

SECTION

3

Assessment

Chapter 9: “It is really difficult to read scientific papers” - Teach me how!



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Introduction

A very high proportion of University students, including science students, leave their undergraduate degrees with limited ability to read or critically evaluate research papers.

By the time students reach their last year of an undergraduate programme they should be capable of dissecting a research paper in their field of study. With appropriate strategies and encouragement there is no reason this cannot be achieved in the majority of cases. Using this final year neuroscience module as an example and through the implementation of Universal Design Principles, we decided to improve each student's ability to read and understand scientific papers in the module topics we teach. The student thus learns about the module topics by extracting the information from relevant scientific papers. We use flexible tools and collaborative and interactive learning.



Figure 1: Relaxing with a scientific paper

Module Name	NEUR40020 Synaptic plasticity
Universal Design Principles	<ul style="list-style-type: none"> - Equitable use - Flexibility in use - Community of learners
Discipline	Neuroscience
Level	UCD level 4
College	Science
Learning Outcomes	<p>On successful completion of the module students should be able to:</p> <ul style="list-style-type: none"> - demonstrate an understanding of scientific papers in general and in this topic. - critically evaluate recent research findings in this field. - discuss the application of modern research methods to studying problems in this topic.

Why Universal Design for this module?

For most programmes in university, it is now good practice to embed research into teaching. This entails the reading and understanding of research papers and is of utmost importance especially in the sciences. Many students struggle with this activity and leave university unprepared in comprehending even the simplest of scientific papers. Whilst there is a vast literature out there purporting to show students how best to do this, it is largely unsuccessful and does not utilise Universal Design. Students in their early years studying science will often come out with:

“Nothing makes you feel stupid quite like reading a scientific journal”

Sinead Lanigan, a 3rd year PhD neuroscience student states:

“Learning to read scientific papers in this module really helped me to understand the papers I now have to read during my PhD”

Laura Batti, a Post Doctoral Fellow previously said:

“It was absolutely vital to have been prepared to dissect research papers before I began my PhD and now post doctoral career”

We therefore set out to create a module that would both cover the topics required (synaptic plasticity), and also use the principles of **Equitable use** and **Flexibility in use** to guide the students in understanding Science research papers. Specifically we set out to achieve **Equitable use** for students with different ability levels in reading and make the module appealing to all. To achieve **Flexibility in use** we carried out a number of assessment methods allowing for a different pace for different users, open book assessment, home and in class exercises and minimal lecturing. Students might have asked: why bother to read scientific papers? We emphasized that it is imperative for a graduate student to be able to read and understand a scientific paper so that they can:

- write their own scientific papers
- better excel at research during postgraduate degrees
- obtain jobs more readily in publishing
- improve their future teaching skills
- allow them to keep up on modern advances in science

Design and implementation of the initiative

Many students read a scientific paper and then say:

"I didn't understand one sentence of it"

or:

"How could any human brain produce such sentences?"

Whilst there is an enormous amount of literature on this topic most publications do not consider a Universal Design approach. One of the key aspects to the design of this module was flexible and group learning through a **Community of learners**. For a successful outcome students must be offered a number of learning tasks some to be carried out in groups and others individually.

Teaching & learning strategies

Many students feel overwhelmed when they look at the title of a paper never mind the abstract or results! Some of the highest impact journals can be the most dense to read. There will always be something they don't understand in a paper.

LETTERS TO NATURE

Long-lasting enhancement of NMDA receptor-mediated synaptic transmission by metabotropic glutamate receptor activation

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evoked a long-lasting enhancement of the NMDA e.p.s.c. which was very similar to that following LTP. Perfusion of 10 μ M ACPD for 2 min caused an initial depression of the NMDA e.p.s.c. lasting 2–4 min (probably a presynaptic inhibition^{9,10}), followed by a long-lasting enhancement measuring 169 ± 13% at peak and 160 ± 13% of control at 20 min after ACPD application ($n=8$; $P<0.01$; Figs 1d and 3a). $I-V$ (Fig. 1e) and normalized $V-g$ curves (Fig. 1f) of the NMDA e.p.s.c. before and during the enhancement by ACPD showed that its effects occurred at all potentials from –90 to +20 mV with no observable voltage-dependency. No change in the rise and decay times or the reversal potential of the NMDA e.p.s.c. was observed after ACPD application. Previous studies have shown that activation of the mGlu receptor induces a long-lasting increase in NMDA receptor-mediated field excitatory postsynaptic potentials (e.p.s.ps)¹¹ and reversible enhancement of responses evoked by exogenous application of NMDA^{12–14}.

