The Effect of Brainstorming Strategy on Grade Eight Students Achievement in General Science in Ajlun Governorate – Jordan

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Problem and Significance of the Study

Though teaching –learning process has been continuous for ages, the main factor is the teacher who shoulders the responsibility of providing the student with information though the latter is unaware of its consistency and logic. Because of the new developments the world has been witnessing like knowledge proliferation, fast communication and openness to the world which has become a small village, it is imperative to turn out new generations that can face these various challenges and developments. This entails developments of new teaching methodology especially in science teaching. New trends focus on the interaction between all the elements of the teaching- learning process to enhance the student performance level. Among the new strategies adopted is brain storming to attain the objectives of science teaching and development (el- Mufti, 1995). Many academic conferences and symposiums asserted the need to development of teachers preparing programs in colleges of education. The student thing should be developed, too through controlled programs and various teaching methods like learning through discovery, riddles, games enrichness activities, brainstorming and brain storming.

The General science is one of the basic school topics that can develop the student though and build his personality. This requires various teaching methods entailing the student to be a knowledge seeker rather than receiver( Ghabyin,1992).

To due to the diverse science learning, the brain storming strategy has been the topic of this study. According to Yacob( 1996) , brain storing has the following features;

1- It reduces student mind slackness.
2- Introducing thoughts without fearing failure.
3- It encourages the students to come up with new ideas.
4- It enhances the student innovative thinking and creates student- centered learning.

To be successful, the brainstorming process must have the following conditions (Jarwan (2000)):

1- The problem must be clear for the group leader and the participating.
2- The rules should be clear and the participant should adhere to them.
3- The leader or the teacher must have adequate experience in the brainstorming process.

Due to the importance of this strategy in fostering innovation and boosting achievement, the researcher of this study conducted an empirical study on grade 8 students to validate the existence of the effect this strategy on the students achievement in general science.

Problem of the Study:

Due the students’ low achievement level in general science and scantiness of student- centered activities, this study is an endeavor identify the brainstorming strategy effect on grade eight students achievement in General Science.

The problem Components:
The study tries to answer the following questions:
1- Is there any significant effect of using the brainstorming strategy compared to the regular method on grade eight students?
2- Are there any significant differences pertaining to sex in the controlled and the experimental group achievement?
The hypotheses of the Study:
The study tests the following hypotheses:
1- There are not any statistically significant differences attributed to the teaching method at(α=0.05) between the means of the controlled and the experimental group.
2- There are not any statistically significant differences attributed sex at(α=0.05) between the means of the controlled and the experimental group.

Significance of the Study:
The importance of this study stems from the significance of the brainstorming strategy in teaching as a whole and in science teaching in particular. Validating its efficacy constitutes a drive for teachers to adopt brainstorming strategy in teaching. It may encourage the educational supervisors to modify their supervision methods, too. Other researchers may be encouraged to carry out other studied pertaining to this strategy.

Limitations of the Study:
- Brainstorming strategy: this strategy provide scientific information in the forms of short problems that challenge the students minds and requires coming up with a number of solutions in short period of time besides giving every student to express his opinion and share others opinions and it fosters coming up with new ideas.
- The Normal Method; It is the method in which the teacher uses the lecturing, discussion or the presentation methods. The teacher has the greater role while the learner is receiver with limited share in the learning process.
- The scholastic achievement: It is the score that student gets on the twenty –five multiple choice item test the researcher prepared for the study.

The Theoretical Background:
Because of the significance of brainstorming in many areas, it has several definitions:
- Jarwan( 2002) defines it as “the active challenge to the problem” and the basic aim of the brainstorming session is to generate a list of ideas that can solve the problem under discussion.
- Rawlinson (1981) sees at “a means to get significant number of ideas in short time”.
- Geimer( 1998) defines it as “ to brainstorm others ideas with criticism or limitations.”
- Al-Qayyesi(2001) defines it as” a collective learning strategy brainstorming the utmost number of the learners ideas without evaluation during the session”.

