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Research Article

SURVEYING THE RESTORATION EFFECT OF MATHEMATICS ON THE ACADEMIC ACHIEVEMENT IN PHYSICS

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ABSTRACT
The present research is aimed to survey the restoration effect of Mathematics on the academic achievement of physics in school students. This research is in the category of quasi-experimental researches with control group. And it is done by pre-test and post-test on two groups of test and control group. Statistical population included the third grade female high school students of experimental sciences in zone 2 in Bandar Abbas who were studying in 2014-15 academic years. 30 people were chosen as sample by random clustered sampling and were placed into two groups of control and test. Trial operation was holding the Mathematics restoring classes which was accomplished by the researcher. The employed tools included two researcher-made Physics tests their validity of which was proved by teachers and experts of physics. Their validity was also surveyed by running the parallel test. To analyze the statistical results, the T-test and co-variances analyses were used by deleting the effect of covariate variable. The researches results show that restoring Mathematics will significantly lead to the Physics academic achievement.

Keywords: *Restoring Mathematics, Academic Achievement of Physics*

INTRODUCTION
Applying the principals of education and training is a known way of human perfectness realization and education is the most effective method to reach goals. So, every active society proceeds to build an educational system considering its circumstances and facilities, the proportion with case history, community property and social and cultural demands. Education and training prophecy is up to Education Department as an official and public system in Iran. Schools are as centers of exposing the education and training opportunities as the principal column of this organization; because the prepared curricula are presented based on the society needs and industrial changes and relationships with the outside world in schools. Since the recognition of the problems and obstacles of cultural and scientific growth is a necessity to reach the right schedule appropriate with great goals of education and training, it is logical to do research about the presented lessons in schools and face the problems of study and study the process of education in the country.

One of the most important issues in these studies is academic down come which the Education system is been handling with it from long time ago. UNESCO organization attributes the academic down come to repeat the grade, to leave the school and reducing the quality of education and learning of learners (UNESCO, 1970, quoted in Langrudi *et al.,* 2005). In a simpler expression, academic down come is a non-acceptable accommodation of scientific status of school students with the goals of educational organization. It brings up many behavioral problems, mental pressures, emotional disagreement and social abnormalities beside the financial aspects. In fact, abortiveness in education will cause many individual and social problems and relinquishment from accessing to the goals of educational system (Changizi *et al.*, 2009). Accordingly, the increase of the quality of educational system is accounted as the most effective factor in the development of countries. Being successful in the education, the learners will access to the situation in which they will use the maximum of their internal and external energy to reach the goals of educational system and get the required qualification for a successful social life. A lot of researches have studied the issue of academic down come and related factors so far, and a lot of costs are paid for this kind of research. But the issue still exists and a high rate of academic down come is been reported annually (Langrudi *et al.*, 2006).

Available statistics show that the most academic down come is happening in basic sciences. Physics is a basic science but it seems that educating this branch had not been in accordance with success in spite of its key role in technology development. The evidence is the increasing academic down come of school students in Physics.

To express the importance of the Physics, it is enough to consider the Piaget's speech. He knew the intelligence training in the school students (meaning the comprehension, creation and solving the life issues potency) as one of the most important goals of training in the contemporary period. He accounted reaching to this goal as the necessity of training the scientific spirit and getting acquainted with experimental sciences (Seyedi *et al.*, 2014, quoted in Kiani, 2007). Physics is the science of nature among the experimental sciences. It is considered as sub structural science. So, Physics education must be able to explain and follow the human relationship with nature in its goals. Nowadays, Physics is not only limited just as a lesson topic to transmit the concepts and phrases with goals, but also is responsible for the development and popularization of physical concepts of life, creating motivation, training critical thought, reasoning ability and creativity, reinforcing the aesthetics and intellectual arrangement of school students based on its nature and worthwhile role in educating the people of society (Seyedi *et al.*, 2014). Physics is presented in the second grade of high school in Iran. As the most fundamental experimental science, physics is the basic and fundamental knowledge of current technology. Physics can help the student know their world, reinforce the ability of students in trying to continually reach the scientific, expertness and theoretical goals in life and give them flexibility and challengeable and structural thought. Students get acquainted with principals and methods of scientific thought by learning Physics and will use them in planning and right decision makings of life (Ahmadi, 2012). In the belief of some Physics professors, the comprehension of student from Physics in high school is vast but shallow. This shallow view that is dominating the educational environment of physics besides the educational problems like emphasizing the understanding the knowledge of Physics instead of doing exercises in class have put the future of education of Physics in a halation of ambiguity and anxiety (Golshani, 2012). Case studies in the high schools of the country in the past years show that the high school Physics failed to reach its goals (Parzhad, 1984). And there was no improvement in the educational status of physics despite the efforts of educational program authorities (Beigzadeh, 2012). The curriculum of Physics is limited to the level of understanding in our country (Kiamanesh and Nuri, 1998; quoted in Azhdari *et al.*, 2013) while it does not help the school student to get the grade (Kargaran, 1996; quoted in Azhdari *et al.*, 2013), and has no compatibility with the past knowledge of school students (Kiamanesh and Ahmadi, 1996; quoted in Azhdari *et al.*, 2013). There is no real test in its labs (Musa and Behzad, 2005; quoted in Azhdari *et al.*, 2013), it is accompanied with executive problems (Ahmadi, 2001; quoted from Azhdari *et al.*, 2013) and has not created any positive theory in teachers and school students (Basaeer, 2009; quoted in Azhdari *et al.*, 2013).

