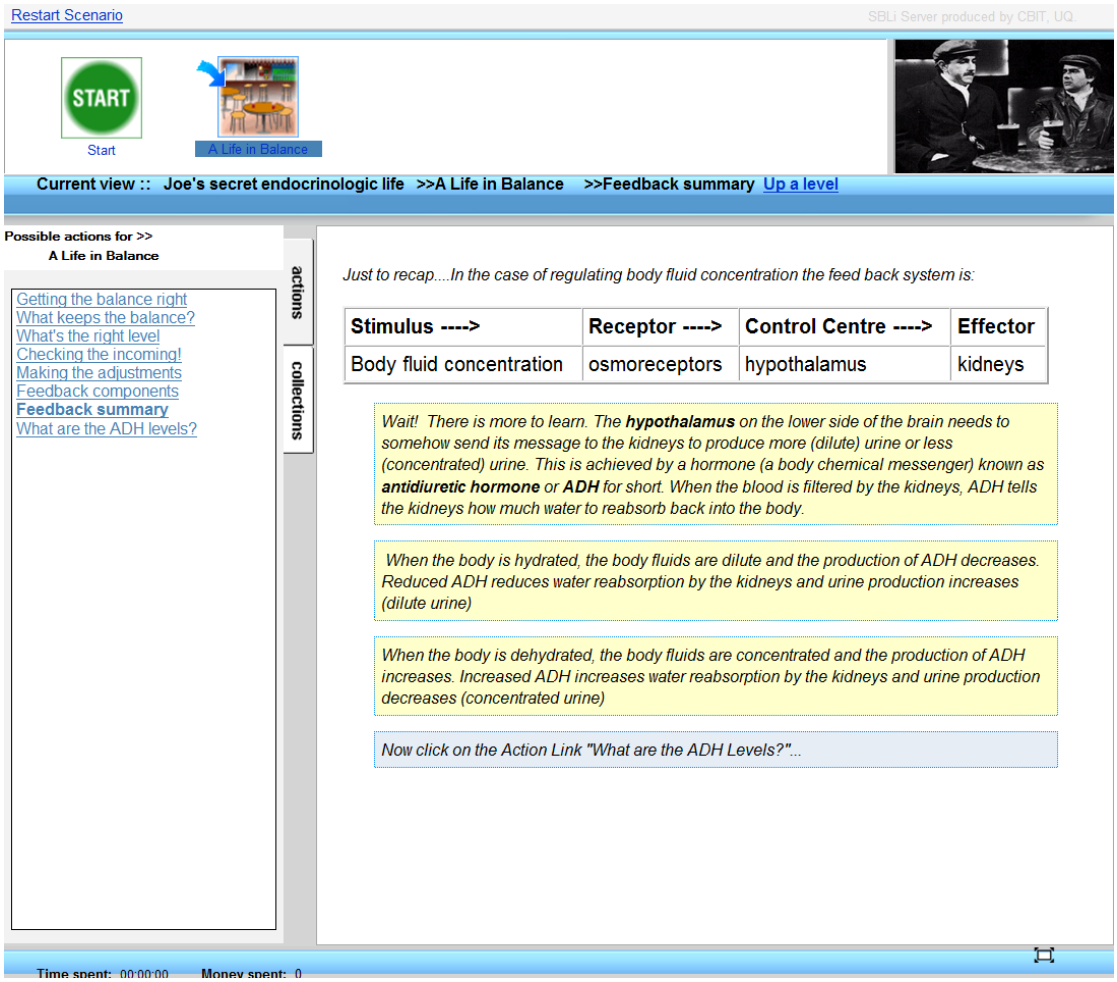


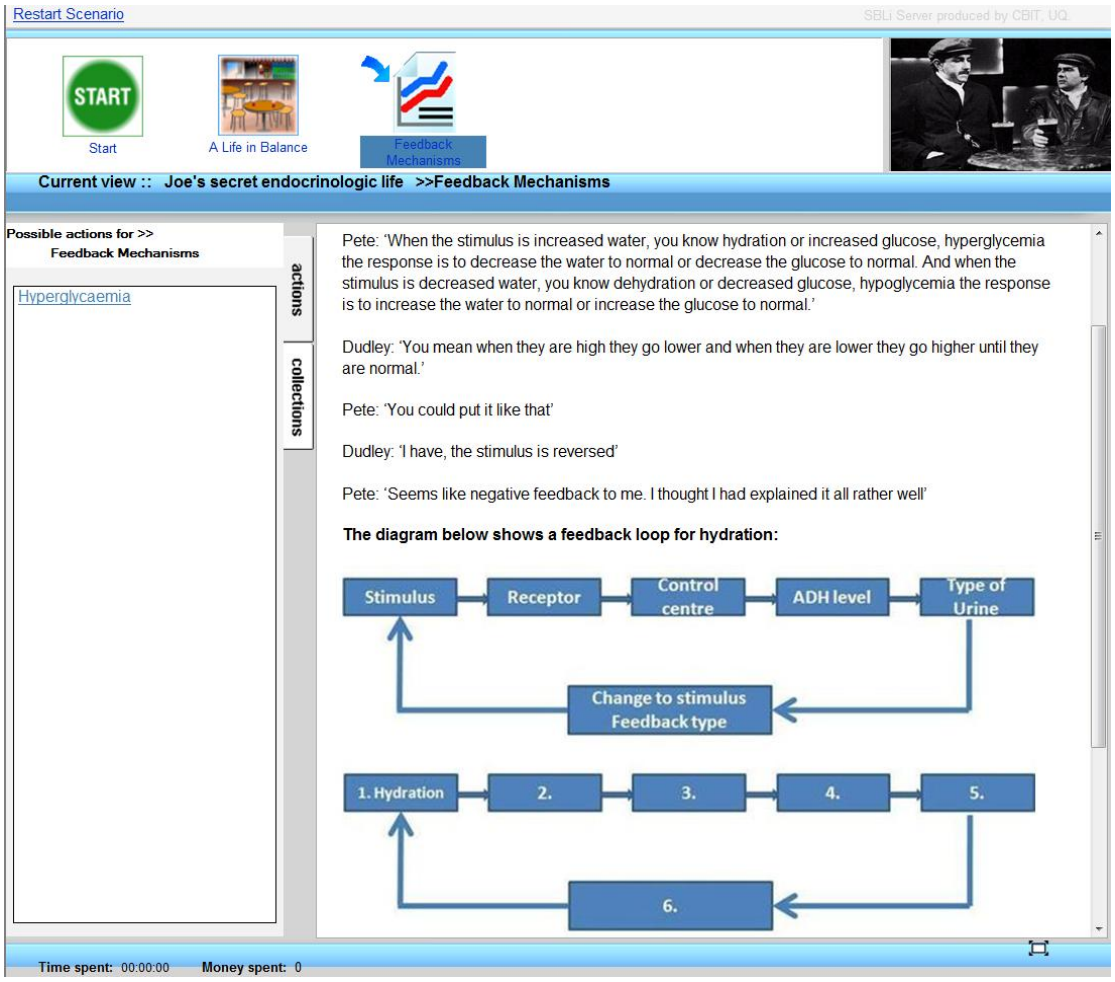
Figure 2. Feedback given in response to the student answer shown in figure 1.

