

## Neuroscience 101 for School Pupils: 'The Brain Apprentice' Project

See Ching MEY<sup>1,2</sup>, Jafri Malin ABDULLAH<sup>3,4</sup>, Muzaimi MUSTAPHA<sup>3,4</sup>,  
Tee Jong HUAT<sup>4</sup>, Nurul Iman Wan ISMAIL<sup>4</sup>, Khalilah HARIS<sup>4</sup>,  
Nanthini JAYABALAN<sup>4</sup>, Muhammad Hanif CHE LAH<sup>4</sup>

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<sup>1</sup> Deputy Vice-Chancellor, Division of Industry and Community Network, Universiti Sains Malaysia, 11800 USM, Pulau Pinang, Malaysia

<sup>2</sup> School of Educational Studies, Universiti Sains Malaysia, 11800 USM, Penang, Malaysia

<sup>3</sup> Center for Neurosciences Service and Research, Universiti Sains Malaysia, 16150 Kubang Kerian, Kelantan, Malaysia

<sup>4</sup> Department of Neurosciences, School of Medical Sciences, Universiti Sains Malaysia, 16150 Kubang Kerian, Kelantan, Malaysia



### Abstract

Community engagement efforts in brains and neurosciences projects involving higher education institutions are currently sporadic in Malaysia and likely to contribute the apparent lack of neuroscience awareness in the society. In this paper, we highlight 'The Brain Apprentice' project as a knowledge transfer effort to raise neuroscience awareness using school-centred neuroscience clubs.

These groups promote the appreciation of neuroscience beyond conventional classroom approaches and the training of neuroscience graduate interns as student facilitators in the teaching and learning of neuroscience.

The Brain Apprentice was delivered through the establishment of two school-based neuroscience clubs, Sekolah Kebangsaan Kubang Kerian 3 (primary level) and Sekolah Menengah Sains Tengku Muhammad Faris Petra (secondary level). The teaching and learning of neuroscience was delivered through practical sessions and competitions.

Questionnaires were collected from the students based on the following four domains: general satisfaction, impact of knowledge transfer, satisfaction with graduate interns, and knowledge and practical relevance of neuroscience.

The National Brain Bee championship has resulted in the first Malaysia representative competing at the International Brain Bee 2012. Students, who had participated as neuroscience club members were exposed to the basic principles of neuroscience, which boosted their interest in science and neuroscience. The graduate interns had also been provided with opportunities to hone in their soft skills and be involved in community-engagement efforts.

This project offered a suitable model of community-engagement in raising awareness about and the profile of neuroscience both in terms of knowledge exposure and from the perspective of career options in the field.

**Keywords:** neuroscience, clubs, primary schools, secondary schools education, psychology

The Brain Apprentice programme was designed on the premise that neuroscience graduate interns be in the position to share neuroscience knowledge that they had acquired from the academic neuroscience members at the Universiti Sains Malaysia. With this model in

mind, the interns were then expected to interact with the selected school community through various means of teaching and learning about neuroscience. This project aims to promote the appreciation of neuroscience in specific and science in general beyond conventional classroom

approaches, featuring training neuroscience graduate interns as facilitators in the teaching and learning of neuroscience.

## Community Partners

Letters querying for interest in the program were delivered to two high-performing schools in and around the local district within the logistic reach of the Department of Neurosciences, School of Medical Sciences, Universiti Sains Malaysia. Each school at the primary and secondary level that was approached had agreed to take part in the programme by adopting a dedicated co-curriculum slot on regular basis. For the primary school, the club recruited from grades 4 to 6, while the secondary school recruited 4 to 5 students.

## Graduate Internships

Five graduate interns, all who were currently pursuing a Master of Science degree in Neurosciences at the Universiti Sains Malaysia, were involved in the project. Their key roles were to assist in executing the planned activities as well as designing additional tasks for the project. Many of these involved sharing neuroscience knowledge with the neuroscience club members at regular school visits through a combination of theory classes, practical sessions and the clubs' co-curricular activities. Many of the neuroscience resources are pooled from the 'Brain Facts 6th edition' textbook (<http://www.brainfacts.org>), which was published by the Society of Neuroscience (SfN).

