

A Delphi Study on Brain-based Instructional Model in Science

UNE ÉTUDE DELPHI SUR LE MODÈLE DE NEURO-PÉDAGOGIE EN SCIENCES

Prasart Nuangchalerm¹

Duangkamon Charmsirirattana²

Abstract: Development of science instructional model for brain-based learning by using knowledge of the brain to be the tool designed of learning process is now interesting. This study aimed to develop science instructional model for brain-based learning. Delphi method was employed with 18 panel members. The findings can be showed that science instructional model for brain-based learning consisted of five steps of learning organization (PRADA- Preparation, Relaxation, Action, Discussion, and Application). It can provide a framework for science teachers that should be elaborated this instructional model to science classroom and beyond to science education.

Keywords: brain-based learning; Delphi technique; instructional model; science learning; science education; teaching model

Résumé: Le développement du modèle de neuro-pédagogie en utilisant les connaissances du cerveau en tant qu'un outil conçu des processus d'enseignement est maintenant intéressant. Cette étude visait à développer un modèle de neuro-pédagogie. La méthode Delphi a été appliquée à un panel composé de 18 membres. Les résultats ont montré que le modèle de neuro-pédagogie consiste en cinq étapes de l'organisation d'apprentissage (PRADA-Préparation, Relaxation, Action, Discussion et Application). Il peut fournir aux professeurs de sciences un cadre qui devrait être élaboré en classe et au-delà de l'éducation scientifique.

Mots-clés: neuro-pédagogie; technique Delphi; modèle d'enseignement; apprentissage des sciences; enseignement des sciences; modèle de l'enseignement

1. INTRODUCTION

The statement of the skeptic's view of the relationship between neuroscience and education, that is, it was possible to bridge the gap between neuroscience and cognitive science, and also to bridge the gap between

¹ Corresponding author, Department of Curriculum and Instruction, Faculty of Education, Mahasarakham University, Mahasarakham 44000 THAILAND. Email: prasart.n@msu.ac.th.

² Department of Curriculum and Instruction, Faculty of Education, Mahasarakham University, Mahasarakham 44000 THAILAND.

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cognitive science and education (Bruer, 1994; Bruer, 1998). The growth of neuroscientific knowledge drive our learning management especially science at all areas. The results of neuroscience influence educational fields in terms of brain and its function when student learn. This innovative instruction called brain-based learning is an alternative perspective on education that has gained attention over the years. As a result of Eric Jensen's studies (Jensen, 2000; Jensen, 2001; Jensen, 2008a; Jensen, 2008b), brain-based learning as the informed process of using a group of practical strategies that are driven by sound principles derived from brain research (Jensen, 2000). At this point, educators need to have more interested in the brain studies and how the brain affects students' achievement (Posner & Rothbart, 2005).

Brain-based learning need students have more creative learning environments that make them feel comfortable in the class. This can help students develop intellectual tools and learning strategies to be productive members in society (Donovan et al., 1999; Bransford, 2003). New information and research on the brain indicates teachers should carefully look at what they teach, decide what method and style of teaching they are going to use, and what they want their students to be able to do before class (Darling & Bransford, 2005). Then, students have more successful when they had learned and it can influence to parents and community.

Science in this era plays its role in present and future because it relevant to all people at all level. Thai Education Act B.E. 2542 provided ways to help students learn science through constructivist views of learning. In this approach, students need to seek and open opportunities of instructional strategies by allowing neuroscientific knowledge. This study aimed to develop science instructional model for brain-based learning by employing Delphi method, this method as a research tool to serve a variety of different purposes in the theorizing process. Increasing the rigor will increase the confidence with which researchers can use the results in subsequent studies and managers can make decisions based on information gathered using these methods (Okoli & Pawlowski, 2004).

The study employed the Delphi technique to obtain a consensus from experts about areas/issues that are most in need of neuroscience and education. Delphi technique was initially developed by the RAND Corporation. Linstone and Turoff (Linstone & Turoff, 1978) described the utility of the Delphi as a research technique particularly in future research:

- Problem does not lend itself to precise analytical techniques but can benefit from subjective judgments on a collective basis
- Individuals who need to interact cannot be brought together in a face-to-face exchange because of time or cost constraints, a conventional conference tends to be dominated by particularly strong personalities or to give rise to an undesirable bandwagon effect.

Delphi technique is a popular technique for forecasting and an aid in decision-making based on the opinions of experts (Landeta, 2006). The result can provide a framework for teachers and educators to set class or lesson in science in which concurrent neuroscience and nature of science learning.

