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Training Students at the Department of Mathematics and Its Impact on Their Teaching Performance and Productive Mind's Habits

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This study investigates the effect of training programs on students at the Department of Mathematics/College of Education/University of Misan, Iraq. It used Neural Branching strategies on their teaching performance and productive mind's habits. The study sample consisted of (70) male and female students in fourth stage, divided into two classes. One was an experimental group (which used the training program) and the other a control group (without the training program), for the first semester of the academic year 2017-2018. The two groups equalized in several variables. Observation cards of teaching performance, and scales for mind productive habits, were prepared in accordance with the learning dimensions model of Marzano. The experimental group was trained according to the program prepared for this purpose. During the practical training (application) the research applied the instruments on the two groups. The statistically significant results show differences in the main average of the two groups, in the observation card of teaching performance, and in scale of mind productive habits for the experimental group. In light of the results conclusions, recommendations and suggestions have been made.

Key words: *Neural Branching strategies, teaching performance, productive mind habits, and training students.*

Introduction

The acquisition of knowledge and information is not only an aim, but a tool for learners' brain development. It increases their thinking, imagining, creating abilities, and makes it easier for them to remember and apply their learning. The strategies help learners to think, create and produce. Accordingly, this is what thinking strategies aim for; to make learners more active, motivating multiple thinkers by asking their opinions about questions to get many answers on ideas that are sent non-stop (Imran, 2001: 27). Recently, many researches highlight Neural Branching strategies. Focuses on brain studies have discovered new trends of teaching which free learners' minds from curricula, training them for fast active suitable answers in different situations. Neural Branching strategies stand on based-brain theory. The cerebral cortex divides into two:

a. Right Hemisphere: its function is responsible for control of the left side of the body, and is the more artistic and creative side of the brain.
b. Left Hemisphere: its function is responsible for control of the right side of the body, and is the more academic and logical side of the brain. There are also neural connections between them so that the brain works as a whole (Caviness, 2000:20). Neural Branching strategies classify into seven forms:

1. Hypothetical Thinking Strategy: This strategy is based on directing a set of hypothetical questions for students that lead them to think about events and consequences.
2. Reverse Thinking Strategy: This strategy provides students with opportunities to see a deep vision of events and situations, and to think beyond them; thus moving from cognitive to meta – cognitive functions.
3. Strategy of Applying Different Symbolic Systems: This strategy is based on different symbolic systems in learning positions. The more it increases students' ability in using it to express, the more it indicates their ability to comprehend the elements of situations.
4. Similarity Strategy: This strategy supports opportunities to search for relationships between things, to identify similarities and differences.
5. Viewpoint Analysis Strategy: This strategy helps students think about their opinions and beliefs, and encourages them to express their own point of view, ideas, principles, and values in many situations.
6. Completion strategy: The process of completing things that motivates the student to think in multiple directions to find and identify relationships between handy elements.
7. Web Analysis Strategy: It shows the links of some situations, events, phenomena and things around us in complex, interlocking and overlapping relationships (Ramadan, 2016:64). The students who have taken tasks with intellectual challenges and many demands in their school life may have more nervous swells and bushes, than students who have not made representations of such tasks (Afana and the Army, 2009). As a result it is necessary to teach learners how to think if they cannot, and to move up the level of those who can think (Arnold & Comphel, 1989:84). In the same way Langer said that students cannot know how to thing effectively if they do not have a sequence of questions that direct their basic thinking process. Unfortunately, many teachers and parents guess that students can learn automatically from these questions, but they do not, because they want to learn question

mechanisms, problem-solving, critical reading, generalization …etc. While they are doing that a lot of other ways of thinking, work too (Langer, 2004: 10-13).

Thinking improvers need to train teachers and students learning teaching, to develop their teaching strategies, programs, and activities which help them send several forms of knowledge in limited time. They also need guide learners in their learning processes, to make and save productive mind habits, and to provide them with a good class environment when working with this kind of teaching. The theory of brain habits is modern in cognitive psychology, where it was started in the mid-1970s by American management scientist Stephen Covey, creating the concept of The Seven Habits of Highly Effective People (Covey, 2007:149). He referred to the important smart habits which are discriminating in their life, and clarified them as “habits” because they build and develop people’s attitude in active, continuous ways (Nufal, 2008: 76).