Therefore, it is necessary to adopt new plans to reduce the academic down come, since it seems that not so effective decisions in this background are been executed. Maybe one of the reasons is that the contemplated plans were not comprehensive. The meaning of being comprehensive is to have an overview on the causes of appearance of school students problems (Beigzadeh, 2012).

The effectiveness of students' weakness in doing Mathematical calculations on Physics academic down come is impressive in the studies surveying the factors that cause these problems in Physics education and eventually rejection of school students from Physics. An academic down come or weakness in physics sometimes is because of the weakness of students in solving the Mathematics equations that lead to their inability in solving the Physics equation, which is due to the close relationship of Physics with Mathematics, while some school students understand the concepts of Physics as well and can explain it easily. Solidarity and compatibility of components in Mathematics when placed beside the accommodation with nature in Physics make a coherent knowledge based on comprehension and intuition in which there is no way to escape from a balanced study in both branches in order to develop in them. By the way, the school students usually know Physics as a confection of the difficult equations of Mathematics in which you should be familiar with Mathematics language completely to understand the

difficulties and justification of its physical phenomena. A language that is unfamiliar with mankind experiments (Rahimi, 2012). It is a lesson that has an especial importance during the study span, despite the dominant reluctance of school student to study the Mathematics, because the students' success in Mathematics has almost an important effect on their academic fate. Observations show that many school students have problem in Mathematics and avoid it to the extent they turn to non-Mathematical majors and try to take some distance from Mathematics in higher grades of education. While the importance of Mathematics is much more inclusive than to be presented in official lesson shapes (Delavar and Qorbani, 2010). There is no doubt that all people in society from every group, with every academic level in different jobs will need Mathematics. But, the way of using this fundamental science will be different, naturally. So, regardless of the future job of school students, they should have enough conversance in basic sciences especially in Mathematics. To state the causes of this reluctance to Mathematics, it can be said that the complexity of thinking and learning processes in people on the one hand and the natural difficulties of concepts, skills and reasoning that exist in Mathematics on the other hand will cause the failure of learners in getting the favorable results in Mathematics and their aversion from Mathematics (Bassey, 2006; quoted in Delavar and Qorbani, 2010). Sometimes, it is leading to change the direction of career and academic decisions. Accordingly, each step that is taken in the direction of improving the quality of Mathematics education will be helpful for their life (Delavar and Qorbani, 2010). Surveying the results of the academic problems of Physics show that having enough Mathematic knowledge is the necessity of the right understanding of Physics because of the direct relationship between Physics and Mathematics on the one hand and dominant problem of school students in understanding the concepts and skills of Mathematics, necessitate the necessity of reinforcing the Mathematics knowledge on the other hand. This article surveys the effectiveness of restoring the Mathematics knowledge the on academic achievement of Physics.

MATERIALS AND METHODS

Methodology

The statistical population of present research is the third grade female high school students of experimental sciences in zone 2 in Bandar Abbas. They were 819 school students based on the announcement of Education Organization in Hormozgan in 2014-15 academic years. 30 school students were chosen by cluster random sampling and were placed into two groups of control and test. This research is in the category of quasi-experimental researches with control group. And is done by pre-test and post-test on two groups of test and control.

Instruments

Two researcher-made tests were used as pre-test and post-test of Physics in collecting data. The questions were from the third grade of experimental science Physics book in the second period of 2014 academic year. The question included many kinds of questions like: short answer, full answer, matching and so on. Grading of different chapters was based on appointed standard grading from the Education ministry and the secretariat navigation of Physics in 2014. Summation of the grading of each test was 20. Reliability of the tests was shown through running the parallel and equivalent tests during 12 days and calculating the Spearman and Pearson coefficient. The results of this survey can be seen in tables 5 and 6.

According to these tables, Spearman and Pearson coefficients report a high correlation.