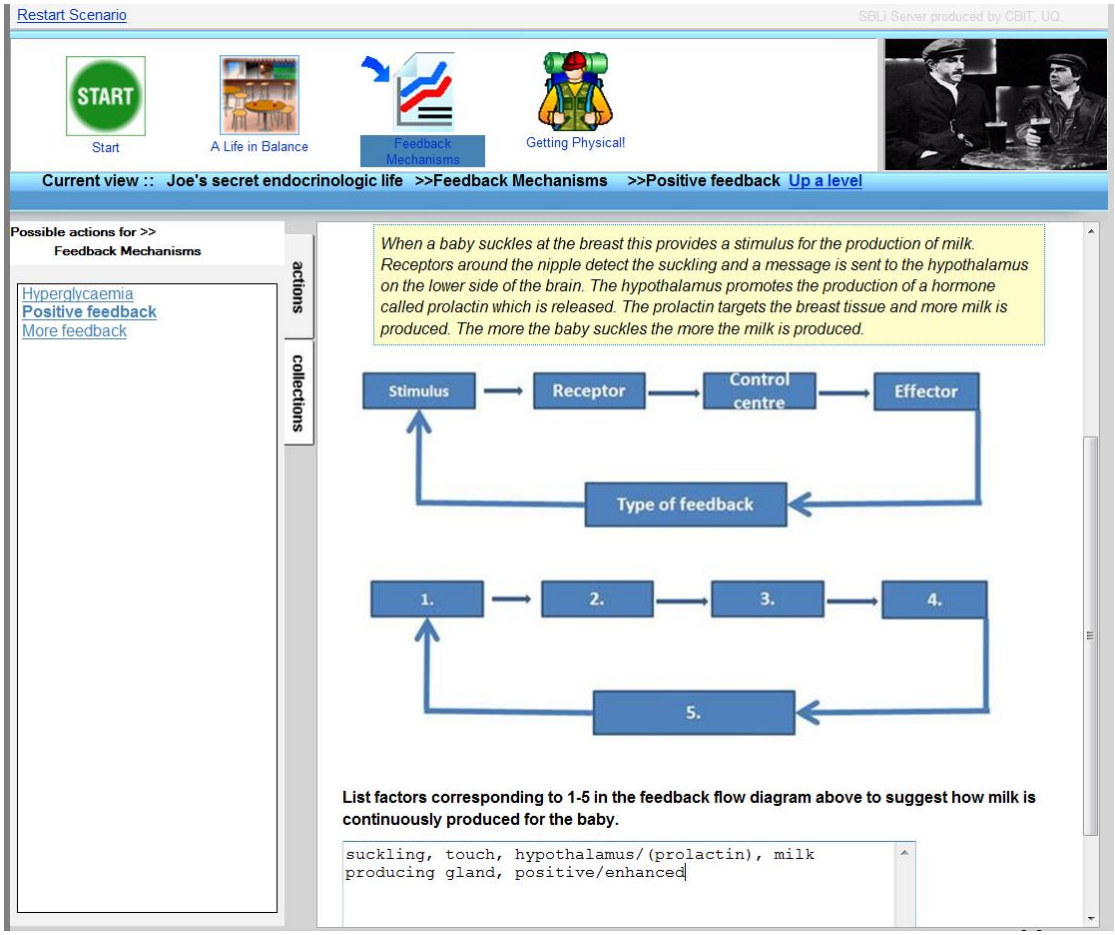

Back to Scenario Launcher
Restart Scenario
SBLI Server produced by CBIT, UQ.
START
Start
A Life in Balance
Current view :: Joe's secret endocrinologic life >>A Life in Balance >>Getting the balance right Up a level
Possible actions for >>
A Life in Balance
Getting the balance right
What keeps the balance?
actions
collections
Submission Accepted. The following feedback is provided.
Define homeostasis, hydration and dehydration. These are all terms relating to "balance":
Your Response
Homeostasis - Keeping the body in balance
Hydration - ensuring water levels are ok
Dehydration - When required water levels are low
Feedback
Keeping the body in balance for optimum function is known as:Homeostasis
Hydration is... too much water or dilute body fluids
Dehydration is....too little water or concentrated body fluids
Water balance is just one part of homeostasis. Too much water, hydration makes the body fluids dilute. Too little water, dehydration makes the body fluids concentrated. Just the right concentration is needed for optimum function.
click on the action "What keeps the balance?" to continue...
Time spent: 00:00:00
Money spent: 0

Appendix 2

Development of knowledge using the scenarios




Restart Scenario
SBLi Server produced by CBIT, UQ.
START
Start
A Life in Balance
Feedback Mechanisms
Current view :: Joe's secret endocrinologic life >>Feedback Mechanisms
Possible actions for >>
Feedback Mechanisms
Hyperglycaemia
actions
collections
Pete: 'When the stimulus is increased water, you know hydration or increased glucose, hyperglycemia the response is to decrease the water to normal or decrease the glucose to normal. And when the stimulus is decreased water, you know dehydration or decreased glucose, hypoglycemia the response is to increase the water to normal or increase the glucose to normal.'
Dudley: 'You mean when they are high they go lower and when they are lower they go higher until they are normal.'
Pete: 'You could put it like that'
Dudley: 'I have, the stimulus is reversed'
Pete: 'Seems like negative feedback to me. I thought I had explained it all rather well'
The diagram below shows a feedback loop for hydration:
Stimulus
Receptor
Control centre
ADH level
Type of Urine
Change to stimulus Feedback type
1. Hydration
2.
3.
4.
5.
6.