Cognitive researchers are interested in education strategies, to put students in a faraway thinking environment, and the philosophy adopted from mind habits offers a wide teaching and learning for the whole of life, because it trains basic and mixed thinking skills which leads to acquired mind habits (Qatami & Amour, 2005: 94). Moreover, Marzano said that mind habits are crucial in teaching, and these are:

1. Self-Regulation. It contains the ability to realize thinking, realize sources, planning, and evaluate work;
2. Critical thinking. It contains the ability to look for quality, clarity, to control feelings, be open-minded, take decisions, and be sensitive to others;
3. Polite Thinking. It contains the ability to discover new problems, solve them, be deep in tasks that do not have direct clear answers or solutions, and wide knowledge (Ibrahim, 2009: 94-95).

From this point of view, the mind's habits are called Intelligent Behaviour, because they consist of a set of intellectual behaviours that lead to productive actions (Abu Riash & Abdul Haq, 2007: 284).

The Study Problem

The problem of current research is answering the following question: What is the effect of the training program on Neural Branching strategies in teaching performance and the productive mind's habits on training students at the Department of Mathematics/ College of Education / University of Misan?

The Study's Significance

The importance of the current study obtains from its including a set of active teaching strategies. They relate to the operation of the brain and activating its potential, which have a positive impact on the achievement of students' cognition and skills. In fact, it offers a model for educational unit formulated in Neural Branching strategies, which possibly advantage teachers, math syllabus developers and educators in preparing modules that resemble different educational stages. It also follows modern trends in terms of the students' mental thinking processes in response to rapid change. Teacher training is a top concern of educational planning, with variables in the field of education. There are many conferences on the topic. A scientific conference held in Iraq focused on issues in teacher training (before and during service) such as:

1. The 13th Scientific Conference of Iraqi Universities held in Baghdad, organized by the College of Basic Education, Mustansiriyah University in March 2011.
2. The 18th Scientific Conference of Iraqi Universities held in Baghdad, organized by the College of Education, Al-Mustansiriyah University, April 2011. (Al Janabi, 2011: 2).

Teacher training before and during service is essential in educational policies. It is needed, to face the challenges arising from cognitive changes and scientific technical developments. It tries to form the professional identity of teachers before service. In addition it offers great benefits for them in possessing productive mind habits, especially in being able to think of Neural Branching strategies, and this positively affects their understanding of what it means to know mathematics. This may help improve their knowledge of maths and education which reflects on their performance; a ruthless topic in teaching mathematics effectively and advancing their students' performance (Hine, 2015: 1).

Teachers must help their students learn; it is that part of their behaviour performances that occur during the teaching process - learning within the classroom directly affects the performance of pupils (Al Janabi, 2011:42).

In this area (Cardellicho & Field, 1997) teaching strategies motivate intercellular thinking and build successful learning, by creating new links between nerve cells. This prompts the individual to expand thinking about new paths that he has not taken before and to unleash the maximum potential of the human mind to work together with real life environments (Willis, 2006; Zull, 2011), as in the following:

1. Hypothetical Thinking Strategy: It means generating information by motivating neurons through conceptualizing problems and their consequences unusually or unexpectedly. This

strategy stands on teacher's hypothetical sequence questions to students, which encourage students to think about events, situations, consequences and consequences.

2. Reversal Thinking Strategy: It means reversing expected things, and provides students with an “asking position” to mention results. Accordingly, it directs student to start from the end, or reverse the reality that exists. Events and attitudes make learners think beyond the acquired knowledge thus giving new ideas.
3. Application of Symbol Systems Strategy: By a lot of symbolic systems in learning situations, students understand, link, and express the elements their own way, during planning, equations or drawings, to relate them. These abilities involve searching for a wide view of integrated knowledge, in an integrated system with a clear relationship of elements.
4. Analogy Strategy: Identify similarities and differences. It requires high creativity, a new idea among the elements, and smart thinking to answer this type of question.
5. Strategic Analysis of Viewpoint: Analyse one’s point of view to reflect its validity, reasonableness and appropriateness, in a learning process, to solve a specific problem. The analysis results in accepting and supporting the point of view, or modifying or rejecting it.
6. Completion Strategy: Complete things prompt Neural Branching to find and identify relationships between elements, to know the missing element; events’ relationships predict what will happen.
7. Web Analysis Strategy: Discover relationships in compound events and phenomena to simplify them. It exercises students' brain, making them think and develop creative skills. In addition, this strategy is different, where in the hypothetical strategy events already happened, but in this, one expects what will happen (Cardellichio, T& Field, W., 1997, 33-43).

