LESSON FROM THE NATIONAL ASSESSMENT OF STUDENTS ACHIEVEMENT IN SCIENCE: NEED OF DRAMATIC REFORMS

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Abstract

The goal of this research is to investigate the level of students' achievement in science and how can we make it easy and competent by taking the feedback from NASA, TIMMS and PISA to develop scientific literacy in Nepal. It provides the criteria to judge progress towards the science education vision of scientific literacy for all. Stratified random sampling was done to pursue this study to select the sampled schools and the students. The sample size for this assessment was 44067 students, including 48% boys and 52% girls from the 1199 randomly selected schools of 28 sample districts, representing each strata of population. The results of the international assessment like Trends in International Mathematics and Science Study (TIMSS) and Program for International Student Assessment (PISA) is compared with the result of this study. The average achievement score in science is 41%, which is very low in comparison to international tests and standards.Nepal government need to improve the condition of scientific literacy through the medium of science education.

Keywords: *Science education, Scientific literacy, Pedagogy*

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Introduction

Background of the Study

The paper argues the need to re-imagine science education in order to effectively respond to the challenge of dealing with new times and new circumstances that have fundamentally changed the social setting within which schools and students operate, compared to the circumstances that surrounded the growth of disciplines and ideals of scholarship that are represented in traditional formulations of school science. Science education in Nepal, as in other south Asian countries, is in a state of crisis (ERO, 2016). It is in the pipeline into this pool of expertise that seems in danger of drying up. The crisis of scientific literacy has many dimensions, namely the shortage of skilled science professionals in the academic institution and the shift in momentum of science-based development, considerable evidence of students' failure rate in the schools (Shrestha, 2009) and a growing concern with a current and looming shortage of qualified persons in the field of science education (Acharya, 2013). In this context, this study attempt to assess the depth of the problem and explore ways forward for the future of science education to develop a scientifically literate Nepalese citizen.

School science education has given emphasis on conceptual knowledge, abstract concepts to interpret and explain relatively standard problems, believing on banking concept of education and use of practical activities for the motto of obtaining marks in examination. Such practicesdo not link to the real life problems of the students (Khaniya, 1990). Public challenges to science from a number of directions have gained much in recent decades, and demand response in science education. Postmodernist critiques of science, attacking its claim to high status knowledge, have been hotly pursued and contested in what has become known as the 'science wars' (Kellaghan and Greaney, 2001). Concern about public attitudes to and knowledge of science have been voiced at high levels now a days. Postmodern, feminist and post-colonial critiques of science also challenge global science research and development practices and their representation in science education. The need to accommodate indigenous perspectives in science curricula in many countries has raised questions about the nature of science and its cultural antecedents (Mirza and Iqbal, 2003). Perspectives from a variety of religions have voiced discomfort over aggressively materialistic versions of science and the perceived lack of human values expressed in traditional science curricula.

Materials and Methods

The population for this assessment was all eighth grader students from the 8000 schools that are running grade eight across 75 districts of Nepal. The sample size for this assessment was 44067 students, including 48% boys and 52% girls from the 1199 randomly selected schools of 28 sample districts, representing each strata of population. Besides, all the head teachers of the sample

schools and 1199 subject teachers responded to related questionnaires. Community and institutional schools were taken from rural and urban areas across the sample districts representing all development regions including the Kathmandu valley and the three ecological zones. Three parallel versions of science test items were administered and the reliability and validity was assured on the basis of the specification grids and the national curriculum framework of science.

Methodological standpoint of this study followed the standard measures available in the present context. For comparing the study results with the international assessment results, linking items were included from the item banks of international tests like Trends in International Mathematics and Science Study (TIMSS)and Program for International Student Assessment (UNESCO, 2006). The tests were administered at a time in one shot in all the sample schools throughout the country in the scheduled day. The answer sheets were marked and achievement scores were tabulated using Optical Mark Reading (OMR) machine, and the assessment results were presented in percentage of mean score.