The questions of these tests included all levels of Blum recognition area and have high accommodation with the two dimensional tables of Blum features. They are provided based on the Education ministry by secretariat navigation of Physics. The scale of this accommodation for pre-teat and post-test are: 92.5% and 97.5%, respectively. Discrimination and difficulty coefficient are calculated for each one of the questions of pre and post-test. The average range of discrimination coefficient is 0.42 that is within acceptable area. Difficulty coefficient of all questions is positive and less than 1. So, all the questions have acceptable validity. Furthermore, the tests of Physics are proved from the viewpoint of content validity by a group of Physics teachers and head group of Physics in zone 2 in Bandar Abbas.

Performance

After collecting the related data on the pre-test of Physics, eight 90-minute sessions were held for students of the test group, and some Mathematic topics of primary and secondary high schools were taught and the problems were solved. Those topics were chosen to be thought that included Mathematics concepts and rules that were useful in Physics and were recognized as the most frequent topics of school students mistakes based on the experiments of the researcher in teaching Physics. The program of this restoring-educational period was:

First session: Integers (integer's axis, algebraic sum concept, four main actions of integers)
Second session: Decimals (scientific notation, four main actions of decimals)
Third session: Fractions (four main action of fractions, sides in middles, combination and subtraction of ration in numerator and denominator)
Fourth session: the power numbers (multiplication and division of the power numbers, power fractions, factorization power, negative and fractional powers)
Fifth session: Equations (solving first rate equations, device of 2 and 3 unknown equations)
Sixth session: Equations (solving the second rate equations, fractional equations)
Seventh session: trigonometric ratios (trigonometric cycle, trigonometric ratios of supplements, trigonometric equations, trigonometric charts)
Eighth session: A review on the listed topics

RESULTS AND DISCUSSION

Descriptive Results

Collected data from pre-test and post-test of Physics in the two groups of control and test are categorized by the descriptive statistics methods. Achieved results are presented in table 1.

Table 1: Descriptive results of pre-test and post-test

	Pre-test		**Post-test**	
Group	Average	Standard deviation	Average	Standard deviation
Control	3.3	1.04	3.45	1.46
Test	3.82	1.64	11.45	2.44

According to the inserted information in table 1, a significant difference in average numbers of the two groups has been created after executing the experimental action which is restoring and enriching the Mathematics knowledge of the test group. Inferential statistics is used in order to generalize the principals and results. Selected statistical method in this research is covariance analysis by deleting the pre-test effect as an interferer variable. The default use of covariance analysis should be observed, when this test is used. These defaults are: linearity, variances' homogeneity, averages in two groups of control and test, normality of pre-test and post-test scores' distribution.

To survey the linearity of relationship between dependent and auxiliary variables, the regression lines are surveyed by scatter plot diagram.

The results show the linearity of the relationship between scores in pre-test and post-test of both groups due to the regression line which is positive and linear between auxiliary variable (Physics pre-test) and dependent variable (Physics post-test). The normality of scores distribution is surveyed by Kolmogroph Smirnoph test. The results are visible in table 2:

Table 2: Kolmogroph-Smirnoph test to survey the normality of scores' distribution

	Pre-test	**Post-test**
Z statistic	0.590	0.878
P	0.878	0.424

The normality of score distribution is obvious, according to table 2.

It is a rare event for averages to be equal, when two samples are chosen randomly. But, it should be determined that how much of difference can be due to the chance in order to execute the test of

hypothesis about the differences of averages. So, it is necessary that the subject groups be surveyed in terms of variances homogeneity and average equality before the data analysis. T and Levin tests will survey this homogeneity. The results of these surveys are listed in tables 3 and 4:

Table 3: Surveying the homogeneity of group variances and dependent variable

Variable	test group		Control group		Variance homogeneity index (Levin)				
	Average	Standard deviation	Average	Standard deviation	Mean differences	F	df	Freedom degree of group variable	p
Physics	3.81	1.64	3.3	1.04	0.51	4.14	28	1	0.051

Table 4: Surveying the homogeneity of group averages and dependent variable

Variable	Test group		Control group		Variance homogeneity of mean (T)					
	Average	Standard deviation	Average	Standard deviation	Mean differences	t	df	p	Upper limit	Lower limit
Physics	3.81	1.64	3.3	1.04	0.51	1.028	28	0.31	1.54	-0.51

Table 5: Pearson correlation coefficient of the grades of covariant parallel tests of Physics

	Variable	First test	Second test
First test	Correlation coefficient	1	0.718*
	P	-	0.003
Second test	Correlation coefficient	0.718*	1
	p	0.003	-

**Meaningfulness in the level of 0.001*

Table 6: Spearman correlation coefficient of the grades of covariate parallel test of Physics

	Variable	First test	Second test
First test	Correlation coefficient	1	0.807*
	p	-	0.000
Second test	Correlation coefficient	0.807*	1
	p	0.000	-

** Meaningfulness in the level of 0.001*

According to the results of these tables, p values related to the Levin test is more than significance level. As a result, zero hypothesis (variances equality) is accepted.

