

ASSESSMENT OF INSTRUCTIONAL OBJECTIVES IN BOARDS' EXAMINATION PAPERS IN PHYSICS: COGNITIVE DEVELOPMENT AT SECONDARY LEVEL IN PAKISTAN

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ABSTRACT

In secondary schools in Pakistan, the pupils are provided with the concepts of physics at higher level and opportunities to do laboratory work and experiments. The survey of journals and periodicals of inter and intra country repute, revealed that from the pre and post implementation of the new syllabus in Physics operative from the early seventies, no research realization of objectives was conducted although its need was felt. This study is intended to find out scientifically the coverage of objectives by Boards' examination question papers in the first three aspects of cognitive development in the subject of Physics at Secondary Level in Sindh. A random sample of 280 school teachers working as examiners in the Board of Intermediate and Secondary Education (BISE) Hyderabad and of Secondary Education (BSE) Karachi was selected. The tool for determining the weightage of objectives was developed. This included an investigation of five years Physics question papers from (1997 to 2001) to classify the concepts of knowledge, understanding and application. The data were collected through tool. It was found that there was imbalance in proportion of knowledge, understanding and application; it reflected inappropriateness and unsuitability of the weightage of the objectives covered by the paper setters. On the basis of the study findings, the question papers of both the Boards' were found to be invalid and incapacitated to cover the objectives of physics at secondary level. As a result of this study, various suggestions were put forth to streamline the process for the coverage of objectives.

Keywords: Secondary schools, Physics, Assessment

INTRODUCTION

In today's world of precision, modern technology largely depends on the application of the laws of physics or physical sciences. The application of the principles of physics requires precise and detailed information. Physics is a subject of paramount importance in the Secondary School Curriculum as it provides a variety of understandings about physical and natural phenomena. In education system of Pakistan at the elementary level the pupils learn elementary concepts of physics while studying general science. But at secondary school, the pupils are provided with the concepts of physics of higher level and they are also provided opportunities to do laboratory work and experiment in order to be well acquaintance with matter and energy aspects of physics and the concepts and principles to tangible world.

As compared to other fields of science, physics is more effective in developing the scientific concept and ideas as it help us to distinguish fact from simple opinion; laws from mere judgment; and theories from personal beliefs. Likewise the basic laws of physics are functional around us and these laws can be observed in our daily life, i.e. motion, force, energy, heat, sound, light and machines. Perhaps due to these reasons in physics at school level, the method of posing a problem, finding the facts and drawing conclusions can very easily be applied to everyday life (Best & Kahn, 2006, p.36).

According to Harvey the boundaries of Physics are very vast so it covers a variety of subjects that can be grouped into two broad categories: Classical Physics and Modern Physics. The classical Physics

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deals with the macro objects and bodies while modern physics studies the micro one i.e. atomic and sub-atomic level (Harvey, 1998, pp.3-5).

Keeping in view the above facts, physics occupies a prominent place in secondary education. If effective instruction is provided to the students, they would become the physicists and engineers of quality, depicting imagination and creativity of mind. Furthermore they would be competent enough to do productive research and experimentation to find solutions to some of the important problems faced by the present world. "Physics at present faces severe problems in the world. Many of these problems influence science in general, but a number of them are specific to physics. Actions are required to give surety the continued health of physics research, teaching and educational control" [International Workshop at UNESCO (1999, p.4).

Moreover, many of the popular aspects of physics, such as space travel, nuclear energy, etc. are actually engineering disciplines. In these fields, much of the information learned from submicroscopic studies can be applied to the macroscopic world.

The Future of Physics in Modern World and its Teaching

The development in the field of science and technology, during last centuries, is based on the Physics in many ways. Therefore today Physics has a central position in the modern society and it is playing an important role in improving environment quality, in overcoming energy crises and in uplifting quality of health that ultimately serving to not only humanity but whole universe.

At different educational levels Physics serve in different ways: UNESCO in its International Workshop 1999 on 'The Future of Physics and Society' has given the following points for the future of physics in the society: "At secondary school level, it is recognizable that other scientific disciplines more and more have need of knowledge of physics. Physics, in both academic and research fields, sets standards of rational thinking in the face of irrationality; it upholds the dominance of observation" International Workshop (1999, p.4).