According to Qattami(2001), the success of brainstorming depends on:
1- Deferring any judgments of the ideas put forward in the initial brainstorming stage, because criticism of an idea or evaluating it hinders the attainment of the best idea.
2- Quantity generates quality: focusing during the session on generating as many ideas as possible regardless of quality.
3- Building on others ideas: others ideas are common for all to come up or develop new ideas by using the ideas introduced during the session.

How can brainstorming be presented during class?
According to Hannorrat(2002) the brainstorming session can be carried out in one or more of the following studies:
1- Introducing in special syllabus issues like drugs addiction, environment pollution and the public opinion.
2- It should not be independent of scholastic curricula.
3- Merging the two preceding steps according the class needs

Brainstorming Objectives:
According to Jarwan( 2002), the most important objects that can be attained during a brainstorming session can be:
1. Innovative problem solving.
2. Creating problems for the opponent.
3. Fostering the trainees thinking and training them in brainstorming.

To achieve these goals Ali( 2001) suggests the following:
1- Testing the main problem and rephrasing the data on the board as an introduction to the brainstorming session.
2- Varying the rephrasing of the problems starting with the know-how questions.
3- The teachers should brief the participants about the problem before the brainstorming session.
4- Diagnosing the session: the participant ideas are introduced at this stage in period of no more than five minutes.
5- Coming up with a unique that generates unprecedented ideas in the brainstorming session

But, El-Sobery (2001) suggests some procedures to obtain the brainstorming:
1. Dividing the students in groups of ( 5-8) and monitoring them.
2. Introducing the clarifying the problem to be discussed.
3. Ensuring that every student understand the problem and the topic to be discussed.
4. Encouraging every student express his opinion about every problem.
5. Warning against pre-formed judgments of others onions
6. Fixing the time: its beginning and it end.
7. Asking the students to answer the questions following the lesson.

Mattalqah (1998) and El-Zu’aby(2003) cite guidelines for using this strategy in teach general science that can be to solve the problem and the questions of the study:
1. Deciding the session topic as the research problem( Environment Pollution).
2. Briefing the class about the topic (Environment Pollution).
3. Rephrasing the problem into questions:
   - How can we reduce air pollution?
   - How can we reduce water pollution?
4. Fostering an innovating atmosphere of brainstorming as the teacher explains the procedure to the students and reminding them with the brainstorming rules such as:
   - Say whatever you like.
   - Don’t criticize any of the other participant’s opinions.
   - Don’t elaborate.
   - You can make use of the participant’s opinions.
   - Listen to the leader instructions and carry them out.
   - Give chance for jotting your ideas down.
5. Appointing the session leader
6. The answers to the questions are sequentially- dependent.
7. The participants are asked to express their opinions are answers to the questions asked.
8. The reporter of the session writes the ideas in sequence.
9. The session leader urges the participants to settle on the most peculiar idea and develop it into a practical one, then associate the ideas together to become up with good idea.
10. Classifying the ideas introduced by the participants into
    - Feasible and teachable ideas.
    - Good ideas but cannot be directly applied and needs further investigation.
11. The session leader selects the applicable good ideas.

Previous Studies:
Following the studies and research that highlight the effect of brain storming on the student’s achievement:
El-Zu’abey (20030 investigated the effect of controlled discovery and brainstorming on el Qoorah district(in Jordan) grade eight the development of critical thinking and achievement in the Islamic
education – jurisdiction. The study showed that there is an effect of the three methods: brainstorming, and discovery and discussion, regardless of sex.

El-Harbi’s study (20020) showed statistically differences on the first secondary biology class in the post achievement of the cognitive objectives of Bloom’s Taxonomy in favor of the controlled group. It also showed significant differences in the achievement of experimental group which was taught by the brainstorming method.

Collado (1992) compared the analogue learning method and brainstorming in the development of the innovative thinking. The results showed that the analogue learning is more effective in the development of the innovative thinking than the brainstorming method.

Berumdez and Prater (1998) conducted a study on brainstorming on the comprehension of a sample at university of Houston, Texas and showed that there were higher significant differences in comprehension for experimental group.