2. METHODOLOGY

The study employed the Delphi technique to obtain a consensus from experts in a various filed of study about issues that are most need of science instructional model as it relevant to brain-based learning. The Delphi method aims to improve group decision-making by seeking opinions without face-to-face interaction.

Participant recruitment: the intent of this study was to investigate the opinion of 20 experts who concern brain-based science learning. The experts was selected by purposive sampling from a several of field studies: five science curriculum developers, five educational technologists and evaluators, five developmental psychologists and brain-based educators, and five national science teachers and master science teachers. All the experts' responses are measured numerically to calculate an average response and to determine the degree of agreement between the groups. The number that is used to represent the consensus opinion of the group is the median and the most commonly used dispersion measure is the interquartile range. The results from each step in the process are returned to the experts so as to collect their

revised individual opinions, ideas and proposals always respecting the anonymous feature of the procedure. Three rounds of Delphi method was conducted and analyzed to raise brain-based science instructional model.

Instrumentation: experts independently react to a list of prompt about particular issues. The response are tabulated, organized, and synthesized into topics which they concerns and responses. These categories are reported back to the experts. This cycle continues until a set of priority themes emerges. The panelists were mailed a set of surveys.

Round 1: Participants were directed to the Delphi study and asked to generate responses to the question about what and how brain-based learning should be shaped in science learning. Round 1 statements were arranged in categories according to research focus. Identified research statements and categories were then used to develop the Round 2 instrument.

Round 2: Participants were asked to rate the research statements and categories identified in Round 1 as to research need. In addition to rating each research statement, they ranked the major research categories in order of their perceived importance. Once returned, descriptive statistics for the group ratings were calculated: median and interquartile range.

Round 3: The ratings of research statements and rankings of major research categories by the group in Round 2 were compiled. Participants in Round 3 again ranked the major research categories as they did in Round 2, but this time descriptive information about how the group responded, as a whole, was provided. Participating experts were asked to review each item, consider the group response and then re-rate the items, taking the information into account.

The three-round Delphi process enabled the participants to generate their own opinions about their views based upon consideration of the entire group's opinions. This process, engendering the dynamics of effective group interactions, enabled researchers to gain a consensus from a panel of expert participants in diverse geographical locations about brain-based learning in science.

3. RESULTS AND DISCUSSION

The results of Delphi study reflect the consensus of opinions from 18 expert participants. In total, 90 statements panel members were asked to rate on a Likert-type scale as to degree of agreement by allowing them to provide more suggestion and discussion in the end of each issue. The experts generated their ideas how brain-based learning seem to be function in science classroom in four areas (Joyce & Weil, 2004): objectives, learning process, assessment, and support system.

Objectives: brain-based learning in science need students to have balance of both left and right hemisphere function, students can solve their problem in systemically, learn science in which knowledge, process, and attitudes referred. Also, students can construct, link, explain, inquire, and communicate science with others by employing theory of multiple intelligences.

Learning process: it can be provided syntax of instruction into five steps (Figure 1 and Table 1). PRADA- preparation, relaxation, action, discussion, and application were described in terms of syntax of brain-based science instructional model.