In Pakistan, Physics is taught at secondary level at 10th grade and higher secondary level at 11th and 12th grade. The teaching of Physics at this level has two principle objectives: to equip students with basic theories, principles and laws that could help in learning of Physics at advance level at University level and to enable students to understand the application of this knowledge in daily life and be applied. This all demands a thorough investigation to see whether the set objectives of physics at secondary level are achieved? This can be estimated through really actualized and mentioned the results reflect the effectiveness of Boards examinations papers at Secondary Level at Province of Sindh in Pakistan.

Overview of Studies on Physics at Secondary School Level

After going through the journals and periodicals of national and international repute, it was found that in Pakistan before and after the implementation of the new syllabus in Physics in the early seventies, no research work was carried out to study the although its need was felt. However Goraha (1981, pp. 171-176), Kalim (1978, pp. 6-17), Mughol (1977), Manzoor (1987) conducted studies on concept development and growth, not related to the coverage of the objectives in Physics. The partial findings of Johnstone and Mughol (1976, 1978, 1979) were published under the titles of (i) Concepts of Physics at Secondary Level, (ii) Testing for Understanding, and (iii) Concepts of Electrical Resistance. Similarly the partial findings of Mughol and Manzoor (1984-85 and 1988), Manzoor (1989, 1995) were published under the titles of (i) Cognitive Development of Concepts in Physics at the Secondary School Level, (ii) Science Education: An Isagogic Infra-Structure, (iii) Development of Science Education in Pakistan, and (iv) Testing for Cognitive Development of Concepts (Nature of Light). The partial findings of Goraha (1981, pp.171-176) pertained to the process of Curriculum Change in Secondary School Science, while the Board of Intermediate and Secondary Education dealt with Curriculum Development of Physics at the Secondary Education. It simply discarded the topics just because there was lack of understanding on the part of students; this was done without analyzing their achievement scores and Kaim's (1978, pp.6-17) findings related to adopted methodologies: A Total View of Curriculum Development in Pakistan. These studies help in grasping 'Curriculum Development View' and 'Concept Development' in Physics in Pakistan but do not delve deep to

ascertain in the coverage of objectives through the Boards' papers in the discipline of Physics at Secondary Level of Education. However Shah and Afzal (2004) conducted a study on - The Examination Board as Educational Change Agent: The Influence of Question Choice on Selective Study. It dealt with Question Choice at S.S.C Examination and coverage of the objectives.

Aims of Cognitive Domain

Aims of Teaching Physics at the Secondary Level prescribed by the Board of Intermediate and Secondary Education Hyderabad / Karachi are given below:

- a. To familiarize the students with Quranic injunctions for the acquisition of scientific knowledge and with the advancement in physical sciences made by the scientists of the Islamic world, past and present.
- b. To present physics to the students as a stimulating subject, intellectually satisfying and significantly related to their experiences of life.
- c. To develop in the students an awareness of the structure of physics and an understanding of the fact that physics is an expanding field.
- d. To familiarize the students with fundamental principles, theories, and concepts of physics in modern terms and with the scope of physics
- e. To develop among the students skills of making careful observations, collecting data, and calculating the results of their experiments
- f. To develop among the students an ability to interpret the results of their experiments and to understand the implications of these results.
- g. To develop skills of setting up appropriate apparatus for experiments and to improvise where necessary.
- h. To prepare scientifically educated individuals as useful members of the society (B.I.S.E Hyderabad Sindh 1994, pp.83-84)

STATEMENT OF THE PROBLEM

This study is intended to find out scientifically the coverage of objectives in the Boards' examination question papers in the Province of Sindh in Pakistan. This study is intended to cover the first three aspects of cognitive development in the subject of Physics at Secondary Level in the Province of Sindh in Pakistan.

OBJECTIVES OF THE STUDY

1. To evaluate the question papers in Physics from 1997-2001 set by the Boards at Secondary Level in terms of the objectives covered by the question papers.
2. To conduct the conceptual analysis of the course contents given in the syllabus.
3. To determine how far the concepts and objectives involved were represented in the Question Papers of five years on which the students' performance was assessed by the examiners.
4. To suggest measures for the improvement of examination papers in general and that of physics in particular

METHODOLOGY OF THE STUDY

This study was conducted on the question papers of all the Boards of the province Sindh in Pakistan at secondary level of (class X) in the subject of physics for the five years -1997 to 2001.