Science contents were analyzed to develop the standardized test items against the expected performance of the national curriculum, and relative weightages in various content areas and various levels of cognitive domain were prepared. The results of pre-test were analyzed by calculating difficulty level and item discrimination of each item. Based on the pre-test results, the difficulty level of items were set around 50% to 60%. In addition to pre-tested items, some linking items from the previous study of NASA and international tests like TIMSS and PISA were selected for the test (Ross, 1997).

Statistical Tools and Analysis Framework of the Research

Means, standard deviations, percentages and frequencies; correlations such as Pearson's product moment correlation coefficient were used to analyze the assessment scores. SPSS software was used to analysis of scores. The Analysis of Variance (ANOVA) and Covariance (ANCOVA) are used in the General Linear Modelling (GLM) when several means are compared. All the p-values are corrected by using Multi-level modelling (Goldstein, 1986) or Hierarchical Linear modelling (Fara, 2009) by using SPSS Linear Mixed models module.

Results and Discussion

Overall Distribution of Achievement Scores

The achievement scores in science subject was not normally distributed, although the science sample was big enough to form a normal distribution. Based on the distribution of achievement scores, the student population has be grouped into three categories: low-performing students,

medium-performing students, and high-performing students. Majority of the low-performing students achieved 15 to 25% score, the medium-performing students achieved 35 to 45%, and the high-performing students achieved 60 to 75% score.

The mean score in science is 48.0 with the standard deviation of 16.8. This finding is muchhigher than the finding of the CERID study (CERID, 1999) which found 29.62 as the mean with thestandard deviation of 14.8. The frequency of distribution of scores in-group of 10 is presented below.

Table 1: Overall Distribution of Achievement Score

Group	0-10	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100
Percent	2.5	4.8	7.7	13.2	22.8	24.7	17.1	6.1	1.1	0.0

Examining the frequency of distribution of scores, it was found that the scores between 50-60 were most frequent (24.7). Based on the score frequency, two thirds of the students were found to have scored above 40. This should be accepted as a positive indication in the process of learning achievement in science. About 15% students were found to have scored 30 and less. In this way, more than 85% of the total students could be considered to have achieved an acceptable level of scores according to the conventional pass cutoff point (i.e. 30%). A very small number of students were found to have achieved more than 80% (1.1).

Achievement of Science at Regional Level

The achievement scores in science achieved by the students from different development regions of the country were organized under five development regions. The details is shown in the table.

Table 2: Achievement of Science at Regional Level

Regions	**Mean**	**Standard Deviation**
National	48.0	16.8
Eastern Development Region	49.7	16.6
Central Development Region	44.8	15.3
Western Development Region	54.0	16.5
Midwestern Development Region	46.3	16.5
Far western Development Region	43.2	17.9

Western development region has achieved the highest mean score (54.0) in science. The eastern region which stands second in the rank achieved (49.7) mean score higher than the national mean i.e., 48.0. The rest of the regions fell below the national mean score. The lowest mean (43.2) was obtained by the far-western development region as happened in other subjects.

Science Achievement at Ecological belt

The achievement scores of the students in science were organized under the four ecological belts i.e., hills, terai, mountain and the Kathmandu valley for the analysis. The mean and standard deviation of the scores in science achieved by the students from various ecological belts are given in the table below.

Table 3: Achievement at Ecological Belt

Ecological zone	Mean	Standard deviation
Mountain Region	49.4	14.6
Hill Region	48.9	16.4
Terai Region	46.2	18.2
Kathmandu Valley	46.6	16.6

Performance of the students of the mountain belt was the highest (49.4) when the national mean was 48.0. The hill stood as the second in the rank with the mean score of 48.9 higher than the national mean. The performances of the terai (46.2) and the Kathmandu valley (46.6) were lower than the national mean value. In order to find out whether or not the differences were statistically significant, analysis of variance was performed on all the mean scores obtained by all ecological belts.

Science Achievement by Sex

The mean score of boys was found to be 48.2 with the standard deviation of 17.3 and for the girls, the mean was found to be 47.9 with the standard deviation of 16.4. At a glance, it would look that the boys were doing better than the girls. However, one withbasic notion of statistics would soon tell that this difference in performance would not indicate much about the difference between the performance of the boys and girls in science.