The average difference between two populations is meaningless and the averages equality is not rejected, according to the upper and lower limit scores and because the upper limit is positive and the lower limit is negative.

In fact, it can be concluded that before executing the trial operation of Mathematics knowledge restoration, the average score of two populations did not show any significant difference in terms of the different schools. So, all the default uses of covariance analysis are true.

The covariance analysis with Physics pre-test control is done to survey the effect of executing the trial operation of Mathematics knowledge restoration on Physics academic achievement. Table 7 shows the results of this analysis.

Table 7: Surveying the effect of trial operation with deleting the effect of covariate variable of Physics

Source	Sum of squares	Freedom degree	Mean squares	F	p
Physics (pre-test)	13.254	1	13.254	3.564	0.04
Group	433.182	1	433.182	116.469	0.00
Error	100.421	27	3.719		
Total	2258.75	30			

The contents of table 7 show that the effect of Mathematics knowledge restoration was significant in terms of statistics. In fact, it can be said that covariance analysis reported a meaningful difference between scores' average of control and test groups after deleting the covariate variable effect which is Physics pre-test. This means that trial operation of Mathematics knowledge restoration has caused a significant difference in the scores of Physics. The post-test averages of test and control groups in terms of listed dependent variables can be compared in order to understand the type of this difference. According to the results of this table, the averages of Physics post-test in test group and control group are 11.45 and 3.45, respectively. This shows that the Physics scores of test group in post-test have a significant increase. So, we can prove hypothesis which emphasizes the effect of school students Mathematics knowledge restoration on academic achievement of Physics (F=116.46 and P=0.001).

Conclusion

The results of this research are indicating that school students Mathematics knowledge restoration has a positive and significant effect on academic achievement of Physics. In fact, restoring Mathematical knowledge and solving the computational problems of school students in solving Math and Physics questions will cause the school students get higher grades in Physics test. This result is in the line of the researches which mostly believe that the problems of many school students in their academic span and in many related courses are because of their weakness in mathematics (Delavar and Qorbani, 2010).

Many of school students know Physics as a boring and a Mathematical lesson since it is necessary to express the Physics concepts by the Mathematics language. A language that is unfamiliar with them and very hard to understand. Besides the problems of working with Mathematics language, Physic includes some pure abstract contents that are not visible, touchable and testable. To understand these concepts, the logic and abstract reasoning ability is needed; a matter that is not easy for most of the students. Especially, that complicated Mathematics is needed to express these deep concepts (Rahimi, 2012). So, one of the challenges for researchers of Mathematics education is to increase the links between the culture, language and education of Mathematics and to make sure that their findings have effect on the decision makings of Math curriculum since the educational systems cannot be separated from language and society culture. Because the Mathematics concept should be translated to the familiar and common language for being understandable, paying attention to this issue in Math curriculum especially in makeup, confirmatory and reconstructive plans of schools is very important because it can cause shaping up Mathematical thinking in school students (Ahmadlu *et al.*, 2009).

Mathematics equations are utilized as thinking guide, when the Mathematical mind is shaped in school students. This attitude is searchable from two aspects: the first one is to understand what the equations are trying to show in the relationships between the Physical concepts like inversely square relationship of indented gravity and electric powers that can be changed after whole understanding of Mathematics concept in class and evaluated in different terms of numerical moods carefully. The second aspect is the manipulation and combination of the equations to achieve an especial result before numbering. As an example, the discussion about the independency of horizontal movement of rocket from the vertical movement can be mentioned that is a good example of symbolic issues that has the most shares in the mistake of school students in Physics exam (Hioet, 2011; Jafari, 2011).

Accomplished researches in the field of fiscal weakness effect of school students in solving Mathematics questions on the academic achievement of Physics show that most of Physics teachers know this matter

and they are handling with it. Insofar as, some parts of each Physics class are assigned to explaining the Mathematics rules and this is difficult according to the limited assigned time to the high school Physics. Additionally, it is better that the Mathematics skills be taught by Mathematics teachers.

Holding the Mathematic knowledge restoration classes in a way which was mentioned in the research can be considered as an early output solution but without high imperishability. It seems that solving the mathematical issues needs more serious surveys and decisions, such programs like: comprehensive verification of Mathematics books from primary to the secondary high school and regarding the survey of prerequisite principals in the chapters related to the Physics, paying attention to the content and writing alignment of Physics and Mathematics books that is inhibited from the bad understanding and misunderstanding of school students in many concepts, revising the rules and laws of choosing major and students selection of experimental sciences and Physics-Mathematics majors, posting up Physics and Mathematics teachers from the researches' results like of this survey and inviting their collaboration in holding the continual classes of Mathematics knowledge restoration and enrichment and operating its results in academic achievement of students. Certainly, creating academic successes in the background of the basic knowledge of Mathematics and Physics will be an underlying factor for the improvement of educational, professional and economic processes in future generations.

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