Basil room
4.25-4.40pm

Providing authentic research experiences in a Life Sciences module: The MORE design

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The Life Sciences (LS) curriculum at the National University of Singapore (NUS) has limited practical time for students to conduct mini-projects that have real-life applications. Often, students are provided with detailed protocols to ensure that they are capable able to execute the practicals and obtain the expected results. Assessments of the practicals, if any, mainly test students' ability to collate data that are standard across the entire class, to write a short report, and perhaps answer questions that are usually covered in the lectures or tutorials. Such a "cookbook recipe" design of a life science practical lacks authenticity and is unable to offer students relevant "real-world" research experiences that are essential to prepare them for future work in the field. The move away from the 'cookbook' style practicals is increasingly becoming common elsewhere in Life Sciences undergraduate teaching and has been shown to provide better learning opportunities for students (Auchincloss *et al.*, 2014). In NUS, this is critical to ensure that Life Sciences students who have neither planned to participate in the Undergraduate Research Opportunities Programme in Science (UROPS) nor are involved in an Honours project are equally equipped with fundamental hands-on research skills.

Ideally, students at the higher level should have the opportunity to perform scientific inquiry as part of an authentic mini-project. In this presentation, we share our "Module Orientated by Research Experience" (MORE) design that incorporates elements we consider relevant for providing Life Sciences students with domain-specific and domain-general competencies to undertake a mini-research project. The MORE design was informed by the instructors' research experience and included tasks such as literature review, proposal preparation, protocol design, data collection and analysis, and research dissemination via scientific reports and presentations (Figure 1). This Year 3 level Life Sciences module (LSM) was held within constraints of five practical sessions, each lasting no more than 4 hours.

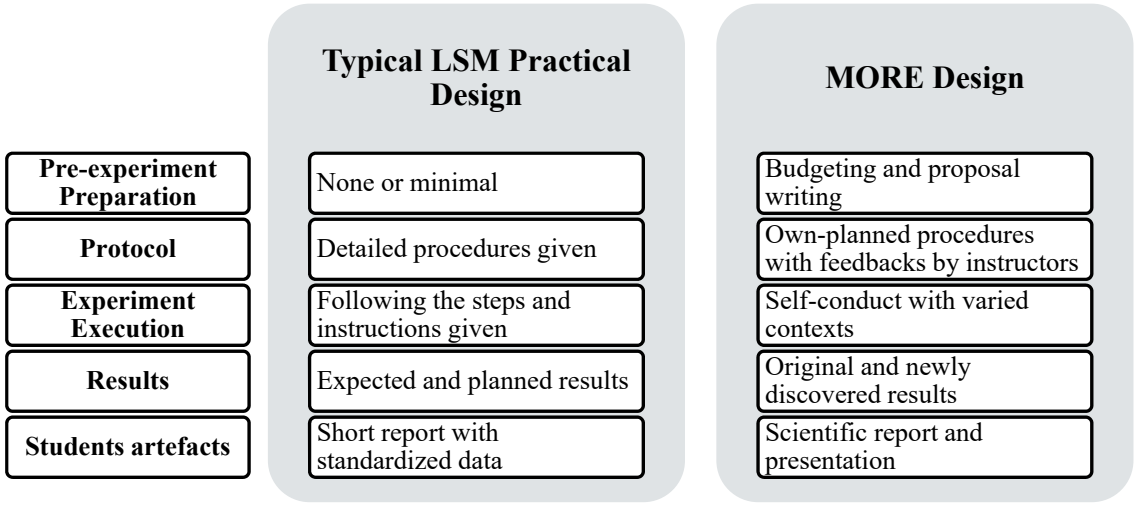

Figure 1. Comparisons between a typical Life Sciences module (LSM) practical design and the MORE design.

We also highlight aspects of our design that encompassed the core values from the framework for authenticity within the context of teaching through research proposed by Wald and Harland (2017). Namely, the three core criteria are:

I. **"Real world" corresponding tasks.** The students worked in groups of three, targeting an assigned problem based on a real-life drug-resistant fungal pathogen outbreak in clinics. The mini-research project required them to perform tasks similar to what scientific researchers do in the field. The students submitted a research proposal which consisted of literature background, proposed experimental flow and budgeting. Prior to the mini-project practical session, the students had to design their own experimental protocols and submit requests for materials and reagents they required for the experiments. The module instructors provided feedback on their proposal and protocols, allowing necessary adjustments to be made before carrying out the experiments. Data was collected and analysed by the students. A group presentation and individual scientific written report formed parts of the module assessment. Hence, authenticity was built into a typical LS module in the form of students being assigned a real-world problem that required a solution.

II. **The existential authentic self.** The students worked in groups of three, promoting self-awareness and responsibility among themselves. Considering that most of the students were undertaking a research project for the first time, the first two practical sessions were used to introduce the case scenario and provide opportunities to practice the laboratory techniques necessary for the execution of the mini-project. The students collaborated with each other to design protocols, organize and analyse results, and often to make arguments and decisions within the group. Post-practical debriefs and discussion sessions were held with the module instructors to provide students with necessary scaffolded guidance or suggestions throughout the process, particularly in cases where experiments yielded no usable results. Our mini-project served as a platform on which students could begin to enter the community of practice of researchers as legitimate peripheral participants (Lave & Wenger, 1991).

III. **A degree of meaning**. In order to inculcate a sense of project ownership, the students led the direction of their own project by critically analysing and interpreting their data after each session. The interpretations and decisions made from the data collected in one session determined the experiment they had to perform in the next session. Each member in a group contributed technically and intellectually to the progress of their project. The peer review exercise introduced in the module also encouraged the students to objectively and critically assess their peers. Here, our design provided an opportunity for students to contribute as a member of a research team, thereby heightening their sense of meaning in their learning.

We will also describe key limitations we faced rolling out the MORE design for the first time and to seek feedback from the audience for continual improvement. Finally, we would like to suggest that the MORE design might serve as a possible model for other practicals in the Life Sciences curriculum that have similar constraints, so that we can provide better learning experiences for our Life Sciences undergraduates

Keywords

Authenticity, research experience, collaboration

References

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