European Journal of Social Sciences
ISSN 1450-2267 Vol. 58 No 1 May, 2019, pp.53-60
http://www.europeanjournalofsocialsciences.com/

The Impact of a Training Program Based on Multiple Intelligence Strategyon the Development of ScientificThinkingAmongPractical Education Students

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Abstract

This study aims to identify the impact of a training program based on Multiple Intelligence (MI) strategyon the development of scientific thinkingamong the students of Practical Education course. The study subjects were selected from the students of Practical Education course at Al-Balqa' Applied University in Jordan during the first semester of the Academic year 2018/2019.The study sample consisted of 60 male and female students distributed into an experimental group with 30 male and female students, and a control group with 30 male and female students. To achieve the study aims, a test was constructed for the scientific thinking. A training program based on MI strategy was also prepared. The program consisted of 8 training sessions, each of which is 45 minutes long. The results showed that there is a significant impact for the training program which is based on MI strategy on the development of scientific thinkingamong the students of Practical Education course, where the scientific thinking level among the experimental group students was significantly higher than that of the control group.

Keywords: Training program, Multiple Intelligence Strategy, Scientific Thinking, Practical Education

Introduction

Education is designed to contribute to the preparation of educated individuals capable offacing practical life by providing them with basic information and skills, developing positive attitudes towards practical life, as well as working on developing learners' creativity. This trend is generated by the rapid change in knowledge and technological methods.

The growing interest in practical education is due to the rapid growth in science and its increasing employment, and to the diversity of sources of access, as traditional means are no longer keeping pace with this growth nor effectively contributing to development. This led to an increase in the need for creative initiatives that provide individuals with open opportunities to learn science in a way that suitstheir present and future needs (Zaitoun,2011).

Saliti & Mufaddi(2014) point out that by 2020 , information will have multiplied every 35 days, while it might double in science and technology every 20 months. Thus, the main aim of modern practical education is to develop the skills of higher order thinking in general, and it has become necessary for those responsible for the university educational process to care about teaching students thinking skills. Thinking is considered asa key factor in man's life as it helps in life's guidance and progress. It also helps in problem-solving and avoiding a lot of hazards (Al-Syouf,2019).The

development of scientific thinking is one of the most important modern topics in education. Many educational decision makers consider the need to focus on the development of effective scientific thinking skills at the university education level as their role is not excluded to teaching concepts and facts, or even teaching about thinking, but it goes beyond that to the level of developing thinking modalities and the ability to practice mental processes (Al-Shalabi& Al-Khlifah,2017). Al-Mefleh(2012) considers scientific thinking as a collection of sequential processes, if followed by an individual,they will lead to a new knowledge.These processes range from observation and assessment to the awareness of the problem, the search for ways to solve the problem, interpret the collected data and formulate generalizations and end with building a theoretical model or testingand modifyingan existing model.Scientific thinking is an approach through which any phenomenon is interpreted by revealing the reasons that led to its occurrence in this way,but this is achieved by a historical empirical study of the phenomenon, provided the disclosure of what is essential and crucial and acting as the role of the cause.

The ability to think scientifically is one of the goals of education, where educators and specialists in the teaching of science look at the development of scientific thinking as one of the basic goals and objectivesthat scientific education should achieve among educated individuals (Zaitoun,2008,94).This was emphasized by the results of a study carried out by Asfour (2015) which addressed activation of psychological immunity to develop the skills of scientific thinking and reduce anxiety of teaching among female teacher students of Philosophy and Sociology Department. To achieve this, a program was prepared to activate psychological immunity among teacher students where it is emphasized that there is a significant difference between the means of teacher students' grades in the pre-application and post-application of a scientific thinking test, and in assessment of the teaching efficiency in favor of the post-application.

In addition, Saliti & Mufaddi (2014) conducted a study that addressed revealing the impact of using MI strategies, problems solving and the six thinking hats in the development of scientific thinking among the 8thprimary graders in Jordan. The study emphasized having significant differences between the score means of the students who studied using MI strategies on the one hand and the score means of the students who studied using the six thinking hats and the problem-solving strategies on the other hand in favor of the group that studied using MI strategies. Meanwhile, Rebecca (2013) carried out a study that addressed the effect of a joint interaction between the scientific thinking style and the variables of gender, specialization and academic level on attributing in concept acquisition. The study showed that the subjects were inclined towards scientific thinking skills. Although teaching university courses requires students to use higher order thinking skills accompanied with problem solving and decision making, all the instruction methods used in teaching the university content still focus on traditional techniques, and the university curricula often focus on the knowledge increase rather than depth. The importance of the instructional strategies appears through the role they may play in raising students' capacities, revealing their potential, developing their thinking abilities and improving their readiness for creativity.

