UNSW Learning and Teaching Grants and Fellowship Program

Final Report

Grant: Strategic Educational Development Grant

31 August 2016

Creating blended learning opportunities to help students think like scientists in first year psychology courses

Project Leaders:

- A/Prof Branka Spehar b.spehar@unsw.edu.au 9385-1463
- Prof Simon Killcross s.killcross@unsw.edu.au 9385-3034

Team Members:

- Dr Lidija Krebs-Lazedic
- Dr Marios Panayi
- Dr Tom Whitford
- Dr Oren Griffiths
- Kathryn Hutton-Bedbrook

Report authors:

- A/Prof Branka Spehar
- Dr Marios Panayi
- Prof Simon Killcross

1. Acknowledgements

Dr Lorenzo Vigentini (PVC (Education) Portfolio) and Brian Landringan (Educational Media Manager) provided helpful advice regarding the learning analytic tools and blended learning software used in this project.

2. List of acronyms used

MCQ – Multiple choice questions

3. Executive summary

Blended learning has emerged as one of the more promising adaptations to the pedagogical paradigm shift in higher education to personalised, student-centered, flexible, 24-h learning environment (Van Doorn & Van Doorn, 2014). Blended learning is also recognised as most suited to UNSW's strengths and needs (UNSW 2025 Strategy). The overall aim of this project was to address the gap in the innovative and adaptive use of technology in large first year Psychology courses in particular, and across the entire Psychology curriculum in general. Specifically, we created, evaluated, and refined a number of adaptive and interactive blended learning and assessment opportunities to increase student engagement and to promote flexible and personalised learning experience.

The primary intended outcomes of this project included:

- a suite of newly developed blended and adaptive learning opportunities that will enable more flexible and personalised engagement with course content both online and through the more interactive, "flipped" face-to-face interaction; and
- the roll-over of innovative blended learning and assessment initiatives developed in PSCY1111 to other Stage 1 and Stage 2 courses, thus empowering staff in the use of blended learning and building their capacity.

The project initially focused on a new core course, PSYC1111 Measuring Mind and Behaviour. The course was developed specifically to improve student understanding of the key characteristics of scientific approach and research methodology, and to prepare them for future research-integrated learning. We developed, implemented, and evaluated three major types of blended learning materials: 1) Weekly interactive learning modules (24 in total); 2) Weekly online formative assessment quizzes (11 in total); and 3) Fortnightly online tutorials (5 in total). The new course, delivered in Session 2 2015 for the first time, afforded a timely and exciting opportunity to create an adaptive and interactive blended learning environment, which is now highly transferable and can be used to further support School-wide capabilities to harness the power of blended learning in the undergraduate Psychology curriculum.

Our approach goes beyond simply arguing for the superiority of blended learning due to its flexible and personalised possibilities regarding the content, time, and place of learning. We provide extensive empirical evidence and quantitative analysis detailing the ways students engage with different blended learning materials; the extent to which the use of blended learning resources is related to student learning outcomes, and importantly, the student experience of the blended learning and reversal of traditional course materials. Our main findings indicate that:

- The usage statistics show a great level of engagement with all online activities even when they are not compulsory.
- To a considerable degree, students are engaged with blended learning materials outside of traditional University hours and to the extent which would not be possible to support with traditional face-to-face arrangements.
- The engagement with online interactive learning and formative assessment activities was positively associated with increased final exam grade and course success. In addition, different online activities have identifiable unique contributions towards predicting increased outcome measures.
- The course feedback, both standard CATEI and custom in-course surveys, show an overwhelmingly positive response suggesting that students liked the mix of online and face-to-face components.
- Students' perception of, and experiences with, the blended learning resources are also significant predictors of course success.
- The use of supplementary online preparation for tutorials and other online activities is an effective way to increase the depth of discussion in traditional face-to-face component of the course and facilitate the flipped classroom delivery mode.
- The effectiveness of this novel mode of course content delivery is clearly evident in the improved students' performance in the final exam when compared to the performance of the previous cohorts in the same topics.

In summary, newly developed blended learning opportunities undoubtedly succeeded in providing a more personalised, student-centered, flexible, 24-h learning environment in a large first year undergraduate Psychology course. Our usage analytics and analyses show that students willingly engaged with these novel learning opportunities; they liked them and most importantly, the novel blended learning approach significantly improved their course learning outcomes. Taken together, the

outcomes of this project provide a successful blueprint for sustainable, empirically based development of blended learning opportunities and their integration with physical, face-to-face resources across Psychology curriculum that enhance learning.

4. Key stakeholders

Students, School of Psychology staff and the wider UNSW community are the key stakeholders in this project. The input, feedback and dissemination strategies include:

Students	School of Psychology	Faculty of Science/UNSW
• CATEI Course Evaluation; • Custom Course Experience Questionnaire;	• Monthly meeting with the project governing committee; • Project updates at the School of Psychology Board and Staff meetings; • School of Psychology Blended Learning Showcase (21 July 2016); • School of Psychology Blended Learning Support Unit;	• Connection seminars; • UNSW Learning and Teaching Forums*; • Publications;

*Poster presentation at the UNSW Blended Learning: Past, Present & Future Forum (October 2015): *Usage and Effectiveness of Online Quizzes in Undergraduate Psychology Courses by Branka Spehar, Marios C. Panayi, Lidija Krebs-Lazendic, Antonio Mendoza Diaz, & Simon Killcross*

5. Project objectives, approach and evaluation

5.1 Project objectives and approach

The overall aim of this project is to address the gap in innovative and adaptive use of technology in large first year Psychology courses in particular, and across the entire Psychology curriculum in general. Specifically, we aim to empower students for science-inspired and evidence-based life-long learning through:

1) creating a high quality blended learning environment in first-year Psychology courses to increase student engagement and promote deep learning;
2) using learning analytics to create personalised feedback regarding both course engagement and performance to provide timely advice and promote students' active responsibility for their own learning;
3) encouraging students to develop deeper meta-cognitive appraisal of their learning activities and achievements; and
4) developing and further supporting School-wide capabilities to harness the power of blended learning in the undergraduate Psychology curriculum.

The project initially focused on a new core course, PSYC1111 Measuring the Mind and Behaviour (359 students), developed specifically to improve student understanding of key characteristic of scientific research methodology and to prepare them for future research-integrated learning. The new course, delivered for the first time in Session 2 2015, afforded a timely and exciting opportunity to create an adaptive and interactive blended learning environment expected to be highly transferable across all psychology Stage 1 and Stage 2 large courses.

