Effect of mastery learning method on performance and attitude of the weak students in chemistry

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Abstract

In this study, effect of mastery learning method on performance and attitude of weak students in chemistry was considered. In this research which was done experimentally, 40 high school students who were 16 years old were randomly classified into two control and Experimental groups of 20 students after selection and matching. Experimental group was taught in mastery learning method and control group was taught in common method. In this study, chemistry attitude questionnaire (Class-Chem) and academic achievement test were implemented on both groups as pre-test and post-test and multivariate variance analysis method was used in order to determine effect of learning method on each one of the groups and the following results were obtained after data analysis:

1- Mastery learning method is more effective on performance of weak students in higher levels of learning method than in common learning method.

2- Mastery learning method caused to increase positive changes in attitude of the weak students to chemistry learning.

Keywords: Mastery learning method, chemistry learning, change of attitude, learning levels, weak student.

1. Introduction

Educational system tries to provide all learners with the opportunities for learning fundamental and emotional specifications. Learning method in other educational system is group based (each group being 20 to 40 persons) and this causes some students to learn material well and some others to learn material in lower levels. Each teacher works with a group of the students and the interaction between teacher and student is suitable for some students and non suitable for other students, because there are some learners who learn material with speed lower than medium level due to their past specifications (such as congenital and family specifications). These students can make achievement in learning but they need more time, attention and resources (Bloom, 1976).

Some training psychologists and trainers believe that learning should be organized in such a manner that each student can act and learn to have more academic achievement on the basis of their abilities. For achieving such goal, individual training methods are very suitable methods because students proceed on the basis of their abilities in this...
kind of methods. One of these individual learning methods is mastery learning method (Spencer, 1996). As Gentile (1994) said, mastery learning method includes two systems each being derived from different theories but they are common in learning goals and standards. The first system is "Keller Personalized System of Instruction" which is an individual method in which some large groups are taught. Basis of this system is on a behavioral model of which development and progress depend on success of the students in doing their homework in the curriculum. The second system is "Mastery for Learning Group-Based Approach" which is applied as communal approach. This idea was presented in John Carroll learning model (1963-1965) and was expanded later by Benjamin Bloom (1968). In Carroll model, classroom learning is a time-based phenomenon that is the longer the time of learning, the higher the rate of learning will be. Bloom confirming this material believed that if the students were provided with learning opportunity and quality of instruction is commensurate with their personal need, about 95% of them reach mastery learning level. Bloom converted theoretical model of Carroll to a practical model for classroom learning, so that one can provide opportunity in the classroom that all students can achieve high level of academic achievement and their differences in learning can be minimized. Bloom believes that there are three dependent variables in classroom learning and if they are considered carefully, the schools will be able to take step toward an educational system free from mistake. On the basis of this theory, change in cognitive entry behaviors and affective entry characteristics and learning quality determine learning outcome (Bloom, 1976). In figure 1, main variables of this theory and their effect on learning are shown.

Bloom believes that one of the methods which can be useful for study on thoughts of this theory and its practical application in classroom is mastery group-based approach. For application of mastery group-based approach in schools, a formative test is taken after the primary training. The students who don’t pass this test in specified level (80 to 90% of correct performance) are taught again and receive final exam until all students pass the exam and some of them have mastery on lesson unit. Then teacher decides to continue teaching. In the following, stages of this learning method application have been summarized as chart 1.
1- Problem and purpose of research

