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Revised teaching and learning approaches in PC-based exercise

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Introduction

This project report has been carried out in relation to the teaching course (Universitetspædagogikum JAN 2021) conducted from January 2021 to January 2022. The project suggest new teaching methods to SFAB20021U Molecular Pharmacology course which I have been involved as a teacher for the past 3 years. This Molecular Pharmacology course offers once a year in spring for the bachelor students. According to the course description they will learn basic theories, methodologies used in molecular pharmacology and how to integrate molecular biology, pharmacology techniques to elucidate the key role that plays in drug discovery process.

This course offers students the opportunity to learn about Molecular Pharmacology in theory and practice. The course is divided into three parts:

1) Workshops covering theory (3 weeks)
2) Laboratory exercises including planning and data analysis (4 weeks)
3) Oral Exam

Until 2019 the course was class room based physical teaching, but in 2021 due to COVID it was online (zoom) teaching. During the course time, I support and conduct Molecular Pharmacology course and assess MolPharm reports submitted by the students as a part of final oral exam (2020). This course has been running for several years, which I think does helped to revise the course material several times to achieve ILOs as mentioned in the course web page (Appendix A).

Some of the key aspects in for improving the course is the need of continued development/revision with an emphasis on current research ideas/work/achievements pursued in the teaching materials for the course. This will help the students to enlighten their goals on their future academic prospects. One other important factor which has been neglected in the early time of 21st century at least to some extend in certain field of higher education is student engagement. Engaging students could be facilitated through a dynamic learning process in the course to make sure that students play a key role as interactively as possible so that the teaching process is non-linear. Nowadays there are various ways to engage students like using pre-recorded videos, flipped class room, discussions/chat forum etc (Dumulescu et al., 2021; Eaton, 2017). The course coordinator who closely monitoring the process, could provide the necessary instructions so that the discussions should be related to the course, while sometimes the chat could evolve into rather unrelated subject. These discussions could later be made public/sharing (only after the permission from the students) so that these discussions could be useful for new students in the following years.

Students also play a key role in the improvement of course curriculum, where they could get a chance to provide online feedback about the course. This doesn't have to be detailed one, it could be an instant summary of what does student like/dislike about the course, ideas to improve the course from their perspectives (Rienecker et al., 2015).

Aim

I would like to improve and re-evaluate a PC-based tutorial (Workshop 2: Genetic engineering) which is a part of the SFAB20021U Molecular Pharmacology course. I will approach this task by explaining the problem associated with it, further describing step-by-step actions required to solve the issue followed by a revised teaching plan. I want to implement these changes in the coming spring 2022: SFAB20021U Molecular Pharmacology course. At the end of the course, we are planning to make a questionnaire for the students asking if they achieve the learning goals through these different teaching practices. While phrasing we choose the question in such a way that's the information is quantitative which could use later for conclusions.

Investigating the problem

The course curriculum spans 7 weeks of extensive workload (200 hours) covering basic to advanced molecular pharmacology techniques. Therefore, it is extremely time demanding and challenging for both students and teachers, where students might end up spending less time learning the topic deeply. While teachers must stay within the teaching program providing new information every day in such a pace that students might not keep up with it. This restrict students to acquire hands on experience in the field of molecular pharmacology, which is one of the competence students shall obtain at the end of the course. It is always demanding for the teachers to engage students constructively irrespective of the type of curriculum. Therefore, it is mostly overwhelming for the teacher to decide how deep or shallow teaching is required to meet the curriculum.

Despite of teachers' great efforts on creatively transferring knowledge for students using existing illustrative tools (power point slides) to make the lectures more interesting, students still left laid-back as the role of an audience. Even though sometimes there seems to be some active student participation through the lecture, such actions quickly decline resulting in a one-way lecture activity. This will eventually end up students acquiring flat surface learning which is a serious problem in teaching and since 2019 it has been a limitation for one of the topics in the Molecular Pharmacology course (Workshop #2: PC-based tutorial)

I want to address the problem by acknowledging three major factors associated with best teaching practice to engage students for achieving the intended learning outcomes (L. Rienecker & Ingerslev, 2015).