Occlusion experiments were carried out to demonstrate that the mGlu receptor-mediated enhancement shared common mechanisms of expression with LTP of the NMDA e.p.s.c. In the first set of experiments, tetanically induced LTP (with identical parameters to Fig. 1) of the NMDA e.p.s.c. was induced 5 min after a cell seal had been obtained. After a further 8 min, 10 μ M ACPD was applied. Although a small decrease of the NMDA e.p.s.c. was still observed, no further enhancement occurred (Fig. 2a); thus, the LTP of the NMDA e.p.s.c. blocked the mGlu receptor-mediated enhancement of the e.p.s.c. In the second set of experiments, ACPD (10 μ M) was applied to the slice 5 min after a cell seal had been obtained, resulting in the

Figure 2: An example of a compact scientific paper, Nature

The journals, Nature (Figure 2) and Science, two of the highest impact journals in the world, are indecipherable to most students at undergraduate level. Students starting off with less scientific vocabulary will be aided by their fellow students. Remember no student is an expert in reading scientific papers when they start this module.

Of course some help is available to students on-line such as from the journal Science or the publisher Elsevier or other journals but these are not always the most helpful to a diverse group of students with varying educational backgrounds.

Bring in a PhD student

Bring in a current or recently graduated PhD student to discuss their experiences of how they learned to read papers and the importance of this activity to their career. Get them to go through a sample paper with the students and draw it out (Figure 3). It is important that these undergraduate students get to hear how important this skill becomes for so many graduates.

- Have other resources at hand
- Read the abstract first
- Skim through the paper
- Go back over & highlight key data
- Understand the methods
- Go through the results
- Consult other sources
- Examine each figure
- Look at authors interpretation
- Current theories & hypotheses

Figure 3: Draw out the research paper such as that described above

Group work

We placed students in groups of 5-6 for presentation of papers and posters. In this exercise they will learn from each other, the tutor and the lecturer helping to create a **Community of learners**. Many students have difficulty with workload management and are over assessed. Within this group work we structure a small number of papers to read. As well as being assessed in group work, questions are asked in the end of semester exams that will require knowledge of these papers. The group as a whole presents the paper as a poster or as individual figures. Each might tackle a single results figure, methods or summary. The tutor awards a group mark and the students award individual marks to each other.

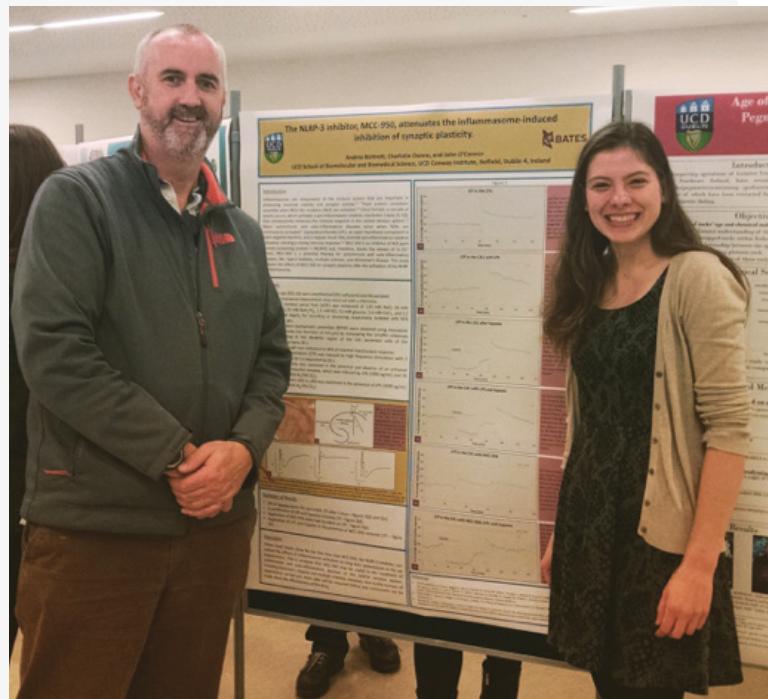


Figure 4: Assessing a fourth year student at her poster

Journal clubs

Using the 'Journal club' style to read and present papers informally at group meetings each week will help students reach competency more quickly and give them more confidence. Science students do not normally carry out this activity until they join a laboratory at masters or PhD level. Again as an incentive to attend these sessions and read the papers students are informed that the content of these papers is examined in the final exams.