The researcher summarizes Neural Branching strategies as asking questions and listening to the answers of students. These strategies are not limited to that, but extend to employ the answers to infer and discover new experiences. Students express themselves and recognize what they like and prefer. Moreover, the teacher guides students' thinking to reach new experiences of evidence.

The Aim of The Study: The study investigates the effect of training programs on training students at the Department of Mathematics/College of Education/University of Misan by using Neural Branching strategies on their teaching performance and productive mind's habits. To achieve the aim, the following hypotheses have been constructed:

1. There is no statistically significant difference at (0.05) in teaching performance between the two research groups, which means: $H_0 = \mu_1 = \mu_2$
2. There is no statistically significant difference at (0.05) in the scale of min's habits between the two research groups, which means: $H_0 = \mu_1 = \mu_2$
3. There is no statistically significant difference at (0.05) of program according to the ETA square equation of the effect size in the two variables studied.

Limits of the Study

1. Fourth stage (training students) at Mathematics Department in College of Education of University of Misan**.**
2. Training program depends on Neural Branching strategies.
3. First semester of the academic year (2017-2018).
4. Seven Neural Branching strategies.
5. Productive mind's habits (Marzano, 2000); namely self-arrangement, critical thinking, and creative thinking.

Terms of the Study

Operational definitions are below:

1. Training: a group of training meetings stands on theoretical knowledge and activities for teachers' mathematic development (trainers) to improve their teaching performance and increase productive minds' habits, which depends on Neural Branching strategies constructed by the researcher.
2. Neural Branching strategies: asks students many questions and listen to their answers which help them discover new experiences and apply it so they express themselves, acquire information, comprehend, represent knowledge in mental structures, towards aligning it with their prior experiences.
3. Teaching performance: scores of the students from observation noted by the researcher.
4. Productive minds' habits: scores of the students from the scale of productive minds' habits (which are self-arrangement, critical thinking, and creative thinking).
5. Student training: male and female students of fourth stage at Mathematics Department of College of Education at Misan University who learn theoretical math materials in first semester and apply it in second semester at high schools during the same year.

Previous Studies

Imai's study (2000) ensured that high school students have to use Neural Branching strategies while learning math, to share many creative thoughts through situations which include open-ended math problems. Likewise, Abdul Azim (2009) introduced the use of Neural Branching strategies to improve creative writing skills and some mind habits of primary students**.** Ali (2009) fixed the effect of using Neural Branching strategies on four primary students in mathematics. Abul Naga and Mohammed (2013) used Neural Branching strategies to develop visual intelligence in engineering achievements for first preparatory grade students. Ibrahim et al. (2014) employed Neural Branching strategies to develop reading comprehension skills in first-graders. Abu Zeid (2014) emphasized the effect of teaching, using thinking strategies, in developing achievement and some mind habits in industrial high school. Abdul Majid (2015) verified the impact of thinking strategies in teaching "Calculus" through self-organized learning skills and the appreciation of mathematical values for students at the College of Education.

Methodology and Procedures

First: Methodology: Semi-experimental methodology was adopted. It includes one independent variable, the training program. It accorded with Neural Branching strategies in the experimental group, and the traditional method of the control group with two follow-up variables, teaching performance and productive mind's habits.
Second: Experimental design: An experimental design was adopted for two experimental groups and control groups, of partial control and post-testing of teaching trainers' performance and productive mind habits.