1) Good interaction
2) Positive teaching atmosphere
3) Within the allocated time, engage students to carry out the exercise efficiently

Before illustrating PCR in the PC-based tutorial, I will introduce the topic and provide essential background covering the technique (Appendix B). Even though students might remember PCR from their previous courses.

ILO's and evaluation criteria

At the end of the PCR tutorial, I want students to accomplish intended learning outcome not limited to:

- How to analyze DNA using PCR method?
- How to describe all essential steps of PCR technique?
- How to design forward and reverse primers for a specific PCR from target gene?
- How to clone the amplified target gene to the vector of interest?
- How to insert/delete tags in the N-terminus or C-terminus of the target gene

Hopefully soon in their near future projects they could apply this knowledge they have acquired during the lecture.

Even though the final exam of the course will not be used to evaluate the ILOs of this lecture, I will interact with the students through chat, questions and dialogues to understand how far I succeeded in teaching the topic per se. Through these efforts I assume that the assessment is aligned with the ILOs.

Previous years reflections after the tutorial

In 2019, 2020 the tutorial was offline while 2021 the whole course was online (Zoom). We (2 teachers) were involved in the tutorial (Appendix B). A short 10-minute introduction to the workshop (Power Point) followed by 30 minutes introduction to Molecular Cloning Tool (SnapGene). The rest 1 hour 20 minutes students worked in breakout rooms of 4 students each (12 break out rooms). We visited each breakout room in succession to examine students' participation in the tutorials. In all 3 years irrespective of changing the time schedule for introducing workshop and programs by using different timelines, it was still not sufficient to finish the tutorial in 2-hour time constrain. Despite of time issue we got good feedback from students who attend the workshop. Some of the feedback comments were as mentioned below

- Good interaction with the students in the breakout room.
- Assisted students to perform the exercise.

i. By explaining the answer right away if necessary, or
ii. Guiding them to figure out the solution themselves

- Provided a relaxed environment for students to ask questions/chat during the exercise for some groups not to every groups.
- Managed to keep students more vocal through constructive dialogue. Engaged students to get more studious in the exercise.
- I was playing a passive role to the students while helping in the breakout rooms
- Finally showed the excitement to be a good tutor

Even though there were some good feedbacks, we had some issue with the whole set up as mentioned below

- During online (Zoom) sessions not all students were willing to turn on their camera and microphones which makes it difficult to interact with all of them.
- There was very little time for individual discussion with all 12 group of students.
- The first breakout group had technical difficulties to share screen and sound quality was not the best to communicate with them.
- The second breakout group also had other challenges. Even though I had good interaction with the students, unfortunately the students did not understand how to proceed. However, I could guide the students to a certain extent, but it was therefore difficult to get an impression that the students could follow the tutorial. Probably here also time was a big constrain.
- The third breakout group misunderstood which exercise to work on. In the interest of time, I encouraged the students to continue with the workshop that they had started working on. Here, more than one student interacted with me. There was some good discussion between the students, and it was clear that the students did understand how to proceed further with the tutorial.
- Due to the time pressure, it was difficult to provide a relaxed environment for students in all groups to ask questions/chat during the exercise.

Therefore, I came up with this new plan from previous year's feedback from the students.

The new teaching plan

As discussed above being in the past years, we did not manage to finish the exercise completely in the allotted time schedule (2 hours). Even though we used different timelines for the below 3 steps, students couldn't manage to finish the tutorial. So, I am proposing a new teaching strategy as mentioned below which involves new teaching and learning activities to accomplish the result.

1. Pre-recorded videos, explaining step by step to an introduction to the Molecular Cloning Tool (SnapGene): 15 minutes.
2. Software demo with a worked example (Step by step guidance in the material provided before the exercise): 30 minutes (should be watched by students before the exercise).
3. We ask the students to perform it by their own using another example in the class: 105 minutes.

Both point 1 and 2 will be analyzed and rated by 1 master student (took molecular pharmacology course in 2021) and 1 research associate (didn't took the course). They will evaluate and provide their feedback about the whole new setup. This will be a good opportunity for me to make any necessary changes and later in spring 2022, I will introduce this to bachelor students at the course.