## Neuroscience Club activities

A variety of the brain activities were conducted with individual schools and joint ventures of both primary and secondary schools. The project was delivered in two phases. *Phase 1 – School-led Activities* are science-related activities and are not necessarily neuroscience-related; these are mainly driven by the school teacher and students with minimal involvement of graduate interns (GIs). Schools were provided with the materials required for the activity of that day. *Phase 2 – Neuroscience-led activities* are neuroscience-related activities that actively involve GIs as the prime movers. Phase 2 activities were designed by emphasising both the theoretical transfer and hands-on experience of students in learning science. The model of neuroscience-led activities includes Anatomy of the Brain and Functions, My Brain Invention

Challenge, National Brain Bee Competition and Mini Brain Bee Competition.

### *Introduction to the Brain Anatomy: Theory and Practical*

This was a joint venture activity that involved students from both schools. The objective of this activity was to provide students with an overview of the brain's anatomy and functions of each part of the brain. Students were taught about the general anatomy of the normal brain prior to hands-on dissection of goat brains (Figure 1). The brain dissection was conducted by health professionals and was assisted by GIs. Then, group activities, such as brain anatomical presentations by school students, were conducted (Figure 2).

### *My Brain Invention (MBI) Challenge “Recycle Melody”*

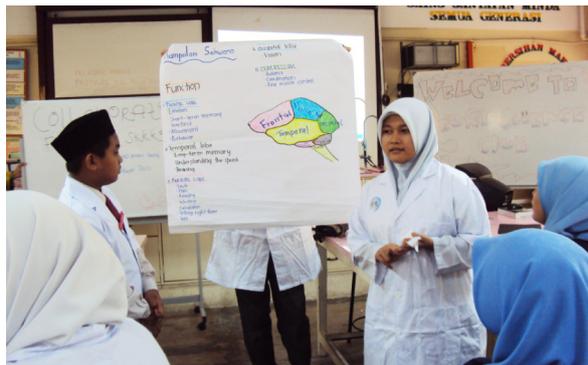
The MBI challenge was an activity that incorporated the use of arts in neuroscience by integrating the culture of thinking, planning, and team-work to innovate creative outputs. Students were given a timeframe of three months to invent “new” musical instruments using recycled materials, and they created a tune using the instruments they invented. Each group was required to sketch their invention idea on a provided form (Figure 3) prior to creating the instrument. GIs occasionally performed informal progress screening. The top five inventions were shortlisted based on the votes cast by other school pupils not counting the neuroscience club members for the final competition, which was held in Universiti Sains Malaysia. During the final competition, all inventions were displayed for public viewing (Figure 4) and students with shortlisted inventions performed on stage (Figure 5).



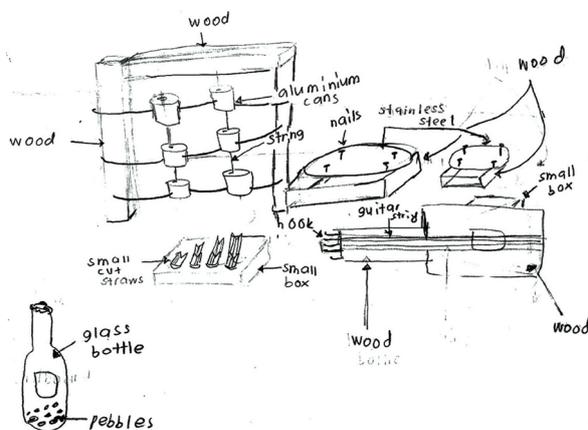
**Figure 1:** Graduate intern explaining about the parts of the brain.

*National Brain Bee (NBB) Competition*

The NBB Competition was held as a high school (secondary level) neuroscience competition, which was designed for the International Brain Bee (IBB). This competition aimed to create a healthy competitive spirit among students and indirectly encouraged them to learn about the human brain and inspire them to pursue a neuroscience career. Students underwent several tiers of tough assessment, from the screening phase until the final stage, which encompassed general knowledge of both fundamental and clinical neuroscience topics. Students were given the “Brain Facts” book and summarized syllabus as their references for self-study miscellaneous brain related materials. The winner of the NBB Competition (Figure 6) represented Malaysia at the International Brain Bee (IBB) Competition, which was held in Cape Town, South Africa last year.



**Figure 2:** Student group presentation on their observation of the brain to the audiences.



**Figure 3:** Students’ idea sketching for My Brain Invention – Recycle Melody.

*Mini Brain Bee (MBB) Competition*

Like the National Brain Bee, the MBB was designed for the primary school pupils. The MBB was aimed to provide an early approach to neuroscience knowledge in primary schools. It was much more challenging for the GIs to share neuroscience basics at a level that was suitable for this age group to understand. GIs had incorporated inquiry-based learning concepts in delivering their teaching using a slightly modified version of THIRTEEN (<http://www.thirteen.org/>). The syllabus was simplified from the book of “Brain Facts” available online at (<http://www.medic.usm.my/neurosciences/>). The winner of the MBB competition was determined through several rounds of written quizzes (Figure 7) and cumulative marks were given during club activities (Figure 8).