Educational literature indicates that the strategies of MItheory care about thinking skills and raising its level among students. Multiple intelligence theory is based on a group of principles the most importantof which is that any individual has various kinds of intelligence (Gardener, 1993).

Jarwan (2015) argues that most people behave in accordance with a collection of intelligence kinds that help them solve different kind of problems they encounter in their life. For most people, intelligence shows how the synergy of all the other kinds of intelligence form a product of anumber of intelligences. Beyer (2011) defines MI as a group of mental capacities and skills, called intelligencesthat enable individuals to deal efficiently with various life situations. These abilities vary and characterize individuals as measured by tests prepared for this purpose. Abu-Semeid (2008:96) points out thatinelegances work together and support each other to solve certain problems and that the work achieved by an individual is merely a result of a synergy between a collection of intelligences. Within this context, the results of a study conducted by Khataybeh, & Al-Budour (2010) emphasized

the superiority of the groups that the were taught using MI strategies over the groups that were taught using the traditional method. Moreover,the results of a study conducted by Khalil (2009) about the impact of using MI strategies on the achievement of 4th grade students and the development of science processes kills and their generative thinking, emphasized having significant differences in favor of the experimental group that was taught using MI strategies in the achievement test and the science skill test.

Study Problem

Educator always express their anxiety about students' inability to think scientifically all through their various university stages as scientific thinking leads to good results in terms of academic achievement. There were continuous development attempts to develop the skills of scientific thinking among students. This is a basic and always present problem for the educational and teaching process. Despite the numerous studies and theoretical research in the literature of this topic,especially in the western communities, there is still many questions about the practical practices to develop these skills and providing training programs in this regard is still dearth. Through theresearcher's work as a faculty member at Al-Balqa' Applied University, and while teaching some academic courses there, he noticed a disparity in students' perception of the importance of scientific thinking. Hence, the idea of this study is to attempt to assess the impact of a training program based on MI strategy on the development of scientific thinking among the students of Practical Education course. The study tries to answer the following question: **What is the impact of a training program based on MI strategy on the development of scientific thinking among the students of Practical Education course?**

Study Significance

Multiple intelligence is a strategy that aims to build new desired behavior styles to activate metacognitive skills. The importance of this study is clarified in the following: checking the impact of a MI in on the development of scientific thinking among the students of Practical Education course. It is expected that the planners of university curricula in general will benefit from the results of this study interms of inserting the strategies of multiple intelligence in the university courses and in accordance with the results of this study. This study might satisfy scholars' need for modern training programsthat play a role in the development of scientific thinking.

Study Terms and Procedural Definitions: The study contains terminology that are defined as follows:

Training Program: a group of ten 45-minute training sessions scheduled as two sessions per week.This includes skills, knowledge, expertise, attitudes, technical, managerial and human elements to be included in the training program provided in this study for the students of Practical Education with the aim of developing their scientific thinking.

Multiple Intelligence Strategies: these strategies are based on the fact that individuals have different kinds of intelligence that they use in problem solving and a way that these inelegancies interact with each other when performing a certain task. In light of this definition, the strategies of this study are: the teaching strategies that contain a group of organized, ordered and planned steps and procedures used by a faculty member in terms of the implementation of various activities, the use of teaching methods and evaluation that are suitable to the thinking modes provided in the Multiple IntelligenceTheory. These kinds are: Verbal-linguistic intelligence, logical-mathematical intelligence, visual- spatial intelligence, musical-rhythmic intelligence, bodily- kinaesthetic intelligence, interpersonal intelligence, intrapersonal intelligence and naturalist intelligence.

Scientific thinking: is a complex mental purposeful activity oriented by a strong desire to search for solutions and access to authentic outcomes that were not previously known(Jarwan,2015:83).**The researcher defines scientific thinkingprocedurally**as the ability of the

students of Practical Education course at this stage to provide products characterized by excellence and originality and to move flexibly between the and the manufacture of some solutions to the problems they encounter. Scientific thinking is measured by the degree that the student obtains in the scientific thinking test prepared by the researcher for the purposes of this study.