We implemented three major types of blended learning materials, briefly described below:

- **Interactive Online Learning Modules:** Every week the statistics and research methods lectures were accompanied by two interactive online modules (one related to statistics and one related to research methods; 24 modules in total). These interactive modules were not a compulsory part of the course assessments. The modules provided an opportunity for students to learn and revise their understanding of key course concepts using a mixture of information/examples presented on interactive slides and multiple choice questions. The online interactive modules were presented using SCORM Moodle packages (created using Adobe Captivate application). Using these modules students could access and interact with the material at any time and then assess their knowledge at different times (usually at the end of the week) by revising the knowledge and answering short questions included in each module. An animated audio version was also trialled to assess student's preference for different mediums of learning and one Moodle Lesson module was used for overall revisions in the final week of course
- **Weekly Online "Test Your Knowledge" Quizzes**: The weekly quizzes were made available each week (starting from week 2) and contained 20 multiple-choice questions (MCQs), 10 relating to the statistics component and 10 relating to the research methods component. The questions covered a range of material that directly related to the weekly textbook/assigned readings and lecture content. Questions were a mix of identifying definitions and applying concepts to novel scenarios. The time limit for completion was 15 mins (i.e. on average 45 s per question). This time limit was

used after extensive testing in other online courses to ensure sufficient time to read and answer the question (across of a range of reading abilities) and to minimise time spent searching reference material for answers. The same time limit was utilised in the two in-session exams and allowed students to practice and experience the level of understanding expected throughout the course. These quizzes were made available for the entire duration of the course once they were released, and students were required to attempt each quiz at least once by the end of the semester to earn 1% (total of 11% from weeks 2-12). This loose deadline allowed students to attempt the quizzes at their own pace.

- **Online Tutorials:** Physical face-to-face tutorials were intermixed with purely online tutorials on alternating weeks. Online tutorials took place on weeks 3, 5, 7, 9 and 11. Online tutorial content involved a series of documents (typed handouts, book chapters, journal articles and newspaper articles) and/or links to online videos. This content was then assessed using a Moodle quiz. Students were provided with clear instructions indicating what order to read/watch the online materials and when to attempt the quiz. The purpose of the quiz was 2-fold: (1) it allowed for the assessment of tutorial participation, and (2) allowed students to assess and refine their understanding of the online materials. Students had unlimited access to the tutorial materials, but the quiz was only kept open for the week in which the tutorial was set (e.g. The online tutorial for week 3 was made available on Monday morning of week 3 and closed by Monday morning of week 4). Thus, online tutorial completion (measured by completing the quiz which was only made available after accessing all the pre-requisite online materials) was time-limited as the content was the focus of more advanced discussion in the face-to-face tutorials on the following weeks.

While the literature on blended learning is growing fast, most interactive and blended learning strategies and materials are primarily scrutinised regarding either their technological characteristics or more pedagogical aspects behind the intended mode of delivery (Garrison and Kanuka, 2004). Relatively little is known about the ways in which students engage with the material delivered via educational technology and many of the approaches and practices associated with flexible learning have not been extensively tested (Lust et al., 2011; Rich et al., 2014). Here we address this gap by taking a different approach that is uniquely based on the quantitative analyses of the patterns of engagements with blended learning materials and its relationship to the course outcomes. Specifically, we ask the following questions:

- What is the level of engagement with blended learning materials: Frequency and time of students' engagement (*Section 5.2.1*)
- What is the relationship between measures of student engagement with blended learning materials and course outcomes, and which blended learning activities best predict successful course outcomes? (*Section 5.2.2*)
- Can we measure the effectiveness of implemented changes and improvement caused by these changes? (*Section 5.2.3*)
- What is the student experience of the blended learning resources? (*Section 5.2.4*)

5.2 The strategies for evaluating the project and its outcomes

5.2.1 Measuring the level of engagement with blended learning materials: How many times and when do students engage with blended learning materials?

Moodle logs, Activity Reports and Activity Completion tools were used to track the level and characteristics of engagement with blended learning materials in PSCY1111 students (N=359) throughout the session. Overall, we have observed very high levels of usage of all online learning and assessment activities, which are detailed below. The interactive learning modules (24 in total), weekly formative assessment quizzes (11 in total) and online tutorial quizzes (5 in total) were accessed an astonishing 11588, 6114, and 1788 times respectively. The raw number of attempts for interactive learning modules, weekly revision and online tutorial quizzes for each week of the session are plotted in the Figure 1 below, showing a strong support for the notion that usage of both interactive learning modules and the quizzes was continually high.

Furthermore, the usage for interactive learning modules and weekly revision quizzes clearly increases in the lead up to each of the three major assessments. There is a pronounced spike in the use of these materials that is linked to revision for relevant major assessments in this course: i.e. the two in-session multiple-choice question exams in Week 5 and Week 9 respectively and the final exam. There is also a large peak in usage in the final week of the course that is due to the deadline for attempting weekly formative assessment quizzes for course marks. However, the peak of the same magnitude is observed for the interactive learning modules, which were purely optional and did not have any assessable component. Overall, this engagement with the non-assessable component strongly suggests that students willingly engaged in revision and learning opportunities provided by these resources.

