

Reporting on experiments with research integration in teaching

Name
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Course Name
<i>Farmaceutisk Biologi.</i> https://kurser.ku.dk/course/sfab20027u/2020-2021
Study Board
<i>Pharmaceutical sciences</i>
Level and class size
<i>BA. 2nd semester, 207 students</i>
Description of the experiment
<i>Generally, the students are divided in 8 large teams of 25-30 students. For the experiment, each of the 8 teams is divided in smaller groups of 5-6 students. They are given a specific compound (from compound libraries generated at ILF) which will be unknown to the students and that may affect a specific reaction in different cellular metabolic pathways. The potential metabolic effect of the compounds is not known (not even by the researchers that generated the compounds) and this is the main contribution of the students. Through a series of analytical methods including live-cell bioenergetics assay (Seahorse XFe96 Flux analyser), ATP NovoStar assay, and metabolic mapping; and by using different biological preparations from the mouse brain, the students can determine the toxicology profile on energy metabolism of different compounds. The students analyse the data and determine whether the compounds have an effect on metabolism. The results are reported in one-page summary. The reproducibility and veracity of the results is verified across teams and supervised by an appointed (student)teacher from the teacher team. In that way the students produce real new knowledge, they learn about the importance of replication of the experiments, and enjoy the experience of having their work in a written product.</i>
Outcome for the students
<i>The students gained an understanding on how to conduct a small research project where the outcome of the experiments is not known. They became familiar with approaches to address a specific scientific question, creating hypotheses, designing experiments to test such hypotheses, planning and doing experiments, as well as analyzing the resulting data and being able to discuss and produce a written report. Some of the students were also able to critically discuss the data during the oral presentations. The students were more engaged, more attentive and overall their performance in the lab was qualitatively better compared to the average students from previous years. This was evident based on the quality of the oral presentations and the written reports. According to the course evaluation, the students had very positive feedback. For instance, they stated “- God og spændende lab, fedt at det var rigtig forskning der bliver brugt i virkeligheden” The students also became more aware of the impact of their work in the lab and felt ownership for the results they were producing.</i>
Outcome for the research
<i>Significant data was generated by the 8 teams of student from testing the compounds in different assays, the number of replicates is substantial and the data can be verified and analyzed as whole data set, Therefore, it is likely that interesting conclusion can be drawn from the data sets upon final analyses.</i>
Interaction between teaching, research and exams
<i>A set of lectures with basic biochemistry background as well as class hours needed to understand and design the content of the experiment preceded the actual lab work. Thus, the experiment helped the students consolidating the knowledge acquired during the lectures as both were linked directly. This was also reflected in the exam as some students used the experiment as example to</i>

illustrate specific metabolic concepts in the exam. From several answers in the exam questions it was also clear that the students could integrate and apply what they have learnt from the lectures and the reading material into “real-life” research questions.

Adapting of the experiment

Due to COVID restrictions, the experiment had to be adapted to comply with the safety measures and regulations in place at the time. Amongst the adaptations, the number of assays had to be reduced as well as the time the students were in the lab. Only 3 type of assays were used instead of 4 and not all the students had the opportunity to test the compounds using all different assays but the students had access to the data produced by other students and had the chance of discussing them and understand how the results were generated in every assay. Without COVID-restrictions in place there is no need for further adaptations.

Strengths and weaknesses

Strengths:

- The experiment facilitates the integration of knowledge and fulfillment of learning outcomes.*
- Improved engagement and student activation*
- Big data sets can be generated and replicated*
- The experiment has made the teaching activities more enjoyable for both students and teacher(s)*

Weakness:

- It is difficult to assess the outcome of the experiment objectively as it requires a comparative analysis of evaluation results, including exam grades from before and after the experiment is conducted.*
- The experiment requires many human, financial and time resources.*

Experienced challenges

- Adapting the experiment under COVID restrictions*
- Large variability across data sets*

The most important experience

The knowledge integration and acquisition was noticeably improved compared to the years previous to the experiment. In general the students appreciate being part of knowledge generation and they displayed improved motivation during the experiment. The implementation of the experiment might be time-consuming but the benefits for student and teacher outweigh the resource investment.

Will the experiment be conducted again?

The experiment can easily become a permanent part of the teaching in the FarmaBio course as it is aligned with the course description and learning objectives. If possible it will likely be conducted again next year.