Table 1: Experimental Design of the Two Groups

Group	Equivalence	Independent variable	Dependent Variable
Experimental	1. Age 2. Pre-achievement of mathematic teaching methods 3. Total average	Training program depends on Neural Branching strategies	1. Teaching performance of students trainers 2. productive mind's habits
Control		without the training program	

Third: Population and Sample: Students' trainers at the Mathematics Department, in the fourth stage, at the College of Education at the University of Misan were the sample. The total number was (70) male and female students, divided into two classes for the academic year 2017-2018. Classes were chosen randomly by the researcher (instructor) where (A) for the experimental group included (35) students taking the training program in first semester, measuring their performance after training period at high schools in second semester. Class (B) for the control group included (35) students using a traditional method.
Fourth: Equivalence of the groups: Statistical equivalence for students' trainers occurred in many variables:

a. Age: The data was taken from the College's registration, and confirmed by the students themselves, as calculated up to 1/10/2017.
b. Pre-achievement of mathematic teaching methods: Scores of students in the course of mathematic teaching methods at third stage of the academic year (2016-2017); these were taken from the general register.

c. Total average: Students' average from their third stage of the academic year (2016-2017) were taken from the general register.

The Mean average and standard deviation of equivalence variables were calculated for two groups, to see the significant differences between them, using T-test independent samples, as described below:

Table 2: The Mean, standard deviation, and T – Value for the equivalence variables

Variables	Group	No	Mean	Std. deviation	Df	Computed t. Value	Tabulated t. Value	Statistical significance
Age	**Experimental**	**35**	**257.43**	**2.78**	**68**	**0.745**	**1.99**	**Not Significant**
	Control	**35**	**256.91**	**2.99**				
Pre-achievement	**Experimental**	**35**	**76.24**	**10.79**		**0.235**		**Not Significant**
	Control	**35**	**75.66**	**13.46**				
Total average	**Experimental**	**35**	**71.14**	**13.06**		**0.158**		**Not Significant**
	Control	**35**	**71.6**	**11.1**				

The table above shows that all T – Values are not statistically significant at (0.05) where Tabulated t. Value (1.99) below Computed t. Value at degree of freedom (68), so that the two groups are equal in all variables.

Fifth: Study instruments

a. Construct training program: Most programs have three stages in a direct or indirect way, namely; planning, applying and evaluating so that the researcher builds the program as the following:

1. Planning: it consists of two basic steps. The first analysis is important in building training programs where they determine the basic lines and needs of it as in the following:

- Determine trainers' characteristics:
  - ✓ the same age
  - ✓ the same material subjects in curricula in whole study levels
  - ✓ they have no pre–experience of any training program about Neural Branching strategies
  - ✓ the same social and economic levels
- Determine the necessity of the training program: most experts who intervene in training and its programs argue that any program should be constructed in the light of learners' need, defined as "a group of information and directions that learners have to acquire, develop, or modify to be suitable with wide changes in performance or thinking ways with different circumstances", so that the needs of aimed trainers are below:

- ✓ ensure that the general and math teaching methods do not have Neural Branching strategies
- ✓ make interviews with mathematics' teachers to know if they have pre-knowledge of these strategies
- ✓ visit the trainers, through teaching their students to make sure they do not have pre-knowledge of these strategies

2. Design: draw the frame of training program from aims to content and all needs of meetings' requires of time, number, and subjects. This process has a series of activities:

- ✓ determine program aims. It is the first step of constricting a program because aims determine what the trainer's performance will be after getting experience and choosing the content, so that aims have been put:

a. Provides experimental group with information, concepts, and principles about Neural Branching strategies.
b. Use Neural Branching strategies in teaching by trainers.
c. Motivate trainers to like their works.
d. Give positive attitudes about using Neural Branching strategies in teaching
e. Determine behaviour objects of training meetings.