Finding of Teams Studies between 1995&2007 has shown that rank of 14-year Iranian students in sciences course is \( \frac{29}{49}, \frac{31}{46}, \frac{31}{38}, \frac{38}{41} \) respectively in comparison to other participating countries and average difference of their performance in sciences course from Teams scale mark in these years has been reported to be (-4). This finding means that most of the Iranian students in sciences course are lower than universal scale level in terms of educational performance and indicates that these students face some problems in sciences learning. Some of the researchers found in study on factors effective on chemistry learning that most students like to memorize the material than to understand it. It seems that they think that these concepts are far from reality and use memorization skill which is more based on algorithms than mental solutions (Niaz, 2005). As some authorities say, all of these cognitive processes are mixed with affective processes and this caused some students to think that chemistry is hard to understand and have some problems with chemical concepts development and problem solving (Carter&Brickhous, 1989). One of the main problems of teachers in most countries is selection of teaching methodology and promotion of progress and learning in students. There are many students who can not learn material as well as the excellent students can and finally have negative attitude to course and school and may not be successful in exam. Therefore, they are forced to repeat it in the next courses and this indicates their need for more teaching time. On the basis of mastery learning method philosophy, anyone can learn anything he (or she) is able to do in different time period. Therefore, one can say that high percentage of weak learners succeed in achieving the same level as the excellent learners have achieved. With emphasis which this method has on cognitive entry behaviors and affective entry characteristics and different time for learning and with regard to characteristics of weak students and major problems in understanding chemistry material, it seems that weak learners can learn complex and abstract problems and apply the learnt thoughts in new problems and succeed in retention of these thoughts like the excellent students. With regard to the above material, the following goals were considered:

1- Determination of effect of mastery learning method on chemistry performance of weak students in low and high levels of learning.
2- Determination of effect of mastery learning on promoting positive attitude of the weak students to learning chemistry.
2- Research hypotheses

i. Mastery learning method is more effective on performance of weak students in higher levels of learning method than in common learning method.

ii. Attitude of the weak students who have passed mastery learning course is more positive than that of the students who have passed common learning method.

3- Research methodology

This research has been done experimentally. For this purpose, a high school was randomly selected among 16-year old students of high school and placement test about prerequisite concepts of chemistry for the related learning credit for distinguishing between weak students and excellent students. 40 weak students with grade lower than the determined level for mastery were selected. For study of research hypotheses, the following tools were used:

1- Colorado Learning Attitudes; about Sciences Survey(Class-Chem), this questionnaire which was designed for testing attitude of the students to chemistry learning in 9 categories was implemented as pre and post test after determination of reliability and validity of test items (with Kronbach Alpha method).

2- academic achievement test made by the researcher: items of this test were designed for measuring performance of educational performance of students in chemistry and their reliability was determined with Kronbach Alpha after determination of their validity (through two dimensional object-content and conformity of content and objects to text of chemistry textbook). Then, each one of the experimental and control groups was taught (atom structure). Experimental group was taught in mastery learning method (in accordance with model mentioned in chart 1) and control group was taught in common method (without receiving any feedback and corrective learning). Then both groups were tested. In order to study effect of learning methods used in change of students' attitudes at the beginning and end of work, students of both groups answered items of attitude questioned and total marks of the subjects in each category were calculated separately.

4- Research results

For studying difference of test and control groups in chemistry learning and change of their attitude after learning, post and pre test marks difference of both groups was studied with multivariate analysis of variance (MANOVA). For this purpose, covariance–variance homogeneity test and then Levine test were performed on data. For testing difference of the groups in each one of the dependent variables, unilateral variance analysis was separately used. With regard to results included in table 1, ratio of F obtained for change of performance in low level of learning is not significant in 95% of confidence coefficient (P>0.05) but ratio of F obtained for change of performance in high level of learning is significant in 99% of confidence coefficient (P<0.01). Therefore, one can say that the first hypothesis that mastery learning method is more effective on promotion of chemistry performance of students than the common learning method is confirmed.

Table 1: Effect of teaching method on dependent variable with one variable variance analysis test.

| Dependent variable                          | F    | Mean Square | df | Sum of Squares | Sig  |
|---------------------------------------------|------|-------------|----|----------------|------|
| Chemistry performance change in the Bloom's| 0.038| 2.025       | 1  | 2.025          | 0.089|
| cognitive domain: Categories of learning    |      |             |    |                |      |
| further down                                | 42.2 | 113.906     | 1  | 113.906        | 0.000|
| superior                                   |      |             |    |                |      |

