



A neuroscience pull-out gifted program in a high school in Hong Kong: Connection of neurodegenerative diseases and traditional Chinese medicine in research-based learning

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Introduction

The development of Neuroscience curriculum in our school (a high school in Hong Kong): *Published previously in*

- 2007 Research-based learning associated with an authentic topic can promote active learning in high school neuroscience lessons
- 2008 Brain cell culture is an effective learning activity for high school students to acquire diverse knowledge and skills about neuroscience
- 2010 Development of a school-based neuroscience curriculum in a high school in Hong Kong
- 2013 An example of a high school in Hong Kong to develop a school-based Neuroscience curriculum as a pull-out program for scientifically gifted students**

In our school, the Neuroscience curriculum mentioned above was run by Neuroscience Club which was a pull-out class for the scientifically gifted students.

The Purdue Three-Stage Enrichment Model (Feldhusen 1973) was adopted in our pull-out Neuroscience class to move students from simple thinking experiences to complex independent activities (VanTassel-Baska 2007).

The Objective of our present report

To study how neurodegenerative diseases and traditional Chinese medicine can be connected as learning activities in the Purdue Three-Stage Enrichment Model in the pull-out Neuroscience curriculum.

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Curriculum design

As there was no any topic about neurodegenerative diseases and traditional Chinese medicine in high-school science curricula in Hong Kong, we introduced them in our pull-out neuroscience program as challenging and enriching learning topics in science.

Neurodegenerative diseases and traditional Chinese medicine were then connected as learning activities in the Purdue Three-Stage Enrichment Model as follows:

Stage I:

Learning objective	Mastery of core contents on brain structure, morphology of neurons, characteristics of neuronal cell death and basic chemistry (e.g. concentration); Mastery of technical skills on cell culture
Learning activities	Taught class, self reading and student's presentation on selected topics

Stage II:

Learning objective	Mastery of the above core contents with enhancement on complex problem-solving abilities
Learning activities	Practical preparation of different concentrations of extracted traditional Chinese medicine; literature review on agents which can cause neuronal cell death in Alzheimer's disease; investigation on different concentrations of the toxic agents (e.g. H ₂ O ₂) to kill neurons; investigation on the morphological changes in neurons treated with the toxic agents; literature review on the functions of traditional Chinese medicine

Stage III:

Learning objective	Development of student's abilities to apply knowledge to solve real problems as a scientist
Learning activities	Research-based learning: Students in groups develop a scientific research to study the neuroprotective effects of traditional Chinese medicine in neuronal cells.

Stage-III learning activities were repeated when students started a study on a new traditional Chinese medicine.

Evaluation

Four scientifically gifted students aged 14-15 were identified and selected to join Neuroscience Club. They did stage-I and stage-II activities once. These pupils repeated stage-III activities for 4 times (i.e. studying 4 types of traditional Chinese medicine) within 6 months.

Qualitative data by teacher's observation:

1. All of the students showed high **interest** towards looking for medicine to rescue neurons.
2. The students were able to **plan and conduct 5-day experiment** (seed cells, grow cells, pre-treat cells with Chinese medicine, treat cells with H₂O₂ and do LDH essay for cell death study).
3. In terms of **data accuracy**, the students had developed a sense of repeating experiments.
4. The students were able to do a **fair test**.
5. About the Nature of Science, the students realized the **limitations of science** and scientific methods.