Teaching future generations of scientists about the fundamentals of neuroscience and brain disorders

Schools/Department/Unit involved: Psychology and Neuroscience, Biology, Medicine

Amount awarded: £4000

Aims and objectives of project:

To teach fundamentals of neuroscience and neurological disorders to high school students using cutting-edge experimental models including human stem cell-derived neurons and the genetically-modified Drosophila (fruit flies). To train new PhD students in teaching and outreach exercises, thus endowing them with critical transferrable skills.

Outcome of project:

1: Development of Innovative Teaching Approach

High School Students:

During this engagement activity a novel integrated approach for teaching high school students was designed and successfully implemented. High school students participating in the international summer program at the University of St Andrews were chosen for this engagement activity. International summer program comprises of students, 16-18 years of age, selected from different countries who are keen on pursuing a college/university degree in the field of engineering or physical/biological sciences. This group of students includes participants from diverse ethnic, social and educational background. Some of these students even came from countries where English is not the preferred language for teaching or social communication. This provided us with an ideal platform to determine feasibility and efficacy of our integrated approach for teaching about fundamentals of neuroscience and brain diseases to students with varied backgrounds and different educational levels.

To determine the impact and success of this engagement activity we collected feedback from participating high school students using a set of questionnaires specifically designed to provide us with both quantitative and qualitative measures. Quantitative data revealed that 95% of participating students were willing to recommend this activity to their friends, 91% of them agreed/strongly agreed that they enjoyed being taught by the organizing team, and 78% of participants agreed to have learnt more about neuroscience and brain diseases after attending this engagement activity.

University Students:

This engagement activity was planned and conducted by university students and its success highlights that they could serve as an important resource for advancing scientific teaching and learning process in a more relaxed setting at the University.

Feedback data collected from students organizing and delivering this engagement activity highlights that, all of them (100%) were willing to recommend participation in this activity to their friends, 78% of them feel more confident in teaching after being a part of this activity, 67% of them feel they can conduct similar activities in future, overall these data reflects the merit and success of this activity towards its objectives.

2: Learning about neuroscience and brain disorders

High School Students:
Feedback data collected from the high school students indicate a very positive impact of this engagement activity on them. An important index reflecting overall impact of this engagement activity was the preference of participating students towards taking a neuroscience course in the future. To begin with, 94% of participating students had never taken a neuroscience course and after this engagement activity 76% of students strongly agreed/agreed that they would be interested in taking a neuroscience course in the future. Another index indicating positive impact of this activity was maintaining the excitement level of high school students before and after attending the engagement. 88% of participating students found their excitement to be justified after attending this activity. Last but not the least, 92% of the participants agreed/strongly agreed that they enjoyed this activity.

Alongside feedback data, the quality of experimental data generated by the participating students during hands on experiments session provided leads for future research work in the area of motor neuron disease. High school students conducted scientific experiments to demonstrate that hydrogen peroxide (H₂O₂) treated fruit fly larvae (high oxidative stress) showed locomotor deficits which may be due to excitability changes of motoneurons a pathophysiology associated with motor neuron disease.

**University Students:**

University students of the organizing team were able to learn new transferrable skills including team work, organization and teaching.

As far as members of the organizing team, this engagement activity had a moderate impact. 67% of them agreed that this engagement activity taught them new skills, 34% agreed to have acquired new organizational skills, 78 % of them enjoyed working with high school students and finally 86% of them would again like to participate in such activities in the future.

**3: Personal development from the project:**

Leading and organizing this engagement activity has proved to be immensely fruitful for my personal and professional development. As a PhD student, who intends to pursue an academic career in the future, this activity provided me a first-hand experience of organizing and handling a project which included 38 high school and 10 university students. During this activity, I got an opportunity to acquire new skills which included grant writing & fund acquisition, financial resource allocations, classroom teaching, team & project management and time management. Though, I taught university level students in the past, teaching high school students was a completely new experience for me. Feedback provided by participating students on my teaching indicated limitations and shortcomings with my style and provided suggestions to improve on them. Feedback from members of the organizing committee, my peers, pointed out deficits with my organization and management, which made me realize and work on these issues and hopefully this will enable me to be better organized for future activities.

**4: Additional comments & supporting materials**

This engagement activity generated interests from many scientific groups and charity organizations. Portable optogenetics apparatus, for doing *Drosophila* larval experiments, designed and 3D printed by students during this engagement activity has already been requested by research groups at the University of Aberdeen and the University of Edinburgh for their own public outreach efforts. We were also successful in obtaining public engagement award from the National Centre for the replacement, refinement and reduction of animals in research (NC3Rs). Furthermore, representatives from NC3Rs came to the University of St Andrews to deliver sessions as part of this outreach activity. This activity
was also successful in obtaining postgraduate development fund award from the University of St Andrews. Internal and external funding support received for this outreach activity indicates its potential and promise for future.

**Supporting Materials:**

1. **Twitter Weblinks posted during this research engagement activity**
   
   https://twitter.com/amitchouhan26/status/1011296781324480517
   
   https://twitter.com/amitchouhan26/status/1014086961722781696
   
   https://twitter.com/amitchouhan26/status/1014113971899691008
   
   https://twitter.com/amitchouhan26/status/1014184273136537601
   
   https://twitter.com/amitchouhan26/status/1014184823110463488
   
   https://twitter.com/amitchouhan26/status/1014770167090503680
   
   https://twitter.com/amitchouhan26/status/1011622452844204032
   
   https://twitter.com/amitchouhan26/status/1011544212179963905

2. **Pictures taken during this research engagement activity**

   1. High school students learning about brain diseases and neuroscience.
2. High school students showing their project design to treat brain diseases
NEURO-diagnostic Imaging

Objective:
- Brain in posterior areas
- Central nervous system (CNS) dysfunction
- Stroke (bleeding)
- Stroke (ischemic)
- Brain injury

Hypothesis:
With less effective arteries, blood flow damage can occur due to clotting, leading to brain damage.

Method:
- Study different brain regions
- Use imaging techniques

Import:
- Practical understanding of RS
- Further understanding of RS
- Develop new imaging technology
- If successful, could diagnose RS at earlier stages.
Objective: To study the effects of a specific medical treatment on patients with Parkinson’s disease.

Impact: The treatment shows promise in improving patients’ quality of life.

Hypothesis: Drug A reduces the progression of symptoms in patients with Parkinson’s disease.

Methods:
1. Randomly assign patients to treatment groups.
2. Administer the treatment to the experimental group.
3. Monitor the progression of symptoms in both groups.
4. Compare the results to determine the effectiveness of the treatment.
3. Optogenetic apparatus designed and 3D printed by students for carrying out experiments during this engagement activity.