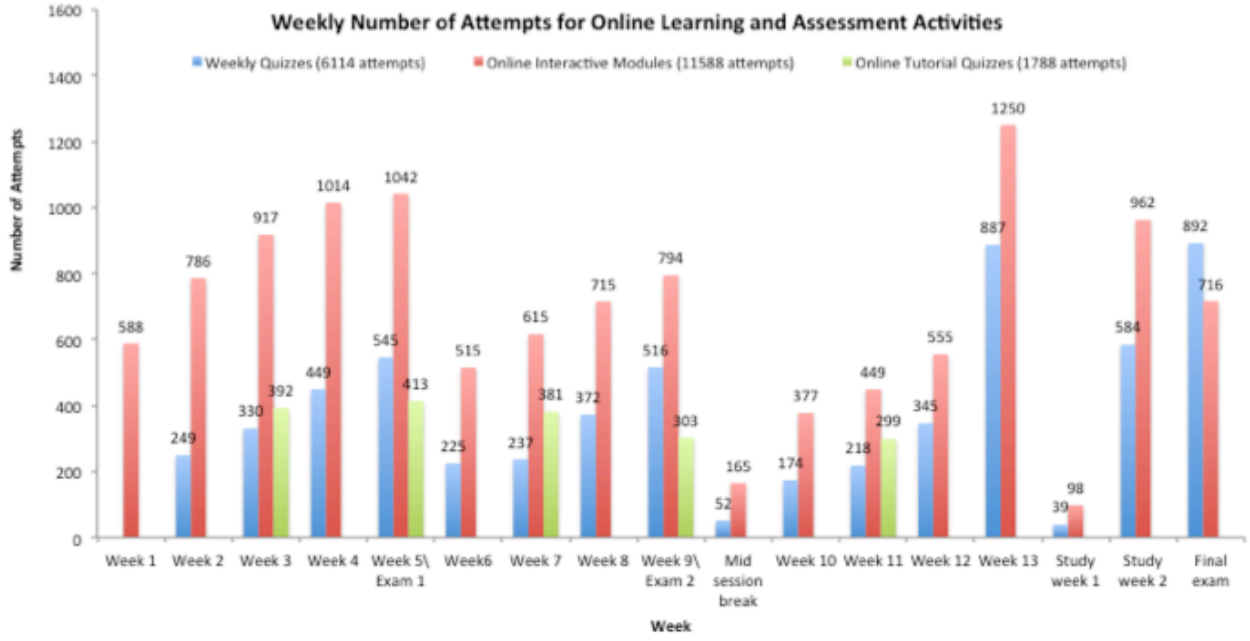

Figure 1: Total number of attempts for online formative assessment quizzes (blue), interactive learning modules (red) and online tutorial quizzes (green) plotted for each week of the session.

The day of the week and the time of day when online interactive modules and formative assessment quizzes were on average accessed are shown in Figures 2 and 3 below. Both figures show that the usage for all three types of blended learning materials show very similar trends and seem quite dispersed across days of the week and hours of the day (except seemingly when they sleep (midnight – 8 a.m., and eat dinner 6p.m.- 8 p.m.). This general pattern suggests that students vary in their preferred study habits and available study times. However, both graphs reveal a strong trend indicating that students generally chose to complete their online study at times when normal university teaching is not possible. Specifically, students tended to attempt interactive online exercises and weekly revision and online tutorial quizzes on Sunday and at the end of the day (8pm-Midnight). Taken together, it is clear that a large number of students chose to interact and learn outside of University teaching hours, and that the existence of these blended learning materials clearly afforded such a possibility.

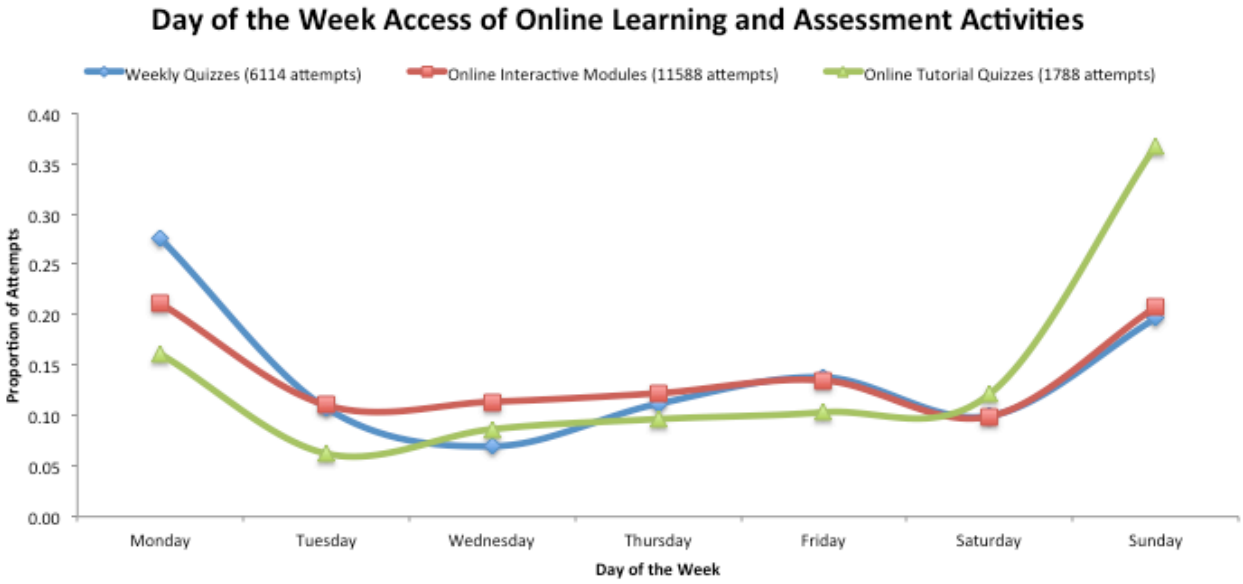

Figure 2: Day if the week when online formative assessment quizzes (blue), interactive learning modules (red) and tutorial quizzes were assessed, averaged across weeks.

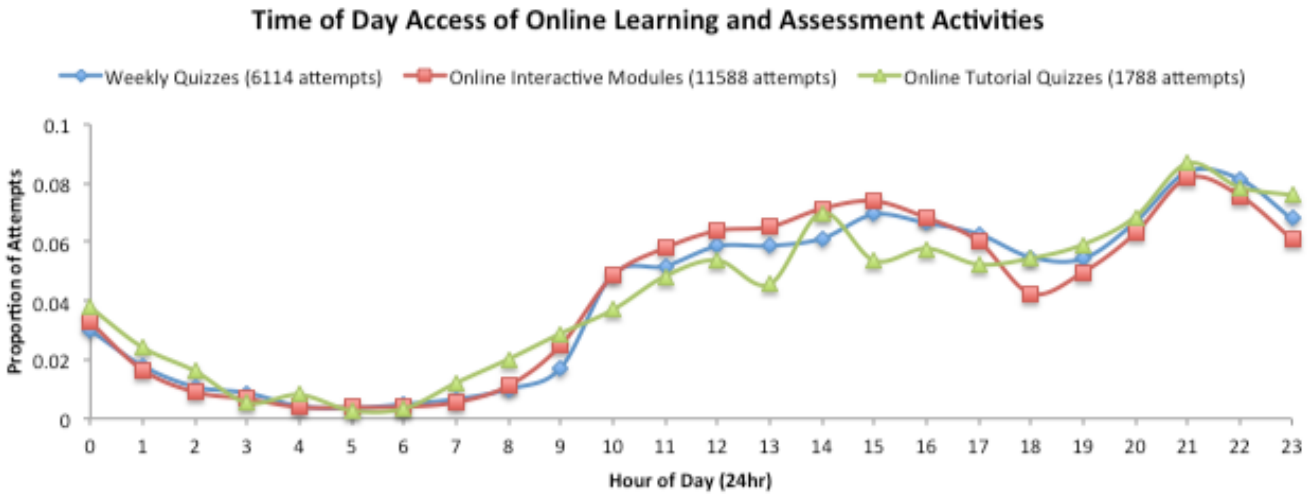

Figure 3: Time of day when online formative assessment quizzes (blue), interactive learning modules (red) and tutorial quizzes were accessed, averaged across weeks.

