# The Effectiveness of Teaching Mathematical Prerequisites on Student learning Light Refraction in Physics Conventional Classes

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**Abstract**. *From historical point of view, there is a close relationship between physics and mathematics and it can't be ignored in educating and learning these sciences. This article analyzes the effectiveness of reviewing and educating mathematical prerequisites on learning light issue, in fact, this study tries to show the effect of teaching mathematical prerequisites such as trigonometric relationships on learning reflective index, critical index, total reflection and also mathematical prerequisites including fractional numbers sum, the solution of first degree equation, on learning lens formula in physics conventional classes. This study has been done by using Salomon four groups using two experimental and control groups. After analyzing data using MAONVA and SPSS , the positive effect of learning prerequisites on learning physics has been shown. The results can be useful for both teachers and students.*

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**Keywords.** Teaching, Mathematical Prerequisites, Learning, Light Refraction, Physics conventional classes.

## 1. Introduction

Physics is a science representing the rules governing over nature worlds. Therefore, it is necessary that a physicist be familiar with rules and principals of mathematics for presenting these rules in the form of equations and mathematical relations [1]. Since mathematics is considered as the language of physics, full understanding of physics concepts requires full domination over mathematical language. Then, one of the main issues in teaching each topic of physics is noticing to mathematical prerequisites related to that topic. If we look at the relation of physics and mathematics from the viewpoint of history, we can see that history clearly shows the close relation of concurrent advancement of physics and mathematics that cannot be ignored in teaching and learning these sciences [1]. Therefore, at first we should be fully familiar with the mathematical language dealing with the presentation of these concepts for acquiring full understanding of physics concepts. However, most of the students work weakly in fulfilling the assignments of mathematics problems. We can at least point to two probable and distinct reasons for this problem: 1- these students do not have mathematical skills for solving the physics problem or they have a small familiarity in this regard. 2- The do not know how to use their skills in solving different physics problems [2]. The weakness of students in solving math problems propounded in physics course caused most of the institutes and physics teachers remove some of the main physics problems enjoying more complex math but these physics concepts make them familiar with most of the other main concepts of physics and students lose the opportunity of facing with these problems with removing them [3,4].

## 2. RESEARCH HYPOTHESIS

Hypothesis 1: Teaching mathematics prerequisites such as trigonometry functions, inverting fractional numbers, etc has positive effect on learning the refractive index, critical angle, apparent and actual depth and total reflection.

Hypothesis 2: Teaching mathematics prerequisites such as algebraic addition of fractional numbers, 1$^{st}$ grade equation solving, etc has positive effect on learning the lens formula.

## 3. RESEARCH METHODOLOGY

This research is in fact a quasi-experimental one, which is fulfilled with the method of four-group of Salomon; two experimental groups and two control groups.
In two experimental groups, math prerequisites are presented before teaching and then the main topic is presented while one group take pretest

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but the other does not take any pretest. In two control groups, only the main topic is presented while one group take pretest but the other does not take any pretest.

## 4. STATISTICAL SOCIETY AND SAMPLING METHOD

The statistical society of this research is all the secondary 1st grade boys students of Abdanan town, one of Ilam province suburbs passing physics I and laboratory In the academic year 2008-09. This society enjoys 625 members. The sampling method in this research is randomly. The experimental and control samples are according the following model:
Sample 1: This is the first experimental group, experiencing pretest and post-test (28 persons)
Sample 2: This is the second experimental group, only experiencing post-test (29 persons)
Sample 3: This is the first control group, experiencing pretest and post-test (30 persons)
Sample 4: This is the second control group, only experiencing post-test (28 persons)

## 5. DATE COLLECTION TOOLS

The researcher made a test, including 20 questions, for collecting data related to the research subject. This test is given in two forms of pretest and post-test at the beginning and ending of course respectively. Since we want to control the effect of individual intelligence in physics learning process, the Rion intelligence test is given to the studying students before the pretest.

## 6. VALIDITY AND TOOLS RELIABILITY EXAMINING

For examining the educational advancement tests conceptual validity, they are prepared according to the lessons provided from the intended topics and we deal with the tests formal validity with the help of enquiry questionnaires from professors and secondary 1st grade teachers and for assigning the reliability of the tests, five coefficients are applied. These coefficients are as follows:
1-Difficulty Coefficient (P), 2- Distinction Coefficient (D), 3- rpbi Coefficient, 4- KR–20 Coefficient, 5- Ferguson Delta Coefficient

It shall be mentioned that the Rion intelligence test has a distinct reliability and it was relied on the same.

## 7. STUDENTS' INTELLIGENCE SCORE ANALYSIS

Since we want to control the intelligence variable and should see whether there is a meaningful difference among the samples mean or not, we used F basis. Table 3 shows students' intelligence scores variance analysis results.

Referring to the table of F, F for df1=3 and df2=111 in 5-percent level is 2.70. Since calculated F (F=0.474) is less than F of the table (F=2.70), the hypothesis of zero, representing the equality of averages are confirmed. Therefore, it is concluded that the sample is congenial.

## 8. EXAMINING THE EFFECT OF PRETEXT ON LEARNING THE REFRACTION OF LIGHT

Regarding the fact that the 4-group method of Saloman is brought forth with this hypothesis that the pretest has different random effect in experimental and control groups, we deal with this claim now.

As you see in Table 4, regarding the meaningful mutual influence of the teaching method and the pretest, which is more than 5 %, it can be said that there is no mutual influence between the teaching method and the pretest. Therefore, it can be said that the pretest has no different effect in two experimental and control groups and only two experimental and control groups experiencing pretest and post-test are examined in continuing analysis for examining the effectiveness of the teaching method.