Study Limits and Limitations

The study limits and limitations are excluded to the following**:**

Time limits: This study was carried out during the first semester of the Academic year (2018/2019).

Place Limits: this study was carried out at Al-Balqa' Applied University in Jordan.

Human Limits: This study was applied on the students of Practical Education course at Al-Balqa' Applied University.

Topic Limits: The study topic was specified by the training program prepared by the researcher. The study results are limited to the tool validity and reliability.

Study Method: The study used the semi-experimental method because it is suitable for the study purposes.

Study Subjects: the study subjects were all the students of Practical Education enrolled in the Practical Education course at Al-Balqa' Applied University during the first semester of the Academic year (2018/2019) with a total of 60 students. The study subjects were divided into two sections. The first section is the control group, while the second section is the experimental group, with 30 male and female students in each group.

Study Tool: For the purposes of this study, the researcher used the scientific thinking test. The following are the most important steps in preparing this test.After reviewing the previous literature and studies addressing scientific thinking, the thinking skills test was developed in the form of multiple-choice to measure students' scientific thinking skills.This test consists of 30 paragraphs each with 4 distractors. These paragraphs have been divided equally into five areas:problem identification: from 1-6,setting hypotheses:7-12,hypotheses testing:13-18,concluding results:19-24 and generalization: 25-30.Building the test of scientific thinking skillswent as follows: previous literature and studies that addressed scientific thinking such as the studies of Barakat (2016) and Asfour(2015) were reviewed with the aim of identifying the ideas, methods and scales used in assessing scientific thinking level. In light of this review, five areas of scientific thinking skills were adopted: problem identification, setting hypotheses,testing hypotheses, interpretation and generalization.

Validity of the Scientific Thinking Test: The scientific thinking skills test which consists of 34 multiple choice paragraphs was shown to 11 reviewers from the faculty specialized in Psychology, Evaluation and Assessment in the Jordanian universities. There was a unifying consensus among the reviewers to delete four paragraphs because their content was incompatible with the intended goals. The directives and suggestions of the panel members were considered and the language of some paragraphs was modified. The final test was composed of thirty paragraphs divided equally on five skills: problem identification, setting hypotheses, testinghypotheses, interpretation and generalization.

Reliability of the Scientific Thinking Skills Test: The test reliability was confirmed by using the internal consistency reliabilityaccording to the analysis of paragraph statistics by applying the test once to a pilot sample of Practical Education students of the same community. The sample consisted of20 male and female students. The students' scores were used to get the reliability coefficient usingKuder-Richardson 2o which was (0.81) which means that it is acceptable for the purposes of applying the test on the study sample.

The Training Program Based on Multiple Intelligence Strategy: The researcher has prepared and designed this program by reviewing the previous literature and studies such as the study of al-Saliti and Mufaddi(2014), where the material of the Practical Education course was analyzed, and then the cognitive content and skills of this unit were reorganized depending on the training programthat is

based on the MI strategy to achieve the course objectives.:A tutorial manual for implementing the training program that is based on the MI teaching strategy has been built to include the following: a theoretical framework that shows the concept of multiple intelligence strategy, its inception, its most famous scientists, its foundations, principles, educational importance and how to employ it, the general oobjectives of the training program,expected educational outcomes, the grouptargeted for implementing the training program that is based on the MI teaching strategy, the philosophy of the training program that is based on the MI teaching strategy, the time required to implement the training program, work sheets containing activities based on MI strategy.

Validity of the training program that is based on the MI teaching strategy:

The program was shown to 8 reviewers from the faculty specialized in Educational Psychology and Evaluation and Assessment. In light of the reviewers' remarks, the researcher made the necessary modifications on the training program.

Study Procedures

The following procedures were followed in implementing the study:

Construction of the training programthat is based on the MI strategy which is expected to work on the development of scientific thinking depending on the previous literature and studies. Then, a letter was obtained from al-Balqa' Applied University to facilitate the researcher's task. The study population was selected who were the students of Practical Education course at the university. The students were randomly distributed into the experimental group (33) and the control group (33). The scientific thinking test was administered to the two groups at the beginning of applying the program and directly after applying it. The data was entered to carry out the appropriate statistical analysis, extract results and provide recommendations.

Study Variables: The study included the following variables:

First:Independent Variable:the training program that is based on the MI strategy.

Second:Dependent Variable: Scientific thinking

Study Design

The study design was based on the control and experimental groups and the pre-test and post-test.