- ✓ Determine training program content: after reading a lot of books and previous studies, the researcher summarized the headlines of content, depending on program aims and learners' needs. The program consists of two parts. The first is a theoretical background about Neural Branching strategies. The second consists of implementation sheets about using these strategies in different lessons of math in high schools. The training subject consists of:

i. General concepts of mathematics (concepts, principles, skills, and solving problems and exercises)
ii. Good skills and principles of teaching content
iii. The steps for solving Neural Branching strategies
iv. Neural Branching strategies, definitions, steps. Using it in mathematics content involves:

- o Hypothetical Thinking Strategy
- o Reversal Thinking Strategy
- o Application of Different Symbol Systems
- o Analogy Strategy
- o Analysis of Viewpoint
- o Completion Strategy
- o Web Analysis Strategy

- ✓ Prepare fourteen meetings training and it contains: unit title, time, aims, needs and activities.
- ✓ Design training techniques: lecture, discussion, brain-storming, cooperative learning, group work to build general teaching idea.

3. Implementation: the program applied to students at 17/9/2017 and ends at 25/1/2018.
4. Evaluation: this has three kinds. First, a pre-evalution occurs through giving program to specialists to know their opinions and suggestions about the whole program. The second aims at continuation of the program through data collecting such as self and group sheets in each

meeting, aims. It also involves asking oral questions, and activities to destroy negative things. The third is a post-evalution to see the program's effect after finishing training terms, and it consists of:

- ✓ trainers' opinions about the program benefits and how much worth they obtained from it
- ✓ Researcher's observations through meetings which reflects the trainers' activities.

Study Tools

First: Observation teaching performance

- ✓ Construct Observation checklist: to ensure trainers' performance after treatment, during direct observation. It is divided into planning, implementation, and evaluating. It consists of (35) items (weak, acceptable, middle, good, and very good), got degrees (1, 2, 3, 4, and 5), so the scores of observation is about (35- 175).
- ✓ Validity of Observation Checklist: The validity was obtained by methodology specialists. In accordance with their suggestions, modifications were made which received 80% agreement.
- ✓ Reliability of Observation Checklist: Two observers from College of Basic Education; specialists in mathematics methodology. The researchers observe five trainers (Pearson Correlation Coefficient), so the overall correlation rate was (0.88). It is a high rate of agreement between the researcher and the observers. The observation checklist is ready to be applied.

Table 3: Correlation Coefficient between Researcher and Observers to Determine Reliability of Observation Checklist

Observation checklist	Plannin	Implementation	Evaluation	Correlation Coefficient
The researchers with first observer	0.89	0.79	0.83	0.84
The researchers with second observer	0.91	0.88	0.91	0.90
The first observer with the second one	0,88	0.84	0.92	0.88
The researcher after two weeks	0.85	0.91	0.87	0.88
Pearson Correlation Coefficient	0.88	0.86	0.88	0.88

Second: Productive Minds' Habits Scale

- ✓ Construct Scale: It consists of (30) items (very little, little, middle, big, and very big) get degrees (1, 2, 3, 4, and 5), so the observation scores are about (30- 150).

- ✓ Validity of the Scale: The validity was obtained by specialists in methodology. According to their suggestions, modifications were made which received 80% agreement. The final Scale consists of (30) items.
- ✓ Reliability of The Scale: By using the Alpha Kronbach equation on a random sample from outside of (25) students, the scale applied and the value of the reliability of the scale was (0.89) which is good.

Statistical Tools

SPSS has been used to find the statistical results.

Analysis of Results

1. The results of first null hypothesis (There is no statistically significant difference at (0.05) between the mean score of the students using the program, and those using the traditional method, according to their checklist performance); T- test is used (See Table 4)

Table 4: Means and standard deviations of the two groups in teaching performance

Group	No.	Mean	Std. deviation	Df	Computed t. Value	Tabulated t. Value	Statistical significance
Experimental	35	108.43	9.03	68	19.39	1.99	Significant
Control	35	74.86	4.84				

There is a statistical significance difference between two groups. Therefore, alternative hypothesis (Ha) is accepted and null hypothesis (Ho) is rejected. It means that “there is a significant effect of applying the program to students’ teaching performance.