Figure 5: Orla Watters, a 4th year Neuroscience student, summarises a paper as a poster

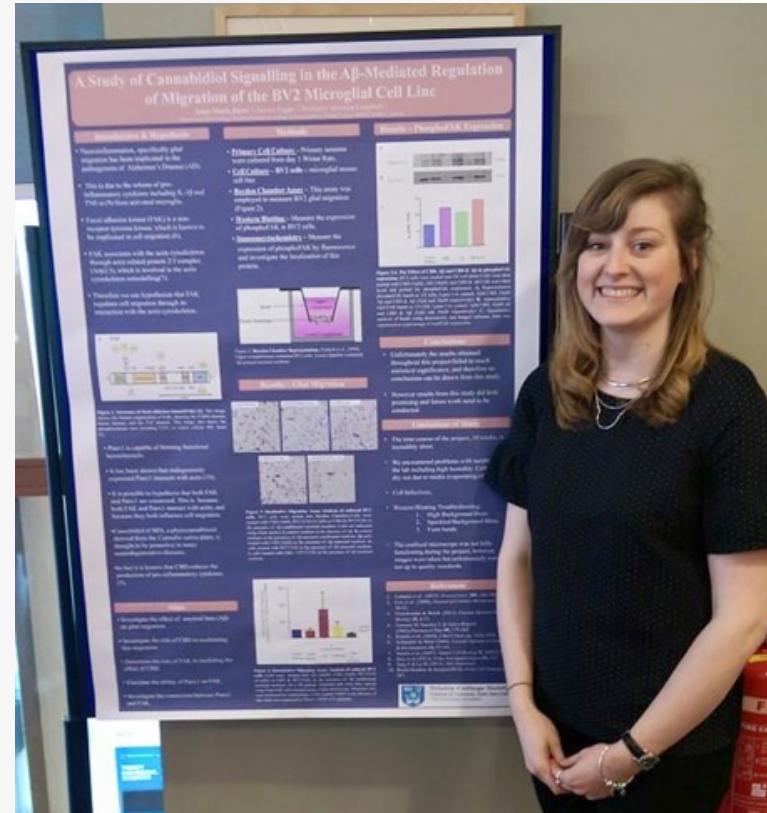


Figure 6: Anne Marie Howe presents her Poster at a journal club

Alternative assessments

Open book assessment

This alternative assessment may be taken by students who do not wish to present a paper. It is unfair to expect students to have similar ability when it comes to this skill. An open book assessment in the middle of the semester allows for **Flexibility in use**. Students are given a science paper to read two days before the assessment. On the day they bring in the paper and any other notes, books and computer they wish. They have 30 minutes to answer 5 questions about the paper. It is my observation and to my disappointment that these type of assessments are rare. The five questions asked of the paper depend on an understanding of the paper so it is a very successful assignment.

Summary of paper

Again for students not comfortable with presenting their paper in a group they might choose to write a 500 word summary of the paper in their own words in a class period. An important strategy to these assessments is that the student understands that the papers are all relevant to the material on the course and can be used in the final exam.



Figure 7: Fourth year Neuroscience students prepare to summarize a paper in 500 words

Final exam

A final 2 hr exam takes place at the end of the semester on the module 'synaptic plasticity' and students will know that a knowledge of all of these papers is imperative to do well.

In summary all of these assessment strategies are employed to ensure the students have strong scaffolding surrounding their learning and that they are not over assessed either in groups or as individuals.

How do you know it worked?

At the end of this module students are more relaxed about reading scientific papers. This can be observed by their ability to discuss new papers at the end of the course. Since this strategy was brought in three years ago the feedback from the students has dramatically changed.

Prior to design change:

“I hadn't got a clue what this module was about”

“I can't understand a word in those scientific papers”

Post design change:

“The module introduced me to the importance of reading scientific papers”

“The way in which the lecturers went through papers to explain them in detail was of help. The lecturers' lack of lecture slides and a focus on papers instead was something I found good as well.”

“The research paper exam is a very good idea in the first few weeks as it gets you used to going through research papers and also takes some of the pressure off final exams”

“Reading papers in class helped me start understanding how to read papers.”

Advice to others for implementation

In general sending a single undergraduate student off with a difficult scientific paper and expecting them to come back the following day with an understanding of the paper does not work.

Reading journal papers is an essential skill for every discipline and for every year of study. It should ideally be progressed from first year of university to the last year. The key issue is that it is not explicitly and frequently taught through the years. Readers are invited to consider how they could interpret reading journal papers into their classroom teaching and may want to include some of the following strategies:

- Be flexible and use multiple assessment strategies.
- Introduce basic understanding principles on how to read papers first.
- Give the best practice guidelines on how to read papers.
- Use a PhD student to tell their story on how they grew in ability to read science papers.
- Use Group work to get students to gain confidence.
- Use Open book assessments.
- Get students to present papers as posters in groups.
- Finally integrate the papers they have read into their final exams.

References and resources

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