Population & Sample

The population comprised of the school teachers who worked as examiners in the Province of Sindh, Pakistan.

A random sample for this study was 280 school teachers who worked as examiners in the Board of Intermediate and Secondary Education (BISE) Hyderabad and Board of Secondary Education (BSE) Karachi in Sindh. The problem was approached in making analysis of the weightage of the concepts

like knowledge, understanding and application of the teaching objectives of the prescribed syllabus in the questions papers of five years respectively.

Instruments

The Tool for Determining the Weightage of Objectives was developed for this study. This tool included an investigation of the question papers of five years Physics papers (from 1997 to 2001) based on the concepts of Knowledge, Understanding and Application. The purpose was to see as to how much weightage was given to these concepts. This tool investigated the opinion of the examiners on the point that the test measured what it claimed to measure.

Data Collection

The data were collected through tools for determining the weightage of objectives of the syllabus covered in the physics examination question papers of B.I.S.E, Hyderabad and B.S.E, Karachi over the period of five years from 1997 to 2001. This was done to conduct the conceptuality of examination papers in the context of first three aspects of cognitive development in physics i.e., knowledge, understanding and application.

Procedure

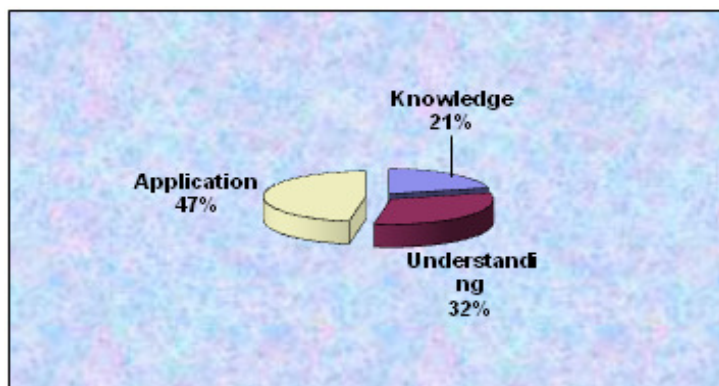
The teachers who worked as the examiners were asked to analyze the Boards' paper into three aspects of learning in the cognitive domain i.e. Knowledge, Understanding and Application. They were provided with the Objectives of teaching of physics as given in the syllabus, the Questions Papers of five years (1997-2001) and a format indicating Objectives, Knowledge, Understanding, Application and Weightage. The examiners analyzed the five-year question papers in terms of coverage given to objectives of physics against the three cognitive aspects of learning.

DATA ANALYSIS

The findings are tabulated below:

The proportion of knowledge, understanding and application according to objectives from the question Paper of the year 1997 was projected through a Pie diagram given in Pie Diagram No.1:

PIE Diagram 1. Showing the % age of learning measured in the question paper



The table and Pie diagram reflect the extent of coverage of the objectives in terms of the cognitive categories.

(a) Knowledge

Under knowledge the question paper – 1997 covered the 8 topics with a weightage of 21.05% to the objectives listed at numbers 3 and 4.

(b) Understanding

Under understanding the question paper – 1997 covered 12 topics with a Weightage 31.57% to the objectives listed at numbers 3, 4, 10 and 11.

(c) Application

Under application the question paper – 1997 covered the 18 topics with a Weightage 47.36% to the objective listed at numbers 2, 9 and 10.

Table 1. Showing Objectives of Teaching Physics in the Cognitive Domain as given in the Syllabus and Covered in the Physics – Class Tenth (X) Question paper – 1997 of Hyderabad Board in Sindh