The studies show that brainstorming has a significant effect improving the student achievements in various topics including general science.

Therefore, this study is based on the past studies and it investigates the effect of brainstorming on the grade eight students in general science and sex has a role in this effect.

**Method and procedures:**

**Members of the Study:**

The sample of the study involved 130 eight graders in the scholastic year 2011-2012, in Ajlun city, the Province of Ajlun. Sixty-four were male students at Ajlun Primary School for Boys grouped into two classes of 32 students each: Class A, the control group, and Class B, the experimental group. Two other experimental and control groups, each consisting of 33 students, of Ajlun primary school for girls were also involved. The brainstorming strategy was adopted in teaching the experimental groups. The two schools were chosen for the study by the purposive method because of teachers’ cooperation and readiness for taking part in the study.

**The Study Tools:**

The researcher prepared the teaching plans for the first unit, “The Electronic Environment of the Elements Atoms Determines Their Chemical Behavior”, for the grade eight general science syllabus, which aims to familiarize the students with the chemical concepts of this unit and how to use the elements periodical table, and mastering the balance of formulas. This entails a separate plan according the content of each lesson. The plans were validated by five expert judges to ensure their level appropriateness, and the proper steps of brainstorming. Then the final versions of other plan were prepared before starting teaching as shown in appendix-1.

- The achievement test: The initial version of the test consisted of (30) multiple choice items to measure grade eight students in the electronic environment unit, but it consisted of (25) items as in appendix-2.
- Test validity: the test was validated by a group of expert specialist judges of the teaching staff; some of the items were rephrased according to their recommendations.
- Test Reliability: The reliability of the test was ensured through neutral pioneering sample of 30 grade students not belonging to the study sample. The test last one hour and the answers were marked and the reliability coefficient (0.85) according (K.R-20), an acceptable value for the purpose of this study.
- Fixing of the Time: the pioneering achievement test took one hour and so is the time the main test.

The steps of study procedures can summarized as follows:

1. Preparing a brainstorming based plan; they were ten as shown in appendix-1 for the experimental group, and training plans for the control group according to the traditional method.
2. Selecting the members of the study.
3. Preparing the achievement test according a specification table and the ensuring its validity and reliability.
4. Conducting the pioneering test on a sample of (30) students belonging to the population of the study to make sure of its appropriateness: clarity of items, instructions and time needed for the test.
5. Orienting the teachers with brainstorming strategy.
6. Then, teaching unit -1 “The Electronic Environment of the Elements Atoms Determines Their Chemical Behavior”.
7. Four weeks after administering the trial study in the achievement test was administered and the students answers were recorded per items of the two groups for analysis and comparison of achievements according the key answer specially prepared for the test.

Generalization of the Study:

The semi-experimental design is adopted to find out the effect of The brain storming on the students achievement. The variables of study are:

G1O1×G2O1
G1: the experimental group
G2: the control group
O1: the post test.
× the experimental factor.

The Statistical Processing:

The statistical processes were used in the study:
The means, and the standard deviations of the students scores for the achievement pre-test and the post test. The t-test was used to compare the control and the experimental groups differences in achievements in the pre-test and the post-test.

Findings of the Study

After carrying out the statistical analysis of the result, the findings of study were as shown in Table-1:

Table -1
The post tests results of the control and the experimental groups

<table>
<thead>
<tr>
<th>Total number of males &amp;females</th>
<th>Group number</th>
<th>the mean</th>
<th>St deviation</th>
<th>t-value</th>
<th>Statistical significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>The experimental G 65</td>
<td>22.2</td>
<td>3.02</td>
<td>5.59</td>
<td>0.001</td>
<td></td>
</tr>
<tr>
<td>The control G 65</td>
<td>17.2</td>
<td>3</td>
<td></td>
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<td></td>
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<tr>
<td>females</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>The experimental G 33</td>
<td>23.3</td>
<td>2.3</td>
<td>4.88</td>
<td>0.001</td>
<td></td>
</tr>
<tr>
<td>The Control G 32</td>
<td>20</td>
<td>2.2</td>
<td></td>
<td></td>
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<tr>
<td>Males</td>
<td></td>
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</tr>
<tr>
<td>The experimental G 32</td>
<td>22.8</td>
<td>2.64</td>
<td>3.36</td>
<td>0.001</td>
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</tr>
<tr>
<td>The control G 32</td>
<td>20.2</td>
<td>1.82</td>
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</tbody>
</table>