Experimental Group	O1	X	O1
Control Group	O1	-----	O1

O1: Pre-test and post-test of Scientific thinking

X: Experimental treatment by applying the training program that is based on the MI strategy.

Statistical Processing

After collecting the data, the test was then emptied and statistical data was processed using the Statistical Package for Social Sciences (SPSS)to answer the study question as follows: The means and standard deviations were used,and the Analysis of Covariance (ANCOVA) was also used.

Study Results and Discussion

This section addresses the study results through answering the following question:

What is the impact of a training program based on MI strategy on the development of scientific thinking among the students of Practical Education course?

To answer the study question,the means and standard deviations of the two study groups performance at the pre-test and post-test of scientific thinkingwere calculated. Table 1 shows the Means and SDs of the study groups performance at the pre-test and post-test of scientific thinking

Table 1: Means and SDs of the Study Groups Performance at the Pre-test and Post-test of Scientific Thinking

No.	Variables	No.	Pre-application		Post-application	
			Mean	SD	Mean	SD
1.	Experimental	30	10.66	1.632	16.90	1.263
2.	Control	30	10.19	1.327	10.68	1.796
Total		**60**	**10.42**	**1.488**	**13.68**	**3.496**

Table 1 shows significant differences between the means and standard deviations of the Practical Education students' scores in the pre-test and post-test of the scientific thinking for the experimental group and the control group. The pre-test means for the experimental group was 10.66, and the SD was 1.632, while the post-test means for the students was 16.90, and the SD was 1.263. Meanwhile, the pre-test means for the control group who were taught using the traditional method was 10.19, and the SD was 1.237, while the post-test means for the control group students was 10.88, and the SD was 1.796. The Analysis of Covariance (ANCOVA) was also used to determine if the difference between the means of the two study groups were statistically significant at the level of (α = 0.05). The ANCOVA analysis results are as follows:

Table 2: ANCOVA Analysis of the Study Groups Performance at the Post-test of Scientific thinking

No.	Variance Source	Sum of Squares	Degrees of Freedom	Square Means	(F)Value	Significance Level	Effect Size
1	Pre-test	4.484	1	4.484	1.866	.177	.032
2	Method	549.713	1	549.713	228.747	000*	.801
3	Error	136.980	57	2.403			
4	**Total**	**720.983**	**59**				

*Significant at 0.05

Table 2 shows that there is statisticallysignificant difference between the experimental group (the group which used MI strategy) and the control group (the traditional method) where F value was (228.747). This is significant at the level of (α = 0.05). This difference is in favourof the experimental group students.This is shown from the adjusted means shown in table 3w, where the adjusted mean of the experimental group was (16.852), while the adjusted means of the control group was (10.719).This shows that teaching using the MI strategy has contributed to the improvement and development of scientific thinking of the Practical Education students.To know the effect size, ETAsquare (η2) was calculated for the scientific thinking test which was (0.801). Thus, it can be said that 80.1% of the variance in the scientific thinking test between the experimental and control groups is due to the method of teaching using the MI strategy.

Table 3: Adjusted Means and Standard Errors of the Study Groups Performance at the Post-test of Scientific Thinking

No.	Teaching Method	Quantity	Adjusted Means	Standard Error
1.	Cognitive modelling	29	16.852	.290
2.	Traditional Method	31	10.719	.280

The superiority of the effect of MI strategy can be explained in the level of scientific thinking compared to the traditional method, as explained in previous literature that the MI strategy includes many situations that require problem solving. This contributes to the development of different ways of thinking among students of different abilities and intelligences, especially those concerned with the skills of scientific thinking. Moreover, this strategy is also characterized by the diversity and multiplicity of the activities involved. Thus, this strategy suits all the students' intelligences, and enablesthem to invest as much of their intelligence as possible, and in the development of various

mental processes such as: observation, data collection, setting assumptions, classification and measurement. The results of this study are consistent with the results of al-Saliti and Mufaddi (2014)and Asfour(2015).

Recommendations and Suggestions

This study recommends the following in light of the concluded results and discussion:

1. To plan teaching by using MI strategy and training in designing instructional learning situations using this strategy.
2. To use the training program that is based on the MI strategyby faculty members at the university and to circulate it to the rest of the academic colleges.
3. To prepare training programs for the faculty members about the development of scientific thinking among students.
4. To carry out more research to determine the characteristics of the procedures of teaching in this strategy and to compare their effects in education and learning with other educational learning strategies.

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