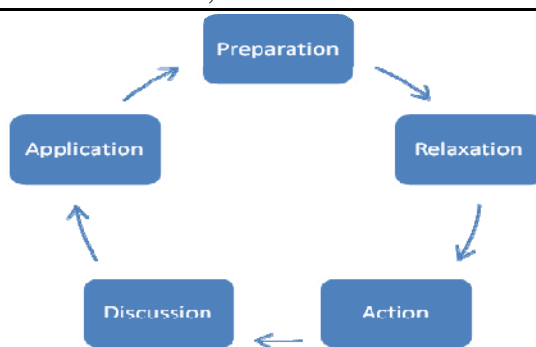


Figure 1: Instructional model of brain-based learning in science

Table 1: Syntax of brain-based science instructional model

Syntax	Teacher roles	Student roles
Preparation	Teacher should plan, prepare, and determine issues/criteria, phenomena, and media to encourage students. He/she should select some teaching techniques for engaging students' learning such as discussion, brain-storming, and questioning. Teacher should play role to facilitate learning environments as brain-based learning strategies defined, and also set classroom is more alertned relaxation.	Student should have prior knowledge and background of learning in which they concerns. Also, they have to question what do I know? How do I know? By participate learning activity based on rational practice and individual differences awareness.
Relaxation	Teacher can show teaching strategies with a various kind of instructional medias based on left and right hemispheres working principle. He/she should act as facilitator or manager in classroom, design learning activities as well as brain-based learning approach. The learning activities should allow students meet their need and interest to open window of opportunities. Teacher also reinforces students to learn and make their concept of learning by themselves.	Student should make a ready in both physical and mind of learning. He/she should practice in which ways of questioning, experimenting, searching, and planning to solve problem. Also, working cooperatively need for this aapproach, constructing knowledge by self in various kind of learning such as mind mapping presentation, project-based working, do experimentation, and so on.
Action	Student-centered approach is milestone for brain-based science learning. This approach, teacher prepares criteria or issues which student should be learned and critiqued in science hours. Students will be stimulated to think and share what ideas concerns. Teacher also act as accelerator process of thinking through simulation, activity, and information that relevant to student's concept formation.	Student makes question and practice to stimulate thinking process by employing evidences in which his/her inquired through learning activity. He/she should seek evidences and makes argumentation through analytical and critical thinkings in which his/her learned in both in- and out- classroom activity.
Discussion	Teacher makes a student's connection between old and new learning experiences through discussion and presentation. This step will allow students meet the nature of peer consensus, it will lead student to have appropriate concept of learning.	Student should investigate more information and can explain what knowledge are. He/she has to learn way of scientific knowledge explanation by providing aproprate rational consideration.
Application	Teacher prepares new learning experiences for student that can help his/her to apply knowledge into real life situation. Also, student should be encouraged to construct scientific knowledge i.e. science project, integrated science learning, positive reinforcement.	Student pays attention to do and learn based on problem-based strategies.

Assessment: the experts express their opinions on systems support that can be considered brain-based science learning in three dimensions: method, tool, and criteria of learning assessments.

- **Method of learning assessment:** the experts showed their opinions on the method of learning assessment that it need authentic, diverse, and congruence. It should reflect student's knowledge, attitude, and process of science. Student should have participation to assess such as self-assessment or peer-assessment that is fair to students.

- **Tools of learning assessment:** teacher can determine tools of learning assessment based on situation. Diversity of tools can be considered and evaluate student's knowledge, performance, and behavior as well as observable phenomena.

- **Criteria of learning assessment:** The criteria should be congruence with real situation. Student should have participation of criteria determination, it will help both assessors and assessed person accepted criteria.

Support system: the experts express their opinions on support systems that can be considered brain-based science learning in three dimensions: media, classroom environment, and learning resources.

- **Media:** the experts showed their opinions on the media of learning that it need IT such as internet, web-based instruction, and so on. Media should be shown as real, interactive, and promote student to express student's feeling, idea, and behavior. Also, media should be made in local area that help student learn science based on individual differences, needs, and interests.

- **Classroom environment:** The classroom environment should be made and created by relaxation. Students should be opened their windows of learning through independent thought and talking processes. Also, news groups and poster presentation should be permitted, students should have interaction time between group. Teacher provides students with task and some practices to aware public facilities as well.

- **Learning resources:** The experts listed their opinions about learning resources emphasized on learning center, experimental laboratory, book center, and computer center. The learning center will provide students perspective and experiences both indoor and out door classroom. It can help students making conceptual and behavioral approach in learning participation based on local learning resources.

4. CONCLUSION

The result of this study employed future research to predict how brain-based learning be effective in science. However, it needs empirical research determining the effects of brain-based learning recognizing in the science classroom. Also, the panel members recommended that brain-based learning need student-centered approach by allowing them learn balance between left and right hemisphere activities. The study can provide specific research priority areas and topics for those engaged in science education.

The members of the Delphi panel advocated a research agenda that includes an examination of the following areas:

- **Objectives-** need students to have balance of both left and right hemisphere function and student can construct, link, explain, inquire, and communicate science with others by employing theory of multiple intelligences.

- **Learning process-** can be provided syntax of instruction into five steps PRADA- (preparation, relaxation, action, discussion, and application).

- **Assessment-** can be considered brain-based science learning in three dimensions: method, tool, and criteria of learning assessments.

- **Support system -** can be considered brain-based science learning in three dimensions: media, classroom environment, and learning resources.

Instructional model in this study response to the aim of brain-based learning and goal of science education, it can inspire students to seek their real competency in science learning. Because of the complex

world in the future, students need to shape their learning abilities, left and right hemisphere is worked in balance, and create new good things for society. This model will be more effective by implementing in science classroom. The result of instructional model will be discussed and propagated as well.

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