In summary, for each type of online learning and formative assessment materials we can see relatively high engagement with these materials with a high number of students choosing to engage with various activities. Averaging the number of attempts across all blended learning materials of the specific type (Figure 4), we see that most students made at least 1 attempt with various online activities (ranging from 45% for the interactive learning modules to 50% and 60% for the weekly revision and online tutorial quizzes respectively). However, a substantial number of students engaged with the blended learning materials 2 or more times (ranging from nearly 20% for online tutorial quizzes to just over 30% and 40% for the online tutorial and weekly revision quizzes respectively), suggesting that they are taking advantage of the freely available material online to either refresh their knowledge or re-testing themselves after revising the material further. This level of flexible revision and practice within the week would not be possible in a standard face-to-face context.

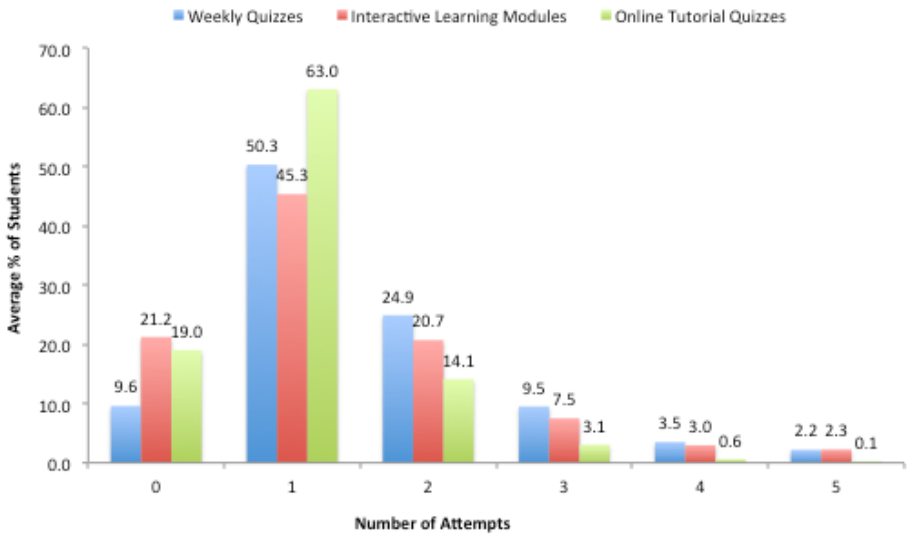

Figure 4: The average pattern of engagement with weekly revision quizzes (blue), interactive modules (red) and online tutorial quizzes (green).

However, this analysis has also revealed that a small proportion of students did not engage with online learning activities, resulting in, on average, 10% of students with zero attempts for weekly online quizzes; 15% for online tutorials and 20% for the interactive learning modules respectively. In the subsequent sections we investigate whether the use of blended learning materials differ between different student groups and whether it is associated with different course performance and outcomes.

5.2.2 Engagement with Blended Learning Materials and the Relationship with Course Outcomes

In order to better characterise the association between engagement with blended learning materials and course outcomes we measured the frequency of the use for each of the three types of blended learning materials. The descriptions of these measures, together with the associated descriptive statistics are detailed in Table 1 below. These statistics, as well as all analyses in the subsequent sections of this report, were based on the sample of 334 students for which there was a complete data set for all measured variables. The sample represented 94% of the total student cohort in this course and consisted of 66% female and 34% of male students; 82% students with English language background and 18% of students with language background other than English. The majority of students, 76% were at Stage 1 of their studies with 14% and 10% of students at Stages 2 and 3 respectively.

Table 1: Completion measures and the associated descriptive statistics for the three types of blended materials

Weekly Revision Quizzes	Interactive Online Modules	Online Tutorial Quizzes
Count of completed and graded quizzes (out of 11)	Count of modules for which there is a record of answered mini-quiz questions (out of 24)	Count of completed and graded online tutorial quizzes (out of 5)
Mean: 10.25 SD: 1.913 Median: 11 Range: 0-11	Mean: 19.77 SD: 6.831 Median: 24 Range: 0-24	Mean: 4.55 SD: 0.944 Median: 5 Range: 0-5

The levels of completion of interactive online modules and online tutorial quizzes differed between male and female students. Overall, compared to male students, female students had higher interactive learning modules ($t=-2.01$, $p<0.045$) and online tutorial quizzes ($t=-2.14$, $p<0.033$). Mean completion rates for male and female students were 18.71 and 20.3 (out of 24) for interactive learning modules and 4.39 and 4.63 (out of 5) for the online tutorial quizzes. Male and female students did not differ in the completion of weekly revision quizzes. Also, there were no significant differences in completion measures between students with English and other languages background.

The measures of overall course outcomes were the final exam and overall course grades, while the individual course outcomes included two in-session exams and two assignments. The detailed descriptions of these course outcomes measures are provided in Table 2.

Table 2. Assessments included in the course and the composition of the overall course grade.

Assessment Task	**Description**	**Weight**
In-session exam 1	Multiple-choice quiz covering the material presented throughout weeks 1-4 (inclusive) in lectures, online activities, weekly quizzes, and suggested readings.	5%
In-session exam 2	Multiple-choice quiz covering the material presented throughout weeks 1-7 (inclusive) in lectures, online activities, weekly quizzes, and suggested readings.	9%
Final exam	A combination of multiple choice and short answer questions. Questions were answered on the basis of all material covered in weeks 1-12 (inclusive).	30%
Assignment 1: Research study critique	Students were given a study that they had to critically evaluate for its methodological soundness.	15%
Assignment 2: Research study design	Students were given a research question and had to design an experiment to test it.	20%
Completion of weekly quizzes	Weekly quizzes provided students with an opportunity to revise and deepen their knowledge of key concepts in the course. 1% of the mark was awarded for completion of each of the 11 quizzes in the course.	11%
Completion of online tutorial activities	These activities were designed to prepare students for face-to-face tutorials. 2% were awarded for the completion of each set of activities – 5 in total.	10%

There were no statistically significant differences between male and female students in any of the course outcome measures. However, students with English language background performed higher overall ($M=74.42$) than students with language background other than English ($M=66.16$; $t=2.82$, $p<0.005$).

For each of the three types of blended learning activities we calculate bivariate correlations between usage level and a wide range of individual and overall course outcome measures, detailed in Table 3.

Table 3. Bivariate correlations (Pearson r) between completion rates of blended learning activities and individual and overall course outcomes.