**Figure 5:** Students perform their melody on stage using their musical instruments invented.



**Figure 4:** Display of students’ invented musical instrument – Recycle melody.



**Figure 6:** International Brain Bee contestant from 13 countries. (2nd row and 2nd from the left – Ammar Ahmad Mokhtar, Malaysian’s representative).



**Figure 7:** Top 10 Primary school students were brief about Final Mini Brain Bee Competition.



**Figure 8:** Neuroscience Club activity at primary school during school-led activity.

## Introduction to Brain Anatomy: Theory & Practice

The Neuroscience Club members were given first-hand insight into the field of neuroscience. The students were introduced to the anatomy of the mammalian brain (i.e., the cow’s and goat’s brains) and their important parts and functions. With the guidance of Graduate Interns, the students were also given first-hand experience for dissecting the mammalian brain. Simple quizzes and students’ presentations on the brain components and their functions after the practical session facilitated the sharing of knowledge between the club members. Additionally, this session increased the students’ interest in neuroscience as well as gave the students the opportunity to explore and explain their own potential and abilities. In return, the GIs could increase their existing knowledge of brain anatomy prior to sharing their knowledge with the students.

## My Brain Invention Challenge

Neuroscience Club members successfully integrated the use of art into the world of neuroscience. Through discussion and teamwork, the students utilised their creativity and innovation to create their musical instruments. Soft skills and confidence levels were nurtured during their presentations of their musical instruments and the scientific rationale behind their creations.

## International Brain Bee

Through a series of knockouts and competitions, we succeeded in choosing the champion of our first National Brain Bee 2012 to become the first Malaysian, and Asian, representative to participate in the annual International Brain Bee Championship. This competition increased secondary students’ knowledge of Neuroscience, fostering their interest in science in general and Neuroscience in particular. Additionally, all students had some degree of improvement in their examination results, specifically in Biology. The National Brain Bee achievements were also reported in the local newspaper (<http://thestar.com.my/>).

## Mini Brain Bee

This series of competitions between the Neuroscience Club members of Sekolah Kebangsaan Kubang Kerian 3 had disseminated the fundamental knowledge of brain science to

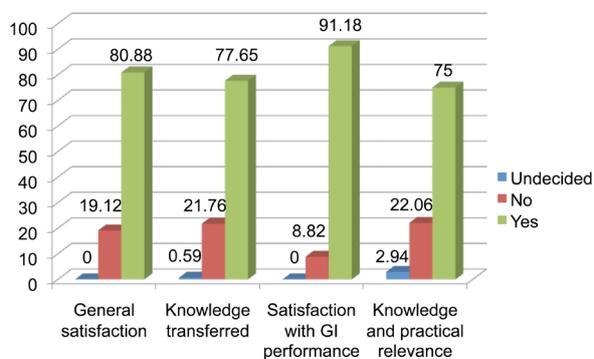
primary school students. Throughout the teaching sessions and competitions, the primary school students had a great deal of interest and evidence for the use of neuroscience knowledge through their full engagement in the assigned activities.

### Assessment of the Learning Experience and Satisfaction by the Community Partners

Both the primary and secondary school students and their teachers anonymously responded to the standard questionnaires. In summary, the students and teachers enjoyed our programs and activities, and they felt that the programs were a valuable learning experience. Most felt that these activities increased the students' interest in Science, which was apparent in their Malaysian Primary School Achievement Test (UPSR) and Malaysian Certificate of Education (SPM) results. These activities also increased the students' appreciation for and interest in science subjects in general, and neuroscience in particular, through their one-year interaction with the graduate interns.

### Sekolah Kebangsaan Kubang Kerian 3

The results from the questionnaires (Figure 9) revealed a significant general satisfaction with The Brain Apprentice program (80.88% satisfaction) and satisfaction with the graduate interns' performance (91.18%). The majority of the participants (77.65%) reported that the objectives of this program of sharing neuroscience knowledge with the primary school students were achieved, while 75% agreed with the knowledge and practical relevance of this program. With



**Figure 9:** Assessment of learning experience and satisfaction among students and teachers of Sekolah Kebangsaan Kubang Kerian 3.

respect to their examination results, of the 24 Neuroscience Club Members who took the UPSR in 2011, 22 of them scored 5As (top scores), while another 2 students scored 4As 1B. All members of the Neuroscience Club scored an A in Science.