To illustrate the difference between the mean for each observation checklist part, the T-test for two independent samples used to compare the experimental and control groups in each part at (0.05) are as following:

Table 5: Means and standard deviations of the two groups in each observation checklist part

Parts	Group	No	Mean	Std. deviation	Df	Computed t. Value	Tabulated t. Value	Statistical significance
Planning	Experimental	35	27.34	3.06	68	15.99	1.99	significance
	Control	35	17.97	1.64				
Implementation	Experimental	35	59.37	6.22		14.21		significance
	Control	35	41.60	4.00				
Evaluation	Experimental	35	21.71	2.54		10.87		significance
	Control	35	15.29	2.41				

The results show statistically significant differences between the means of the experimental and control groups, for the experimental group. That indicates the training program has an effect in raising the teaching performance of students' trainers.

The researcher believes that the training program achieved its objectives. It influences the students and improved their teaching performance, including teaching skills (planning, implementation, evaluation), training on writing behavioural objectives, and daily planning. Neural Branching strategies, various activities, the use of different teaching methods and the good educational environment make them able to apply these professional skills in the workplace. All of these things make the experimental group successful in improving their teaching performance.

2. The results of second null hypothesis (There is no statistically significant difference at (0.05) between the mean score of the students using the program, and those using the traditional method, according to their productive minds' habits scale). A T- test is used (See Table 6).

Table 6: Means and standard deviations of the two groups in productive minds' habits scale

Group	No.	Mean	Std. deviation	Df	Computed t. Value	Tabulated t. Value	Statistical significance
Experimental	35	92.69	7.58	68	14.703	1.99	significance
Control	35	69.8	5.23				

There is a statistically significance difference between the two groups. Therefore alternative hypothesis (Ha) is accepted and null hypothesis (Ho) is rejected. It means that "there is a significant effect of applying program on students' productive mind's habits".

This result can be traced back to the nature of the program and the attitudes of training activities that, by using the seven strategies, improve students' performance in the scale of mental habits. In addition, they employed individual lesson or groups plans to link concepts to enhance their mental competence, and focused on basic cognitive skills; intensive training that can activate the brain's memory. Likewise, they encourage the learner to employ necessary information and self-assessment. According to Marzano (1992): When a person tries to take a point of view on a subject, he has no information about him. Then he seeks evidence, which is not differentiated to give difficult situations to answers in different ways, to try to find solutions. Marzano explained that productive mind habits, by self-regulation, critical thinking or innovative thinking, can be found by the student in every school exercise, and these skills impact the acquisition of information and refinement of knowledge.

3. The results of third null hypothesis (There is no statistical significance at (0.05) for the program according to Equation of ETA square of the effect size in the study variables). The size of the effect of the training program on teaching performance variable after calculating the value (T-test) with calculating the ETA square:

$$\eta^2 = \left(\frac{t^2}{t^2 + df}\right) = \frac{(19.39)^2}{(19.39)^2 + 68} = 0.84$$

Then change η^2 to d by relationship $d = \frac{\eta^2}{\sqrt{1-\eta^2}} = \frac{0.846}{0.392} = 2.158$,

while the effect of the training program on the productive mind's habits is:

$$\eta^2 = \left(\frac{t^2}{t^2 + df}\right) = \frac{(14.70)^2}{(14.70)^2 + 68} = 0.760 \qquad \therefore d = \frac{\eta^2}{\sqrt{1-\eta^2}} = \frac{0.760}{0.489} = 1.55$$

The effect size happens because the independent variable is a training program, where the size effect was big on dependent variables. It means this program satisfies the students' needs.

Conclusions

In the light of results it is concluded that:
1. The program succeeds in improving students' teaching performance and productive minds' habits at the fourth stage of the Department of Mathematics, in the College of Education.
2. The program improves students' abilities in preparing lesson plans. It does so through applying teaching techniques from training meetings, to change them into behavioural patterns, to create an active educational environment, thereby providing cooperative learning during the learning process, which makes productive mind habits.

Recommendations

In the light of result it is recommended:

1. The necessity of using Neural Branching strategies by students' trainers.
2. Train teachers on using Neural Branching strategies to reduce students' weakness in mathematical situations.

Suggestions

The researcher suggests**:**

1. Make training studies depend on Neural Branching strategies with new variables in other colleges or universities.
2. Make studies depend on training programs, which in turn depend on Neural Branching strategies for mathematics teachers, to improve their students' productive mind habits.
3. Make studies on productive mind habits on new variables.

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