	Weekly Revision Quizzes	Interactive Online Modules	Online Tutorial Quizzes
Overall course grade	0.330****	0.332****	0.441****
Final exam	0.231***	0.257****	0.383****
In-session exam 1	0.168**	0.267****	0.311****
In-session exam 2	0.321****	0.333****	0.443****
Assignment 1	0.209***	0.112*	0.287****
Assignment 2	0.171**	0.107	0.169**

**** p<0.0001; ***p<0.001; **p<0.01; *p<.05

- The count of completed **interactive online modules** was positively and significantly correlated with all course outcome measures except Assignment 2 (which is just at the threshold of statistical significance). This is a remarkable outcome given that the use of interactive online modules was not mandatory and was not awarded with any participation marks. Thus, relatively high and significant correlations observed here are strong and clear evidence that increased usage of this type of blended learning activities is associated with better performance across a wide range of course outcomes.
- The count of completed **weekly online revision quizzes** was positively and significantly associated with the increased level of performance across all course outcomes. As previously indicated, the completion of weekly online quizzes was credited with 1% participation mark with a maximum total contribution of 11%. Consequently, when determining the level of association with the overall course grade, the overall course grade was adjusted so that it did not include the quiz completion component (11%). Nevertheless, the positive association between the completion rate of revision quizzes and better overall course grade remained highly significant.
- Similarly, when calculating the correlation between the completion rate of **online tutorial quizzes** and the overall course grade, the overall course grade was adjusted so that it did not contain this component. Despite this, the high positive association remained indicating that higher rate of completion of online tutorial quizzes was associated with the better overall course performance. This was the case for the association between the completion of online tutorial quizzes and all other course outcome measures.

Overall, there are strong positive relationships between the use of online learning and formative assessment resources, and course performance in individual assessments and the final course grade alike. As the completion rates of interactive online modules, weekly formative assessment quizzes, and online tutorial activities increase, so do the indices of course performance. It is important to emphasise that even though this correlational analysis does not imply a causal relationship between the variables, the associations are strong enough to suggest promising course intervention strategies.

In addition, multiple regression analysis allowed us to determine which blended learning activities were uniquely associated with the overall improvement in course grade as our dependent variable. Again, the overall course grade was adjusted so that it did not include the completion component for the weekly revision and the online tutorial quizzes. This analysis further extends correlational analyses to show that the three forms of online engagement uniquely contribute to the positive relationship with overall course outcomes as detailed in Table 4. This suggests that they are not measuring the same thing i.e. generic online engagement. It is also noteworthy that the completion of online tutorial quizzes emerged as the strongest predictor of overall course performance. Presumably this is related to the fact that the maximum score on this measure required that the successive regular deadlines were met in timely fashion, a characteristic requiring greater level of conscientiousness and better time management skills.

Table 4. Predicting students' overall course grade from the frequency of use of three types of blended learning activities

Overall equation	Adjusted	R^2	F	Sig
		0.181	25.48	0.001

Predictor	Beta	t	Sig
Completion of Interactive Online Modules	0.124	2.313	0.021
Completion of Weekly Quizzes	0.134	2.469	0.014
Completion of Online Tutorial Quizzes	0.296	5.229	<0.001

5.2.3 The effectiveness of implemented changes and improvement caused by these changes

Some of the content of PSYC1111 Measuring Mind and Behaviour (in 2015) was previously taught as two smaller, secondary-stream components of two very large first-year psychology courses (in 2014). As such, the main characteristics of scientific approach, research methods and data analysis were formally assessed in the final exams of these courses. Given that these

topics were expanded and addressed in greater depth in PSYC111 Measuring Mind and Behaviour, we could track the actual improvement in students' understanding of these key concepts by retesting them with the same final exam material that was used when these concepts were previously taught within small components of other courses. Specifically, the re-test component consisted of 30 multiple-choice questions that were combined with the novel final exam material (additional 30 multiple choice and 30 short answer questions) for PSYC1111 Measuring Mind and Behaviour.

The comparison was based on an individual item analysis for the overlapping multiple-choice exam items in 2014 and 2015 final exams and showed a large average improvement as illustrated in Figure 5 below.

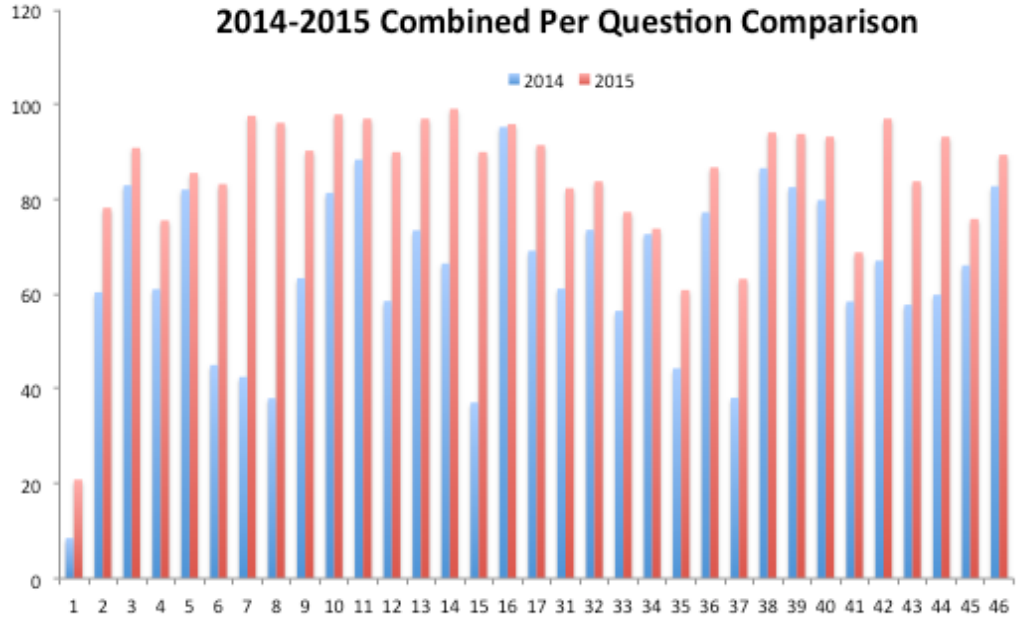

Figure 5: Average correct level for each question in years 2014 and 2015 in blue and red columns respectively. The significant and substantial improved performance is obvious for each of the questions involved

5.2.4 Student experience of the blended learning resources

At the end of the course we administered a custom-made course evaluation survey to specifically target students' experience of blended learning materials in the context of 1) overall course experience; 2) course resources; and 3) face-to-face and online tutorials.