The First Question: Is there any significant effect of using the brainstorming strategy compared to the regular method on grade eight students?
Table -1 shows a difference in the means of the two groups; the mean for the experimental group is (22.2) whereas it is (17.40) for the control group. To confirm this result, the t-test was used and showed a value of (5.59) at (α+=0.001). This is a statistically significance difference that shows that the experimental group using the brainstorming strategy scored higher than the control group.
The Second Question: Are there any significant differences pertaining to sex in the controlled and the experimental group achievement?

Table -1 show that there is a difference between experimental and the control female groups in the post test means: the value for the experimental was (23.3) and for the control group, it was (20). To confirm this result, the t-test was used and its value ($\alpha=0.001$). This is a statistically significance difference that shows that the experimental group using the brainstorming strategy scored higher than the control group.

The table also show that the post test mean for experimental group was (22.8), whereas it was (20.2) for the control group. To confirm this result, the t-test was used and its value was ($\alpha=0.001$). This is a statistically significance difference that shows that the experimental group using the brainstorming strategy scored higher than the control group.

Discussion of the Results:

The first question: Is there any significant effect of using the brainstorming strategy compared to the regular method on grade eight students?

The results of the study show a difference in the means of the two groups; the mean for the experimental group is (22.2) whereas it is (17.40) for the control group. To the t-test confirmed this result with a value of (5.59) at ($\alpha=0.001$). This is a statistically significance difference that shows that the experimental group using the brainstorming strategy scored higher than the control group. This result agrees with El-Harbi’s (2002) study that investigated the effect of brainstorming in development of the critical thinking and post test achievement and showed that the experimental group scored higher the control one. But it contradicts Collado (1991) study that show analogue learning surpasses learning by brainstorming.

Therefore, the brainstorming strategy has a positive effect on science teaching and students scholastic achievement. This achievement advantage can be attributed to the following reasons:

- The recent introduction of brainstorming as learning strategy in teaching science the Jordanian schools. This encourages the students to take part in the teaching – learning process.
- This strategy requires cooperation and interaction among the students themselves through questions and this boosts their willingness and impulse to learning as indicated by el_Zu’abey (2003).

The Second Question: Are there any significant differences pertaining to sex in the controlled and the experimental group achievement?

The study shows that there are no significant difference ($\alpha=\leq0.05$) attribute to sex; the mean score for the females was (23.3), whereas it was (22.8).

This can be attributed to:

- The similarity of the educational environment, the curricula, preparation, training and the teaching environment of both sexes.
- The similar credentials of female and male teachers.
- Following the same methods and procedures for teaching both sexes and this created an equal positive effect on the students regardless of sex.

Recommendations:

The study came up with the following recommendations:

1. Teachers should be urged to use the brainstorming strategy in teaching science.
2. The Ministry of education should focus on training and qualification of teachers and should adopt new teaching strategies including brainstorming.
3. Further studies should be conducted to investigate the importance of brainstorming and its effect on other facets the teaching learning process.
Appendix–1
The lesson Design according To the Brainstorming Method: Atomic Number and Mass 1-Appendix
You are expected to be able to
- Differentiate between the atomic number and the mass number.
- Describe the case of the electrically balanced atom.
- Identify particles that determine the atom mass.
- Learn as you are told by the teacher

Selecting the problem (topic) for the students:
You have already learnt in the Measuring the Atomic Mass Unit is important because it studies the elements properties. What makes the element different? Why the atom is electrically balanced, though it has particles with negative electrons and positive protons? Does the number of the atom electrons have role in determining its atomic number, mass number and the method of their calculations?