Discussion and conclusion

In 2021 due to COVID-19 restrictions being molecular pharmacology course is laboratory based exercise, students couldn't able to learn the techniques by hand, while teachers prepared video tutorials displaying how to carry on practical exercises in the lab referring to the molecular pharmacology techniques that is described as ILOs. Here students were just watching the video and no interaction between the student-teacher and lab was carried out. One of the solution we used in the pre-project of Universitetspædagogikum is to introduce virtual lab work, using SmartBuilder application. We provided "Testing for COVID-19 using RT PCR" an interactive application where students need to follow steps as how to at least virtually perform COVID-19 test using RT-PCR. These kinds of interactive oriented activities were helpful for the students to be confident to perform experiments

in the lab, which makes them less nervous to handle equipment's that are mostly very costly. Additionally, due to COVID pandemic PCR technology prevails in diagnosing people infected with SARS-CoV-2.

All these above-mentioned formats chat, active forums, podcasts, videos and virtual labwork could be integrated to the course in such a way that students felt more engaged in the course, rather than assuming that students are following 45 minutes lectures. At last students, teachers and content should provide a dynamic character to engage and responsibly delegate and share the knowledge while respecting and partially building on user knowledge with focus on the core ILOs (Schmidt et al., 2011). In the end, there should be a space to focus on research based and research integration using tools available from lab, collaborators, journal clubs, peer discussions and concept to prepare students for their carrier path.

References

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A Course description

https://kurser.ku.dk/course/SFAB20021U

SFAB20021U Molecular Pharmacology

Volume 2021/2022

EXPAND ALL

Education

BSc Programme in Medicinal Chemistry (BA i medicinalkemi - SCIENCE) - compulsory
BSc Programme in Pharmacy - elective

Content

Through an integrated approach of lectures, project work and laboratory exercises, the students will learn about central topics in molecular pharmacology, such as ligand-receptor interactions, recombinant techniques (cloning of drug targets, mutagenesis), expression systems (mammalian cell culturing), transgenic techniques, pharmacological assays (binding/functional assays), molecular probes, structure-activity relationships, gene-expression studies (mRNA/protein), data analysis and interpretation (GraphPad Prism etc).
During the course the students will work together in groups of 3-6. They will cover 4 themes and write up material used for both the practical work and examination.

Learning Outcome

Overall course objective
Molecular pharmacology is an important research field integrating molecular biology and pharmacology. The field is central to the drug discovery process. The objectives of this course are to provide a theoretical foundation of central molecular pharmacology terms and methodologies through theoretical and practical experience.

After completing the course the student is expected to be able to:
Knowledge

- understand central molecular pharmacology principles, methodologies and terminology
- obtain research-based knowledge of theory, methodology and practice within the field of molecular pharmacology
- describe molecular mechanisms of important drug targets, understand the use of cloned targets in research, and obtain knowledge about cell-based pharmacological assays
- explain how these principles and methods can be exploited in practical experiments aimed at reaching distinct research goals
- reflect on the subject molecular pharmacology in relation to the drug discovery process

Skill

- identify critical steps and describe technical details in relation to planning a pharmacological assay
- carry out experiments using common methods in molecular pharmacology
- calculate and interpret pharmacological data
- formulate 1-3 in a short report (technology and data sheets)
- present and discuss results in a relevant drug discovery/pharmaceutical context

Competence

- argue for choice of pharmacogical assay in a specific research situation
- transfer theories and principles to other areas of drug discovery
- translate theoretical knowledge into practice (assay design)
- collaborate and communicate effectively with other professionals with expertise in molecular pharmacology and related subjects
- comprehend molecular pharmacology in relation to drug discovery

Course information

Language	English
Course code	SFAB20021U
Credit	See exam description
Level	Bachelor
Duration	1 block
Placement	Block 3
Schedule	B
Course capacity	48 students: 24 seats reserved Students of BSc Programme in Medicinal Chemistry and 4 seats reserved for international students.
Course is also available as continuing and professional education	
Study board	Study Board of Pharmaceutical Sciences

Contracting department
Department of Drug Design and Pharmacology

B Workshop 2 (Genetic engineering) plan – theoretical and practical parts

Time	Activity	Title
45 minutes	Lecture	Recombinant DNA technology
45 minutes	Lecture	Expression systems
105 minutes	Tutorial	Analysis of m1 plasmid and cell line, demo and hands-on