5.2.4.1 Overall Course Experience

In this section the students were asked to rate the following questions on a scale from Strongly Disagree (1) to Strongly Agree (5) as anchoring points:

- I enjoyed the course.
- I found the course challenging
- I found the course useful for other courses
- I liked the mix of online components with traditional face-to-face lectures and tutorials
- I think there should have been more online components
- I think the online components should not have been compulsory/graded

The average ratings for each question are shown in Figure 6. Overall, students enjoyed the course, found the content challenging and strongly indicated that the content was useful in other subjects. With regards to the online components, students liked the mix of online and face-to-face components, however they also indicated that they did not have a strong preference for more online materials. Students also had a strong preference that the use of online materials is compulsory and graded. In other words, although students engaged with non-compulsory online materials to a high rate, nevertheless they preferred to see their efforts in engaging with the online materials rewarded with participation marks.

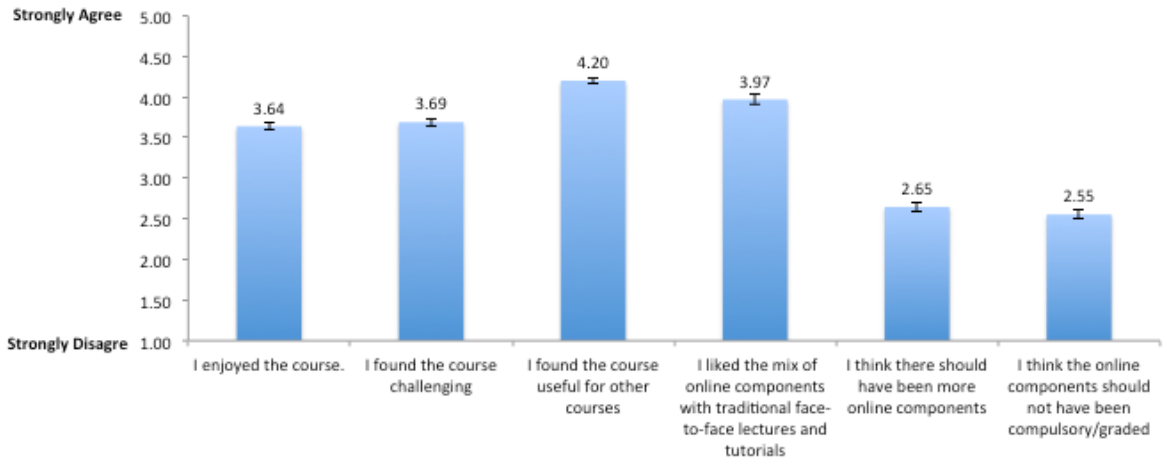

Figure 6. Overall course experience ratings (N=334). Different questions are shown on x-axis. The scale represented on y-axis included the following points: Strongly Disagree (1), Disagree (2), Neither Disagree nor Agree (3), Agree (4), and Strongly Agree (5). The error bars represent the standard error of the mean

There were no significant differences between ratings of male vs female or English background vs non-English background students on different questions, except for how challenging the course was perceived. Female students found the course more challenging than male students (3.81 vs 3.45 for female and male students respectively; t=3.579, p<0.001).

Correlations between components of overall course experience

Follow up bivariate correlations on the course experience ratings are detailed in Table 5 and suggest that students who liked the course were more likely to find the material useful for other courses (r=0.432, p<0.0001), more likely to have enjoyed the mix of online and face-to-face content (r=0.381, p<0.001) and thought that there could have been more online materials (r=0.125, p<0.05). Students that liked the course were also most likely to think that the online materials should have been compulsory/graded (r=-0.315, p<0.001). It is interesting that there was no correlation between enjoyment of the course and the perception of the course difficulty (r=0.033, n.s). Indeed, the perception of the course difficulty did not correlate with any of the other variables except for a small positive relationship with the ratings of usefulness for other courses (r=0.16, p<0.01).

Table 5. Bivariate correlations between different aspects of the overall course experience, usage of online materials and overall course success.

	Enjoyed the course	Found it challenging	Useful for other courses	Liked the mix of online and f2f	Wish more online materials	Online not compulsory
Enjoyed course	-	0.033	0.432***	0.381***	0.125*	0.315***
Found it challenging	-	-	0.16**	0.006	-0.092	0.003
Useful for other courses	-	-	-	0.312***	0.0019	-0.224***
Liked the mix of online and f2f	-	-	-	-	0.445***	-0.456***
Wish more online materials	-	-	-	-	-	-0.175***
Quizzes completion	0.232***	0.017	0.129*	0.177***	0.116*	0.281***
Modules completion	0.306***	0.002	0.210•••	0.330***	0.181***	0.325***
Online tutorials completion	0.295•••	0.035	0.180•••	0.184***	0.0035	0.237***
Overall course grade (wto online completion)	0.304***	0.175***	0.268***	0.195***	0.043	0.229***

**** p<0.0001; ***p<0.001; **p<0.01; *p<.05

Other notable correlations indicate that higher ratings for the mix of online and face-to-face materials are associated with higher ratings for more online materials (r=0.445, p<0.001) and that they should be compulsory (r=-0.456, p<0.001). Students who liked the mix of online and face-to-face materials also thought that the course was more useful for other courses (r=0.312, p<0.001).

Interestingly, the dimensions of the overall course experience were associated with both, the completion rates of online blended activities and overall course performance. Specifically, the higher ratings of course enjoyment, the mix of online and face-to-face materials, wish for more online materials and the view that online materials should be compulsory were all associated with higher rates of completion for online activities. Similarly, the overall course grade (without the online completion component for online revision and tutorial quizzes) was associated with higher levels of course enjoyment, lower ratings of course difficulty and a greater liking of the mix of online and face-to face components. Students who performed better in the course also preferred that online activities were compulsory.

To examine whether these associations can uniquely predict the overall course performance, we ran a multiple regression analysis in which the course experience variables were added to the completion rate of online activities, which were previously found to uniquely predict the overall course outcome. The results of this analysis are presented in Table 6 and indicate that course enjoyment, perception of the course difficulty and whether it was found useful for other courses were all significant positive predictors, uniquely able to account for a portion of variance associated with improved overall course performance.

Table 6. Predicting students' overall course grade from the frequency of use of three types of blended learning activities

Overall equation	Adjusted	R^2	F	Sig
		0.280	18.11	0.001
Predictor		Beta	t	Sig
Completion of Interactive Online Modules		0.145	2.788	0.006
Completion of Weekly Quizzes		0.103	1.976	0.049
Completion of Online Tutorial Quizzes		0.239	4.270	<0.001
Enjoyed the course		0.122	2.100	0.029
Found the course challenging		0.225	4.663	<0.001
Found the course useful for other courses		0.182	3.388	<0.001
Liked the mix of online and face to face		0.038	0.709	0.479

5.2.4.2 Experience of Blended Learning Materials in the Context of Other Course Resources

We also considered blended learning materials developed as a part of this project in the context of other course resources that are available online. For a direct comparison and benchmarking purpose we chose lecture notes, lecture recordings and discussion forums and asked students to report 1) how much they used the resource; 2) how much they liked the resources and 3) whether they perceived them as useful. The average usage, liking, and usefulness ratings for all tested resources are depicted in Figure 7.