With regard to table 1, ratios of F was significant in confidence coefficient of 95% (P<0.05) in some dimensions of attitude. Therefore, one can say that mastery learning method has effect on change of students' attitude in some attitude dimensions, effort to understand concepts of chemistry, use of argumentative concepts of chemistry, application of chemistry knowledge in solving problem, relationship of chemistry concepts with the peripheral world and interest in chemistry.
Table 2- Effect of teaching method on dependent variable with one variable variance analysis test

| Dependent variable | F   | Mean Square | df  | Type III Sum of Squares | Sig |
|--------------------|-----|-------------|-----|-------------------------|-----|
| "Atomic-Molecular Perspective of Chemistry" | 2.311 | 48.4 | 1 | 48.4 | 0.137 |
| "Conceptual Learning" | 3.451 | 72.9 | 1 | 72.9 | 0.071 |
| "Conceptual Connections" | 2.048 | 30.625 | 1 | 30.625 | 0.161 |
| "Sense Making / Effort" | 5.489 | 160.0 | 1 | 160.0 | 0.024 |
| "Problem Solving Sophistication" | 14.354 | 286.225 | 1 | 286.225 | 0.001 |
| "Problem Solving Confidence" | 1.578 | 9.025 | 1 | 9.025 | 0.217 |
| "Problem Solving General" | 8.216 | 168.10 | 1 | 168.10 | 0.007 |
| "Real World Connection" | 32.601 | 265.225 | 1 | 265.225 | 0.000 |
| "Personal Interest" | 4.474 | 90.0 | 1 | 90.0 | 0.041 |

5- Discussion and conclusion

In traditional education, it is assumed that there are excellent and weak learners in learning. On the basis of this hypothesis, excellent learners can learn complex and abstract thoughts while weak learners are able to learn the simplest thoughts. In contrary, Bloom believes that an essential hypothesis in mastery learning method is that if there is suitable opportunity for education and there is enough time, all learners can learn all educational targets and have mastery over them (Bloom, 1976). As LeDuc said, purpose of mastery learning method aims is that all students achieve high levels of learning. Therefore, one should concentrate on high level mental skills and processes while learning and implementing this learning method (LeDuc, 2001). In this regard, the obtained results showed that there was no significant relationship between chemistry performance of two control and experimental groups in low level of learning but weak students taught in mastery learning method had higher chemistry performance in comparison to the students who were taught in common learning method. With regard to the fact that different factors may be effective on learning of students, effect of teaching methodology on performance of students in chemistry was considered by controlling all factors. Therefore, reason for these findings is that low level of learning includes low cognitive classes in which some goals such as remembering, memorization, retention and comprehension of the learnt material are emphasized. Therefore, it is possible to achieve educational goals of this level which include superficial abilities and skills and memorized lessons and have no complexity with use of the most common teaching methodology and simplest educational equipment. In contrary, achieving higher level educational goals which include high cognitive classes and include complex mental abilities and skills such as application of principles, skill of problem solution, analysis and synthesis and evaluation requires special method for presentation of the content. Results obtained from the previous results are consistent with the above results so that the researches performed by Block & Bronze (1976), Soled (1986), Mevarech (1989), Brandt and Marzano (1988) in different educational subjects confirm finding of this study. Other findings indicate that mastery learning method has effect on change of students' attitude in some attitude dimensions, effort to understand concepts of chemistry, application of chemistry knowledge in solving problem, relationship of chemistry concepts with the peripheral world and interest in chemistry. Attitude is a kind of learning which is acquisitive and is affected by the external factors. It is changeable and if this change occurs due to recognition of anything in person, it will have effect on his emotions and his readiness for acting and behaving toward it. It seems that application of mastery learning method has effect on recognition and image of the person about his success and as a result, it has effect on his emotions to chemistry and has created readiness in the person for learning chemistry. The previous researches confirm the above finding so that this result conforms to the results which have been provided by Block (1970, 1974), Anderson (1973), Levine (1975), Chung (1979), Kazu & Ozdemir (2005), Ashok (2005) in his studies on application of mastery learning method in sciences, matrix algebra, biology, statistics and probabilities, mathematics and physics in different grades.
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