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THE IMPORTANCE OF SYMBOLS AND UNITS IN NATURAL SCIENCE

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ABSTRACT: The science and engineering students are expected to know the basic quantities and to distinguish the derived quantities regardless of their majors. The symbols and units are important to be understood, interpreted, and correlated in natural science. The purpose of this study was to investigate the importance given to the symbols and units by students. The research was conducted with 220 students. Data were collected using an evaluation form designed for examining the students' knowledge about the some symbols and units. The students were asked twelve fundamental quantities. The descriptive statistical analyses of the research data were performed. The results of the research indicated that the students ignored the symbols and units. Detailed results and recommendations based on the findings of the research are presented in the research.

Keywords: Higher education, natural science, symbol, unit

INTRODUCTION

Numerous researches were practiced on physics teaching at every level of education. New methods and techniques for active learning were developed in these researches. The aim of these developed methods was to enhance students' learning, understanding, perception, confidence, and motivation epistemologically (Domert, Airey, Linder, & Kung, 2007; Lising & Elby, 2004; May & Etkina, 2002). Some research examined the students' understanding of the symbol and unit (Sherin, 2001). These researches reported that students had problems showing the variables in formulas.

The connections among units and equations have an important role in physics teaching. This teaching could be provided with the correct usage of the scientific language. If they are not taught correctly, the students can encounter with some drawbacks in problem-solving. Therefore many studies will be needed to develop new methods for physics teaching of the symbols and units.

The correct usage of the physics/science language can be provided with using the international standards. The standards concerning quantities' name and symbols which are valid all over the world are expressed as "*Many of the quantities, their recommended names and symbols, and the equations relating them, are listed in the International Standards ISO 31 and IEC 60027 produced by Technical Committee 12 of the International Organization for Standardization, ISO/TC 12, and by Technical Committee 25 of the International Electrotechnical Commission, IEC/TC 25. The ISO 31 and IEC 60027 Standards are at present being revised by the two standardization organizations in collaboration. The revised harmonized standard will be known as ISO/IEC 80000, Quantities and Units, in which it is proposed that the quantities and equations used with the SI will be known as the International System of Quantities" (Taylor & Thompson, 2008, p. 10)*. The aim of this research is to investigate the students' awareness towards learning of some quantities' symbol and unit.

METHOD

The study was conducted on four departments offering two-year programs in Torbali Technical Vocational School of Higher Education at Dokuz Eylul University, Turkey. The research was applied to 220 college students. The present study used survey methodology. The research data was collected with a survey included some physical quantities' symbols and names.

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The survey provided the information on participants' usage of symbol and unit. The survey covered 12 items on the symbol and name of the some quantities. The students were conceptually asked for determining the derived quantities. The collected data were calculated and analyzed statistically.

RESULTS AND FINDINGS

Table 1 demonstrates the findings of the descriptive statistics concerning students' awareness on quantities' symbol and unit. When the data were generally evaluated, it could be concluded that many students did not realize physical quantities' symbol and unit while learning physics and/or problem-solving. 78% of the students knew the force concept and 53% of the students answered the velocity and acceleration concepts while fewer than 10% of students responded the angular velocity, impulse and momentum concepts. The range between 100 and 125 students could not give any answer to density, work, and power concepts. The range between 126 students and 150 students could not respond the torque, weight, and impulse concepts. Over 150 students could not answer to density, heat, and angular velocity concepts.

Table 1: The Descriptive Analysis of Some Physical Quantities

Physical Quantities		Correct		No Answer	
Symbol	Unit	N	%	N	%
d	kg/m^3	51	23.2	114	51.8
$\boldsymbol{F}$	N	171	77.7	47	21.4
$\boldsymbol{\tau}$	N.m	47	21.4	146	66.4
$\boldsymbol{W}$	N	61	27.7	128	58.2
$\boldsymbol{v}$	m/s	116	52.7	82	37.3
$\boldsymbol{a}$	m/s^2	120	54.5	90	40.9
$\boldsymbol{w}$	rad/s	16	7.3	183	83.2
W	J	68	30.9	103	46.8
Q	J	47	21.4	157	71.4
P	W	43	19.5	113	51.4
$\boldsymbol{I}$	N.s	20	9.1	145	65.9
$\boldsymbol{p}$	kg.m/s	10	4.5	173	78.6

CONCLUSION

The results reported that many students have great problems showing the quantities' symbol, and unit. These problems could be resulted from the students' motivation, confidence, and anxiety. The other drawbacks could be resulted from the instructors' teaching style. Many instructors do not even notice the symbol of physical quantities, the difference between the vector and scalar quantities in Turkey and besides they do not follow the international standards for presenting the symbols and units of the quantities. As a result of this many students have difficulty in conceptual learning. The students should encounter the difference of the usage of the symbols from the elementary school level to the university level. In the current case, the students do not comprehend the fundamental concepts of the physics and they cannot solve problems based on the principles of the physics.

RECOMMENDATION

Some recommendation based on the findings of the research could be reported as follows: 1) The instructors should use a scientific language in their course from elementary school level to university level. 2) The instructors should consider psychology of the students while teaching physics/science from the lowest to the highest level of the education. They should develop a curriculum plan by thinking psychology of the students in the current situation. 3) The instructors should explain vector and scalar quantities for each concept to help the students to distinguish the fundamental differences in concepts.

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