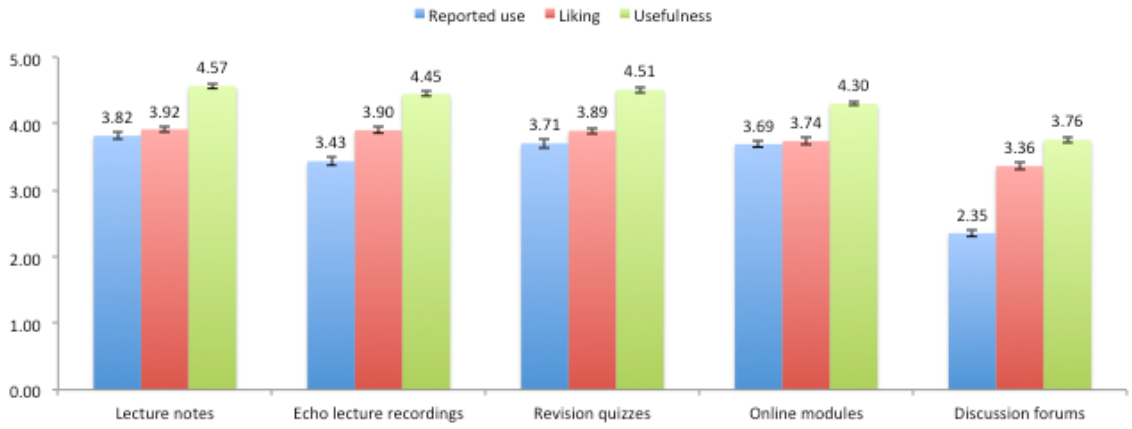

Figure 7. Ratings of the frequency of use, liking and perceived usefulness of different types of course resources (N=334). Different resource types are indicated on x-axis. The scale for liking and perceived usefulness was the same as described earlier in the text. Resource use was reported on a scale which included the following points: Never (1), Once a month (2), Fortnightly (3), Once a week (4), and Several times a week (5). The error bars represent the standard error or the mean.

Regarding the reported use of these resources, the least used resources were Discussion forum and Lecture Recordings. Their reported usage was significantly lower than that of any other resources. The reported usage for other types of resources did not significantly differ. The ratings of how much these resources were liked indicate that with the exception of Discussion forum, all other types of resources were well liked and to a comparable degree. A similar pattern was observed with the ratings of perceived usefulness of these resources.

Our analyses also indicate that there was a statistically significant difference between males and females in the reported use of Lecture notes (t=3.321, p<0.001) and Lecture recordings (5.749, p<0.001). In both cases males reported significantly lower frequency of use these resources than females. Male students also gave significantly lower ratings for how much they liked Lecture recordings (t=4.055, p<0.001) and Discussion forums (t=2.235, p<0.026). Consistent with this trend, male students also reported lower perceived usefulness of Lecture recordings (t=4.529, p<0.001) and Discussion forums (t=2.346, p<0.015).

With the Revision quizzes and Online modules there were no differences between males and females in their reported use, liking and the perceived usefulness. Also, there were no differences between students from English and non-English language background regarding the reported use, liking, and perceived usefulness of these resources.

Overall, these comparisons suggest that the reported use, liking and perceived usefulness of blended learning materials is as high as lecture notes and lecture recordings, presumably one the most frequently used resources. However, we have found evidence suggesting that the level of use, satisfaction and perceived usefulness of these resources might be different in male and female students.

5.2.4.3 Comparison of Face-to-Face and Online tutorials

Our final comparison concerned face-to-face and online tutorials. For each of the face-to-face and online tutorials, students rated how much they enjoyed particular tutorials and the extent to which they found that particular tutorial useful for the understanding of course material. The responses were averaged over 5 face-to-face and 5 online tutorials and the average percentages of each category of responses are plotted in Figure 8.

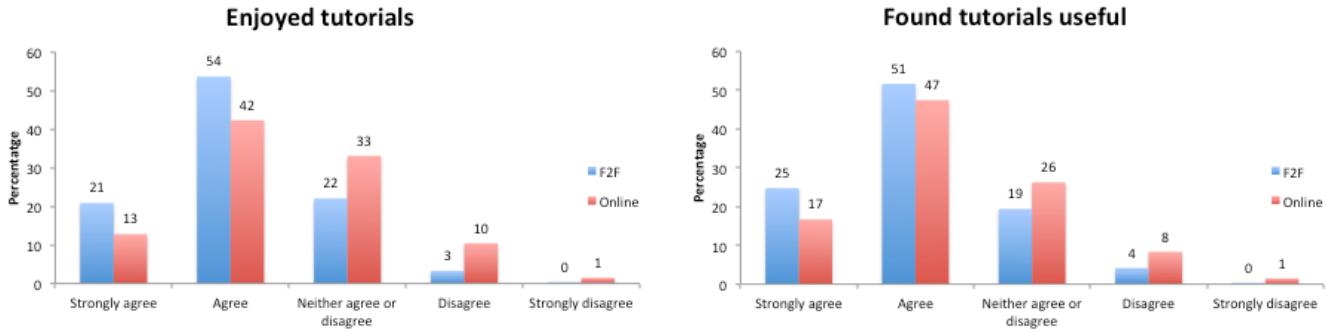

Figure 8. Percentage of responses regarding enjoyment and perceived usefulness of online and face-to-face (F2F) tutorials (N=334).

Again, we can see the remarkably similar responses regarding how much students liked both types of tutorials and whether they found them useful. The average ratings of enjoyment and perceived usefulness were somewhat higher for the face-to-face (3.96 for enjoyment and 4.01 for usefulness) compared to the online tutorials (3.61 for enjoyment and 3.75 for usefulness). At the surface level these findings are consistent with the overall preference for, and the superiority of, the face-to-face teaching mode. However, we also believe that the ratings for the face-to-face and online tutorials influence each other in a reciprocal way so that the use of supplementary online preparation for tutorials and other online activities is an effective way to increase the depth of discussion in traditional face-to-face component of the course and facilitate the flipped classroom delivery mode.

6. Project outcomes and deliverables

This project has delivered an empirically-based model of how to develop and evaluate blended and adaptive learning opportunities that enable more flexible and personalised engagement with course content both online and through the traditional as well as the more interactive, “flipped” face-to-face interaction. We have developed a blueprint for a customisable set of guidelines and designing principles in both creation and analysis of blended learning environments to be used by Psychology, and wider UNSW community staff in the roll-out of innovative blended learning and formative assessment initiatives.