## 9. RESEARCH HYPOTHESIS EXAMINING

Our statistical calculation shows that we can use t parameter test for comparing first and third sample according to the first hypothesis because both first and second sample follow the normal distribution according to the first hypothesis. However, since the third sample in the second hypothesis does not follow the normal distribution we cannot use independent t statistics and we should use it equal nonparametric test, i.e. Man Vitni test.

Regarding the results mentioned in table 5, the variance of difference average of learning pretest and post-test scores is 7.18 in the first experimental group and the variance of difference average of learning pretest and post-test scores is 1.73 in the first control group. Regarding the results mentioned in table 6, the amount of bilateral test meaningfulness is equal to zero which is less than 0.05. therefore, the zero hypothesis are not accepted that is it can be said that there is a remarkable difference between the modern teaching method and the common one and on the other hand the amount of t is equal to 13.708 which is positive amount. Regarding this issue that the experimental group scores have deducted from the control group in this research, it can be said that the new teaching method has more effectiveness in learning progress of high school 1st grade in refractive index, critical angel, apparent and actual depth, and total reflection of physics course and the first hypothesis is fulfilled. The rectangle charts of error and differences average confirm this issue.

According to the results mentioned in table 7 and 8 and according to the zero meaningfulness amounts which is less than 0.05, zero hypothesis representing indifference of in average rank of two groups is rejected that is the remarkable difference in average ranks and average scores of two groups is certified. Therefore, it can be said that the new teaching method is more effectiveness in improving the high school 1st grade students' learning in lens formula topics rather than the common teaching method and the research second hypothesis is fulfilled. The rectangle charts of error and differences average confirm this issue.

## 10. EDUCATION SUGGESTION

1. The required mathematical concepts of each chapter are presented as a note in the beginning of each chapter in physics textbooks.

2. The required math prerequisites should be considered in writing physics textbooks. For example, the student should learn Derivation in math course before learning Instant Speed and Acceleration or learn Trigonometrical Ratio before reading critical angle.

3. Regarding the volume of material, learning and teaching the required concept, the time of teaching is short. Therefore, it is suggested that physics weekly teaching period be increased.

## 11. References


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**Table 1: Brief Result of Original Version Coefficients**

| Acquired amount average | Standard Amount | Consistency Coefficient |
|---|---|---|
| 0.58 | 0.3-0.9 | Difficulty Coefficient |
| 0.4 | < 0.3 | Distinction Coefficient |
| 0.36 | < 0.2 | pbi Coefficient |
| 0.92 | < 0.7 | KR–20 Coefficient |
| 0.93 | < 0.9 | Ferguson Delta Coefficient |

**Table 2: Students' Intelligence Score Analysis of All the Samples Together**

| Statistical Index | All Samples |
|---|---|
| Number | 115 |
| Median | 108 |
| Mode | 105 |
| Mean | 109.35 |
| Variance | 124.053 |
| Standard Deviation | 11.138 |

**Table 3: Students' Intelligence Scores Variance Analysis Results**

| Changes Source | Freedom Degree (df) | Sum of Squares (SS) | Variance ms= ss/df | F Basis |
|---|---|---|---|---|
| Between Average of Groups | k-1=4-1=3 | 178.952 | 59.651 | 0.474 |
| Inside of Groups | N-K=115-4=111 | 13963.135 | 125.794 | |

**Table 4: Testing the Effects among the Testable on Learning Refraction of Light Variable in Post-Test**

| Changes Source | Sum of 3rd Type Squares | Freedom Degree | Squares Average | Statistics Amount F | Meaningfulness |
|---|---|---|---|---|---|
| Total Model | 1857.027 (a) | 3 | 619.009 | 266.566 | .000 |
| Width From Origin | 10267.315 | 1 | 10267.315 | 4421.448 | .000 |
| Teaching Method | 1822.316 | 1 | 1822.316 | 784.750 | .000 |
| Pretest | 50.602 | 1 | 50.602 | 21.791 | .000 |
| Pretest * Teaching Method | 6.391 | 1 | 6.391 | 2.752 | .100 |
| Error | 255.438 | 110 | 255.438 | - | - |
| Sum | 12439.000 | 114 | - | - | - |
| Total Sum | 2112.465 | 113 | - | - | - |

**Table 5: Differences Average Statistics According To the First Hypothesis in First Experimental and First Control Group**

| Group | Sample volume | Differences average | Standard deviation | Average Standard deviation |
|---|---|---|---|---|
| First experimental | 28 | 7.18 | 1.278 | 0.247 |
| First control | 30 | 1.73 | 1.701 | .0310 |

**Table 6: Independent T Test for Comparing the Averages Based on the Research First Hypothesis**

| Educational Progress Score Difference | Levance Test For Equality Of Variances | | Average Comparing Test | | | | | |
|---|---|---|---|---|---|---|---|---|
| | F Amount | Meaningfulness | Amount Of T | Freedom Degree | Meaningfulness (Bilateral) | Differences Average | Reliance | |
| Supposing That Variances Are Equal | 2.550 | .116 | 13.708 | 56 | .000 | 5.445 | 4.649 | 6.241 |
| Supposing That Variances Are Not Equal | - | - | 13.842 | 53.627 | .000 | 5.445 | 4.656 | 6.234 |

**Table 7: Average Rank of Two First Experimental & Control Group**

| Group | Sample Volume | Average Rank | Total Ranks |
|---|---|---|---|
| First Experimental | 28 | 42.25 | 1183.00 |
| First Control | 30 | 17.60 | 528.00 |
| **Total** | **58** | - | - |

**Table 8: Wilkakson- Man- Vitni Test**

| - | Experimental Group |
|---|---|
| Man-Vitni U | 63.000 |
| Wlkakson W | 528.000 |
| Z Statistics | -5.669 |
| Meaningfulness (2- Continuation) | .000 |