Table 6: Science Achievement by Sex

Mean Score by Sex		
Category	**Mean**	**Standard Deviation**
Boys	48.2	17.3
Girls	47.9	16.4

To compare the achievement scores of the boys and girls, t-test was applied. It was revealed that the difference was insignificant. It means there is no significant differences between the achievement scores of gender.

Chapterwise Achievement in Physics, Chemistry, Biology and Astronomy and Geology

The scores obtained by the students were analyzed under the category of Physics, Chemistry, Biology, and Geology and Astrology. Since the achievement test in science had covered all these broad areas, item-wise analysis was carried out to trace out the strengths and weaknesses of the students in those areas. The table below presents the average responses to each item under the given sub-components. For example, there were three test items under the "Life process" which got 88, 41, and 40 mean scores. It can therefore be observed that this item was found reasonably easy by the students. Following table shows the detail.

Table 7:Chapter Wise Achievement Mean Score

Area	Topic	Mean Score
Physics	Measurements	57
	Motion	45.14
	Machines	30
	Pressure	36.25
	Works, Power and energy	52.26
	Heat	75
	Light	32
	Sound	40
	Electricity and magnetism	36.52
Chemistry	Matter	51
	Mixture	65
	Acid, Base and Salt	80
Biology	Living beings	88
	Cell	41
	Life process	40
	Metabolism	33
Geology and Astronomy	The earth	39
	Air	38
	Universe	39

In all the category of the chapters, most scores fell in between 36 to 65 which mean that theperformance of the students in science is reasonable though it should be noted that the mean score was not so high. It also indicates that the students achieved overall command over most of the areas.

Conclusion

The average achievement score in science is 41% which was very less than the report of PISA and TIMSS. Students have not done better in biology than chemistry, physics, and geology and astrology. The students' ability to solve complex problems is low as only 23% scores were obtained in higher ability items. Students are much better in the remembering and understanding type of questions (49%). The students are good in recognizing the correct answer and in very fundamental knowledge, such as choosing the facts and numbers, and writing the definitions. They are much weaker in reasoning, problem solving, plotting, proving the theory or formula, and constructing the shapes and figures. In many cases, the students did not even start to do the open ended questions and hence, they got poor score.There is a remarkably wide difference between the highest and lowest achiever ecological zones in science. Students in the Kathmandu valley have done better than other zones. There is wide difference in students' achievement scores among the various development regions in science. The difference between the lowest performing regions (Eastern and Far-western regions i.e., 32%) and the highest performing region the Kathmandu valley (56%) is remarkable.Gender explains only 2% of the variation in achievement. Boys have done better than girls but not with significant differences.

Wide differences in achievement among development regions, ecological zones, districts, schools and students in science was found. When district is taken as a unit of analysis, the disparity in the level of achievement is big. Further analysis of the highest and lowest performing community schools reveals that those students tend to perform higher who afford more time on homework, have positive attitude towards to study science, receive the required support from siblings or private tuition from teachers, do not need to work for earning while studying, receive textbooks timely, and reach the grades at their correct age. On the other extreme, lowest achievers are those who belong to illiterate parents, especially the mothers who are involved in agriculture work, need to work for earning, receive neither private tuition nor support from family members, and the children not receiving textbook, and so on. Remarkable gap in achievement between institutional and community schools was found. Students' performance found better in lower levels of cognitive skills, but poor in higher cognitive skills. Students are good in lower level of cognitive ability, like knowledge and comprehension, but they are poor in higher level of cognitive ability, like analysis, evaluation and applying the gained knowledge and skills in a new situation. The result reveals the fact that the students are good in recognizing the correct answer and in very fundamental knowledge such as choosing the facts and numbers, and writing the definitions. They are much weaker in reasoning, problem solving, proving the principle, and constructing the figures. Comparing the achievement scores of NASA of science with the achievement scores of an international assessment TIMSS and PISA; it is found that the achievement score in science is lower than the international means.

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