The blended learning resources developed, implemented and evaluated in this project have transformed the existing and static face-to-face learning and teaching methods in large first year Psychology courses into interactive and personalized learning

opportunities for the students, and more efficient teaching and assessment opportunities for lecturers and tutors. The new blended learning initiatives have provided students with opportunities for deep and adaptive (thus personalized) learning of the fundamentals of critical scientific thinking and literacy, as well as for understanding the scientific, evidence-based approach. At the same time, these initiatives have allowed for a marked improvement in the quality of both formative and summative assessment practices.

The developed blended learning resources have created opportunities that promote analysis, synthesis, and evaluation of the class content and the ability to apply this knowledge to various fields of research in psychology and to transfer this knowledge to a broad range of scientific disciplines.

7. Sustainability of outcomes

From its conception, this project has aimed to develop, implement, evaluate and disseminate the use of effective blended learning materials and activities across the Psychology curriculum. In developing new blended learning resources, we purposefully avoided reliance on any commercially based platforms and fee-based access arrangements. The academic and project support staff developed resources that are high in quality, fit-for the course, original, and independent. A suite of newly developed blended learning opportunities is sustainable, easy to disseminate, and of considerable benefit and potential applicability across a number of other courses.

The expertise developed in the course of this project has been showcased in the School of Psychology as well as the promotion of course development and learning analytics tools and findings to establish the best-fit and most successful blended learning activities that enhance learning. The School of Psychology now has a Blended Learning Support Unit to continue developing and further supporting School-wide capabilities to harness the power of blended learning in the Psychology curriculum

8. Evaluation of Outcomes

The development of quality teaching and learning resources requires considerable expertise, effort and time and our experience has been no exception. In this project, we adopted an evidence- and evaluation-based approach for the selection, creation, implementation, and refinement of online learning and assessment activities and have not encountered any unexpected challenges during this project.

Our approach goes beyond simply arguing for the superiority of blended learning approach and we provide extensive empirical evidence and quantitative analysis regarding the ways students engage with different blended learning materials; the extent to which the use of blended learning resources is related to student learning outcomes, and importantly the student experience of the blended learning and traditional course materials. Our main findings indicate that:

- The usage statistics show a great level of engagement with all online activities even when they are not compulsory, and, to a large extent, outside of traditional University hours.
- The engagement with online interactive learning and formative assessment activities was positively associated with increased final exam grade and course success. In addition, different online activities have identifiable unique contributions towards predicting increased outcome measures.
- The course feedback, both standard CATEI and custom in-course surveys, show an overwhelmingly positive response suggesting that students liked the mix of online and face-to-face components
- Students' perceptions of and experiences with the blended learning resources were also significant predictors of course success.
- The use of supplementary online preparation for tutorials and other online activities is an effective way to increase the depth of discussion in traditional face-to-face component of the course and facilitate the flipped classroom delivery mode.
- The effectiveness of novel mode of delivery of course content is evident in the improved students' performance in final exam performance in these topics compared to previous cohorts.

In summary, newly developed blended learning opportunities succeeded in providing a more personalised, student-centered, flexible, 24-h learning environment in a large first year undergraduate Psychology course. Our usage analytics and analyses show that students willingly engaged with these novel learning opportunities, they liked them and most importantly, the novel

blended learning mode developed significantly improved course learning outcomes. Together, the outcomes of this project provide a successful, blueprint for empirically based and sustainable development of blended learning opportunities that enhance learning and their integration with physical, face-to-face resources across the Psychology curriculum.

Student testimonials:

- *"I loved every part of this course. I felt like I was being set-up to succeed which was the opposite experience in many other courses where it has always felt like you are set up to be continually tested."*
- *"I really liked all of the online material. The quizzes and tests are an excellent study source."*
- *"I really enjoyed the structure/formatting of the course. It was great the fact that the information learnt in lectures was carried over into online activities/quizzes and then later tutorials. I thoroughly enjoyed it, even though found it quite difficult at times."*
- *"The course was by far the most helpful and useful university course I have ever done. The learning model of a combination of face-to-face lectures, online tutorials and face-to-face tutorials enabled me to learn at my own pace."*
- *"The course consolidated the information more thoroughly and we have dedicated online tutorials most weeks which is heaps helpful. Tutorials every second week was also very practical and enabled us to do more at home rather than travelling to uni."*
- *"I like the way the course was constructed having a mix of face to face tutorials, online tutorials, online activities and face to face lectures. It helps a lot as in making sure that the students understand what has been discussed in lectures."*

Figure 9: Word Cloud Summary of CATEI comments, S2 2015; CATEI Overall Satisfaction Rate of 93%

9. References:

Garrison, R. & Kanuka, H. (2004) Blended learning: Uncovering its transformative potential in higher education. Internet and Higher Education 7 (2004) 95–105

Lust, G., Vandewaetere, M., Ceulemans, E., Elen, J. & Clarebout, G. (2011) Tool-use in a blended undergraduate course: In Search of user profiles. Computers & Education 57, 2135–2144

Rich, J.D., Colon, A.N., Mines, D., & Jivers, K.L. (2014) Creating learner-centered assessment strategies for promoting greater student retention and class participation. Frontiers in Psychology: Educational Psychology, doi: 10.3389/fpsyg.2014.00595

Van Doorn, J.R., & Van Doorn, J.D. (2014) The quest for knowledge transfer efficacy: blended teaching, online and in-class, with consideration of learning typologies for non-traditional and traditional students. Frontiers in Psychology: Educational Psychology, doi: 10.3389/fpsyg.2014.00324

10. Financial statement acquittal of funds

All expenditure should be reported in whole dollars.

	Budget $	Expenditure Actual $	Committed[1] $	Balance $
PERSONNEL				
Stage 1 (Krebs-Lazendic & Panayi)	91,200.00	65,521.00		25,679.00
Stage 2 (Krebs-Lazendic & Panayi, RA)	92,400.00	110,612.00		-18,212.00
Stage 3 (Krebs-LazHutton-Bedbrook, RA)	94,000.00	101,467.00		-7,467.00
Subtotal				
	277,600.00	277,600.00		-
PROJECT SUPPORT				
Stage 1 - Software and Consumables	7,949.00	1,270.00		6,680.00
Stage 2 - Software and Consumables	5,000.00	12,834.00		-7,834.00
Subtotal				
	12,949.00	14,103.00		-1,154.00
PROJECT ACTIVITIES				
Stage 3	5,000.00	3,077.00		1,923.00
Subtotal	5000.00	3,077.00		1,923.00
TOTAL	295,549.00	294,780.00		769.00

[1] Committed expenditure represents funds for purchases or personnel costs that have already occurred and are awaiting invoices/payments