Time spent: 00:00:00
Money spent: 0


Restart Scenario
SBLi Server produced by CBIT, UQ.
START
Start
A Life in Balance
Feedback Mechanisms
Getting Physical!
Current view :: Joe's secret endocrinologic life >>Feedback Mechanisms >>Positive feedback Up a level
Possible actions for >>
Feedback Mechanisms
Hyperglycaemia
Positive feedback
More feedback
actions
collections
When a baby suckles at the breast this provides a stimulus for the production of milk. Receptors around the nipple detect the suckling and a message is sent to the hypothalamus on the lower side of the brain. The hypothalamus promotes the production of a hormone called prolactin which is released. The prolactin targets the breast tissue and more milk is produced. The more the baby suckles the more the milk is produced.
Stimulus
Receptor
Control centre
Effector
Type of feedback
1.
2.
3.
4.
5.
List factors corresponding to 1-5 in the feedback flow diagram above to suggest how milk is continuously produced for the baby.
suckling, touch, hypothalamus/(prolactin), milk producing gland, positive/enhanced

Appendix 3 Student Summary

Keeping the body in balance for optimum function is known as **Homeostasis**

Hydration is too much water or dilute body fluids

Dehydration is too little water or concentrated body fluids

Receptors that detect body fluid concentration are known as **Osmoreceptors**

The required balance level is known as the **set point**

Stimuli are detected by a **Control Centre**

The parts of the body that responds to the control centre to make the adjustment are known as the **effectors**

The components of a feedback system are **1. Stimulus 2. Receptor 3. Control Centre 4. Effector**

An explanation of the hypothalamus and the role of antidiuretic hormone (ADH) is given prior to completion of labels 1 – 4 in the following table:

stimulus	**receptor**	**control centre**	**ADH level**	**Type of urine**
dehydration	osmoreceptor	hypothalamus	**(1) High ADH**	**(3) Concentrated urine**
hydration	osmoreceptor	hypothalamus	**(2) Low ADH**	**(4) Dilute urine**

The scenario then goes on to introduce the effects of alcohol and caffeine on ADH production and uses the example of blood glucose regulation to show that the same feedback system components are used. At this point the student uses there knowledge of diabetes