Objectives	Knowledge	Understanding	Application	Weightage (%)
1. To familiarize the students with the Quaranic injunctions.	-	-	-	-
2. To present physics to the Students as a stimulating Subject.	-	-	Electric Bell, Human Eye, Compound Microscope (3)	7.89%
3. To develop in the students an Understanding of the structure of Physics.	Scalars & vectors, Centripetal /Centrifugal Force, Scalars/ vectors, P.E & K.E, Physics & Branches, Speed & Velocity, Heat/temp (7)	Specific Heat Real/Virtual Image, Long/Short Sightedness, SHM + Pendulum, (4)	-	28.94%
4. To familiarize the students with the fundamental laws and concept of physics.	Laws of motion (1)	Newton's Law Of Gravitation, Coulomb's law, Reflection & Laws, Total Internal Reflection, Refractive Index (5)	-	15.78%
5. Experiments.	-	-	-	-
6. To make able the students to interpret the results of experiment	-	-	-	-
7. To make able the students to Collect data.	-	-	-	-
8. To prepare scientifically educated individuals.	-	-	-	-
9. To inculcate the scientific attitude among the students.	-	-	Galvanometer, Screw Jack, Inclined Plane, Ammeter (4)	10.52%
10. To inculcate among the students the habit of thinking scientifically.	-	Prove $2as = Vf^2 - vi^2$ Prove $V = f(2)$	All the numerical are included (11)	34.21%
11. To help the students feel that the advancement of physics is necessary for healthy growth & Economy.	-	Alpha & Beta Particles (1)	-	2.63%
Weightage (%)	21.05%	31.57%	47.36%	99.9%

Coverage of Objectives in Karachi Board's Examination Papers:

The analysis of Karachi Board, on the same lines, is given in Table No.2:

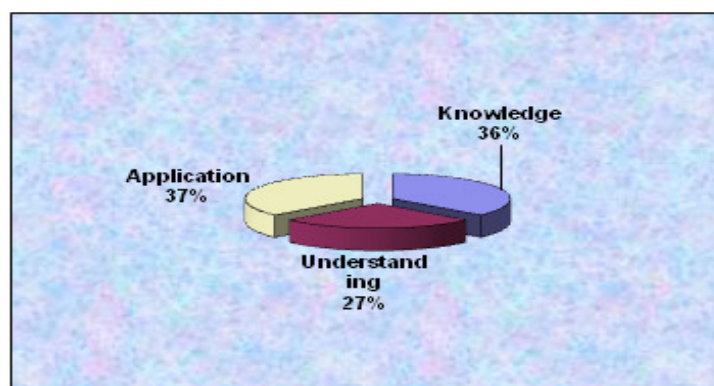
Table 2. Showing Objectives of Teaching Physics in the Cognitive Domain as given in the Syllabus and Covered in the Physics – Class Tenth (X) Question paper – 1997 of Karachi Board in Sindh

Objectives	Knowledge	Understanding	Application	Weightage (%)
1. To familiarize the students with the Quaranic injunctions.	-	-	-	-
2. To present physics to the students as a stimulating subject.	-	-	-	-
3. To develop in the students an understanding of the structure of physics.	Center of gravity, Acceleration, Momentum Principle focus, Ampere, Capacitance, Center of curvature, Electric field, Linear Magnification, Power of lens, Electric field, Resonance, Radio isotopes, Radioactivity, wavelength (15)	Stress & Strain, Scalars & Vectors, Magnitude of x-y components (3)	Inclined plane & its mechanical advantage (1)	46.34%
4. To familiarize the students with the fundamental laws and concept of physics.	-	Newton's law of Gravitation, Newton's Third law of motion, Pascal's law, Ohm's law, coulomb's law (6)	-	14.63%
5. Experiments.	-	Resistors combination (1)	Specific heat of lead shot (1)	4.87%
6. To make able the students to interpret the results of experiment	-	Loudness and effects (1)	Effect of pressure on boiling point Fission reaction, Hazards of Radioactivity (4)	12.19%
7. To make able the students to Collect data.	-	-	-	-

8. To prepare scientifically educated individuals.	-	-	-	-
9. To inculcate the scientific attitude among the students.	-	-	Compound microscope Electric Bell (2)	4.87%
10. To inculcate among the students the habit of thinking scientifically.	-	-	Numericals (7)	17.07%
11. To help the students feel that the advancement of physics is necessary for healthy growth & Economy.	-	-	-	-
Weightage (%)	36.58%	26.83%	36.58%	99.9%

The proportion of knowledge, understanding and application according to objectives from the question paper of the year 1997 is projected through a Pie diagram given in Pie Diagram No.2:

PIE Diagram 2. Showing the % age of Learning Measured in the Question Paper



The table and Pie diagram reflect the extent of coverage of the objectives in terms of the cognitive domain.