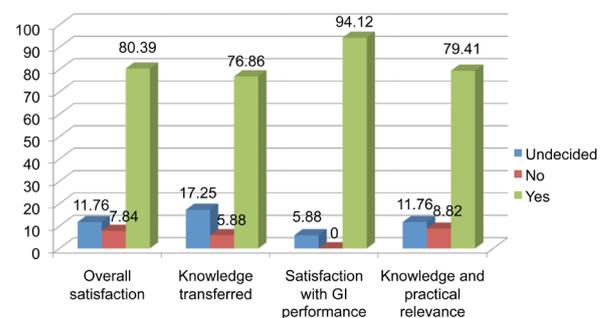
### Sekolah Menengah Sains Tengku Muhammad Faris Petra (SMSTMFP)

The results from the questionnaires (Figure 10) showed significant general satisfaction with the program and satisfaction with the graduate interns' performance among teachers and students of SMSTMFP, with 80.39% and 94.12% satisfaction, respectively. The majority of the participants (76.86%) agreed with the success of knowledge sharing achieved with this program, while 79.41% participants agreed with the knowledge and practical relevance.

### Assessment of the Learning Experience for Graduate Interns

In general, this program nurtured leadership and communication skills among the graduate interns as well as provided graduate students with teaching experience while they shared neuroscience knowledge with laypeople. Additionally, graduate interns succeeded in gaining experience and science knowledge beyond their own research degree studies.

In this article, we demonstrated that a model of a university-school partnership program, "The Brain Apprentice", could effectively provide schoolchildren and graduate interns with meaningful and engaging science learning experiences. Graduate interns, together with academic instructors, successfully developed



**Figure 10:** Assessment of learning experience and satisfaction among students and teachers of Sekolah Menengah Sains Tengku Muhammad Faris Petra.

a series of interactive activities that effectively transferred neuroscience knowledge to school children. In Malaysia, although the clear advocacy for science in schools according to the National Education policy is limited by the focus on examination-based outputs, this project incorporated natural science with students' extra-curricular activities as an alternative to these advocacy efforts. Introducing neuroscience to the school program suggested an option for overcoming the educational gap problem between the university and surrounding community in Malaysia. This effort successfully became a framework that other fields could utilise.

Throughout the engagement of school children in neuroscience-related activities, teachers rated the club members' interest in science based on their routine performance in the class, and their achievement was considerably higher than that of non-members. Brain dissection activity provides hand-on experience for students as they learn about human brain anatomy. This is crucial because learning science with slides and verbal explanation without hands-on experience is generally considered an incomplete approach. Hands-on in science is necessary at this stage of education especially at the amateur level because hands-on activities provide direct practical applications that build on theoretical class activities, automatically improving understanding as well as developing student's passion towards science. Fredembach et al. summarised that the sense of touch provides a better connection between vision and hearing and, therefore, enhances the learning process (1).

The My Brain Invention Challenge has successfully demonstrated the fusion of science and arts in producing creative innovation. This activity encourages students to use their creative input to imagine something possible from nothing. Albert Einstein stated that "Imagination is more important than knowledge." Einstein's strength came from his imagination, creativity and passion in science (2).

The Selection of National representative to International Brain Bee Championship allowed students to compete among themselves and gave the winner the opportunity to meet international challengers. Research by Henry and Gordon (2003) showed that competition improved the educational outcomes among students (3). Burguillo further concluded that competition-based learning significantly motivates students and increases their learning performance(4). Positive feedback from both teachers and students demonstrated that this engagement program

effectively fostered the involvement of student scientists and health professionals in increasing knowledge transfer and neuroscience literacy. The program also provides a unique and challenging opportunity to expose graduate interns to neuroscience beyond their own fields of study so that they can study the selected topics in depth before teaching and discover methods for sharing their experience and interest in neuroscience with the school children.

We conclude that this 'Brain Apprentice Project' is a suitable model of community-engagement for increasing the awareness and profile of neuroscience both in terms of knowledge exposure and from the perspective of career options in the field.

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## Conflict of Interest

None.

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## Correspondence

Professor Dr Jafri Malin Abdullah  
MD, PhD, FRCS (Ed), FACS, DSCN (Belgium)  
Editor  
Malaysian Journal of Medical Sciences  
Universiti Sains Malaysia Health Campus  
16150 Kubang Kerian  
Kelantan, Malaysia  
Tel: +609-767 6300  
Fax: +609-765 3370  
Email: brainsciences@gmail.com

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