Rephrasing the problem for the students:
- What is the meaning of the atomic number and the mass number?
- Describe the electrically balanced atom.
- What are the particles that determine the atom mass?
- Inference of the charge type of each atom particles.

When answering the questions, the students should abide by these rules:
- Don’t criticize any idea introduced by your colleagues.
- Suggest the maximum number of related Ideas that come to your mind.
- Your ideas are common for all; they can make use of them in producing new ideas like merging two ideas into one or more.
- The innovation atmosphere should be facilitated for the teacher.

The teacher explains the work method to students illustrating the basics of the brainstorming session depending on:
- Encouraging the students say whatever they like regardless of its peculiarity, reality, unreality, or strangeness.
- Not to criticize or oppose the ideas of others.
- Making use of and developing ideas introduced by the group members.

The Role of the Teacher during the Brainstorming session:
The teacher writes the questions made in the rephrasing stage on condition that the students introduce their ideas in sequence. The class will be divided into four groups and everyone them will discuss one of the following questions:

Group One:
The main question: “What is the atomic number and what is the mass number? What is the difference between them?
The teacher listens to the group and writes the ideas introduced on the board.

Group Two:
The main question: How are the charges in the electrically balanced atoms?
The teacher listens to the group and writes the ideas introduced on the board.

Group Three:
The main question: The particles of the atom are the electron, the proton and the neutron, which one of them decides the atom mass?
The teacher listens to the group and writes the ideas introduced on the board.

Group Four:
The main question: Every particle inside the atom has a charge, identify it?
The teacher listens to the group and writes the ideas introduced on the board.
Deciding the Strangest Idea:
The teacher urges the students to come up with the strangest idea, scrutinizes the ideas introduced to deduce the important and strange ones to develop them into feasible ones.

**The Appraisal Session:**
All the ideas are written on the board for classification and then summarized into the minimum number of ideas into:
1- Feasible and applicable ideas (every element has its unique properties based on the atoms it consists of).
2- Useful; but inapplicable ideas (the number of the electrons and the protons are equal.)
3- Curious and non-scientific ideas (all electrons are alkaline).
4- Excluded ideas: (they represent the elements the interaction elements under common circumstances).

**Appendix – 2**

Achievement Test Instructions:
1. This test consists of (25) items.
2. Every item has four choices, one of them is true. Put (×) inside the space of the correct answer against each item. Example:
   - The shadow form behind retina because of:
     a- D deformation in the eye ball
     b- Slackness of lash muscles
     c- ( a+ b) correct
     d- None of the above

<table>
<thead>
<tr>
<th>Item no.</th>
<th>Choices</th>
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<tbody>
<tr>
<td></td>
<td>A</td>
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3. You test score is the sum of all correct answers.
4. Don’t write anything the question paper and hand it in with the answer sheet.
5. Answer all the question items.
Good Luck The researcher

1. The unit measuring the atom mass is
   a. Kg.   b. atom mass unit   c. Newton d-atomic number unit
2. The element atom that can give one positive charge ion is:
   a. Sodium   b. Aluminum c. oxygen d. chlorine.
3. The fireworks element is:
   a. magnesium nitrite, sulphur and carbon.
   b. silver nitrite, sulphur and carbon
   c. potassium and carbon
   d. aluminum nitrite and carbon
4. The substance color resulting from magnesium and oxygen is:
   a. ozone b- red    c- black d- yellow.
5. Mendel’s table was accepted because of:
   a. Discovery of Uranium
   b. The existence of vacuums for the elements atoms.
   c. Ordering the items with their atomic weight.
   d. Ordering the element according to their chemical interaction
6. The state of the element in the room normal temperature is:
   a. solid   b. liquid   c. gas d. fluid
Achievement Test Answer Key Sheet:

<table>
<thead>
<tr>
<th>No</th>
<th>Answer</th>
<th>No</th>
<th>Answer</th>
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<td>1</td>
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