(a) Knowledge

Under knowledge 15 topics have been covered with a weightage of 36.58% to the objectives listed at number 3.

(b) Understanding

Under understanding the question paper – 1997 covered 11 topics with a weightage 26.83% to the objectives listed at numbers 3, 4, 5 and 6.

(c) Application

Under application the question paper – 1997 covered 15 topics with a weightage 36.58% to the objective listed at numbers 3,5,6,9 and 10.

The same procedure was used for question papers in the subsequent years of 1998, 1999, 2000 and 2001 in the subject of physics of Hyderabad and Karachi Boards; it is projected in the Table No.3:

Table 3. Showing Objectives of Teaching Physics in the Cognitive Domain as given in the Syllabus and Covered in the Physics – X Question paper 1997-2001 of Hyderabad and Karachi Boards

Hyderabad and Karachi Boards in Sindh						
Years	Knowledge		Understanding		Application	
	Hyderabad	Karachi	Hyderabad	Karachi	Hyderabad	Karachi
1997	21.05%	36.58%	31.57%	26.83%	47.36%	36.58%
1998	30.95%	39.13%	28.57%	26.08%	48.47%	34.78%
1999	33.33%	52.17%	22.22%	08.69%	44.44%	39.13%
2000	34.78%	34.78%	17.39%	17.39%	47.82%	47.82%
2001	42.10%	43.90%	15.79%	29.26%	42.10%	26.82%
AVERAGE	34.44%	41.31%	23.10%	21.65%	46.03%	37.02%

The table shows that the emphasis of knowledge with an overall range of 21.05% to 42.10% on average 34.44% in Hyderabad and 36.58% to 43.90% on average 41.31 in Karachi. The questions about understanding were in the range of 31.57% to 15.79% on average 23.10 in Hyderabad and 26.83% to 29.26% on average 21.65 in Karachi. The questions at application level were in the range of 47.36% to 42.10% on average 46.03 at secondary school level in Hyderabad Board and 36.58% to 26.82 on average 37.02 in Karachi Board.

The proportionate coverage of Knowledge in question papers of the Hyderabad Board was much less than that covered by the question papers of the Karachi Board over the years 1997-2001. The proportionate coverage of understanding in the question papers of the years under study of both the Boards were on the average was almost equal. The proportionate coverage of application in the same question papers of the Hyderabad Board was more than it was covered in the question papers of the Karachi Board.

The imbalance in proportion of knowledge, understanding and application reflects inappropriateness and unsuitability of the weightage of the objectives covered by the paper setter in the question papers in assessing students. On the basis of these observations, these question papers of both the Boards' could be seen as invalid, and unable to cover the objectives of the syllabus of the subject of physics at secondary level.

CONCLUSION

While setting papers the paper setters did not take into consideration the weightage of the content related to cognitive objectives i.e. Knowledge, Understanding and Application. But after analysis of the various aspects of question papers it was found that there was no balance between the weightage assigned to knowledge (content), understanding (comprehension), and Application (solution of problems). The imbalance in Knowledge, Understanding and Application created conceptual inadequacy among the students from level to level as the students move forward they experienced deterioration in all cognitive aspect of the subject. This proved harmful to the cause of education in Physics.

SUGGESTIONS

At present the Hyderabad and Karachi Boards follow the policy of using a single textbook, which was rarely modified even if needed. This practice should stop and be replaced with some good books in order to enrich knowledge, understanding, and application aspects of students' learning.

Question paper setting should be done to measure the mental processes of the students. The language of the question paper should be before measuring mental processes of the problem given in the question papers and the easy language suited to the process be used. It should exacerbate the student to go through all the contents of the syllabus and must provoke the student's thought and reason so that their conceptual knowledge could be enhanced. There should be no single paper setter but it should be set by a secret panel of jury composed of experts in the subject. The pattern of paper setting should be improved and brought to the international standards. It should combine the use of objective and essay type questions so that the power of comprehension of the students in the subject could be tested. The paper must contain short and definite questions requiring to the point answers so that maximum course could be covered. The question paper should be moderated in such a way that all ambiguities in tapping mental processes are removed.

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