

SCIENCE-RELATED ATTITUDES AND INTERESTS OF STUDENTS

by

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Abstract

This paper presents a profile of interests and experiences of Filipino students nationwide, that are related to science in school and outside school. The profile describes and inter-correlates what students want to learn about, their future job, environmental challenges, attitude towards their science classes, opinions about science and technology, out-of-school science-related experiences, and what they would like to do as researcher. Gender and regional differences are also examined. The Philippine data are compared with some international results, including inter-correlations of overall rating in selected items, human development index and student science achievement in an international study of eleven countries.

Keywords: science curriculum, children's experiences, interests, priorities, gender difference, regional comparisons

Introduction

The Philippines took part in the international study, Relevance of Science Education (ROSE), based in the University of Oslo, Norway and funded by the Norwegian government (Schreiner and Sjoberg, 2004). The research questions of the Philippine study are:

1. What is the profile of the Filipino students' areas of interest and experience in terms of topics they wanted to learn about, future job, perceived environmental challenges, attitude towards school science, opinions about science and technology, out-of-school science-related experiences, and researches as future scientists?
2. Are there differences in the Filipino students' mean ratings in these areas by gender and school type (public or private)?
3. Are the areas of interest and experience of Filipino students positively inter-correlated?
4. What are the Filipino student perceptions in relation to those in other countries?
5. What are the inter-correlations of ROSE ratings, human development index, and science score in the Trends in International Science and Mathematics Study (TIMSS)?

The ROSE rating of a country, in the Philippine study is the overall rating in ten selected ROSE items. These items were analyzed using data from participating countries (Sjoberg and Schreiner, 2006) were:

1. "Science and Technology are important to society."
2. "Thanks to Science and Technology, there will be greater opportunities for future generation"
3. "New technologies will make work more interesting."
4. "Benefits of science are greater than the harmful effects it could have."
5. "I like school science better than most other subjects."
6. "I would like to have as much science as possible at school."
7. "I would like to become a scientist."
8. "I would like to get a job in technology."
9. Important for future job: Working with people rather than things.
10. Important for future job: Working with machines or tools

The Human Development Index (HDI) of countries in 2003 was used in the study. HDI, as defined by the United Nations Development Programme, is a composite index of measures of life expectancy at birth; adult literacy rate; combined gross enrolment ratio for primary, secondary and tertiary schools; and gross domestic product per capita (UNDP, 2003). The TIMSS science score was the average scale score of a country in the science achievement test items in TIMSS 2003 (Martin *et al.*, 2004).

Methodology

The Philippine sample consisted of 6, 943 Grade 10 (age 15) students in 148 high schools (one class randomly selected per school) in 15 regions of the country. The schools were the TIMSS 2003 schools that were randomly selected, using a probabilistic proportional-to-size sampling procedure with region as an implicit stratum. The ROSE instrument was administered by Metro Manila teams in February 2003, on the same day as the TIMSS instruments (for Grade 8 students) in a given school.

The ROSE instrument was a 250-item questionnaire that used a 4-point scale, either 'Disagree – Agree' or 'Never – Often'. The questionnaire had seven parts: Out-of School Experiences, Topics Students Want to Learn About, Future Job, Environment, Attitude to School Science, Opinions about Science and Technology, and the Student as a Scientist. The reliability of the instrument, using Philippine data and measured by the average Cronbach alpha, was 0.705.

Percentages and means were computed for the student profile of interests and experiences. Factor analysis was done to determine the empirical structure of the items on issues about future jobs. Two-tailed t-tests for independent groups were done to test significance of differences of mean ratings by gender and school type. Student ratings on areas of interest were correlated to their ratings on areas of experiences using Pearson product-moment correlation coefficient and tested for significance.

For eleven participating countries, namely, Egypt, England, Estonia, Ghana, Israel, Japan, Latvia, Norway, Philippines, Russia, and Sweden, their ranks in the ROSE rating were correlated with their rank in human development index and with the rank of their TIMSS score, using the Spearman rho correlation coefficient and tested for significance. All significance levels were set at .05.

Profile of Student Interests and Experiences

The most popular topics to the student respondents were Biology topics, followed by physics topics. While Biology topics were expected to be most popular to the adolescent respondents, the choice of physics topics needs further study, in view of the common perception of physics as a difficult subject. However, one possible explanation is that the respondents were, at the time of data collection, completing their physics course.

More than 90% of students wanted to learn about how computers work; stars, planets, universe; clean air and water; and mobile phones. Except for clean air and water, an environmental science topic, the other top choices are physics-related. The other perceptions of this percentage of students are:

1. Developing knowledge and abilities, using talents and abilities, and helping other people were most important to their future jobs.
2. For environmental challenges, each person can contribute to environmental protection and that people should care about it.
3. School science is interesting, has shown importance of science for students' way of life, has enabled the student to learn things that are helpful in everyday life, has taught the student how to take better care of one's health, and should be learned by everybody.
4. Science & Technology are important to society, provide greater opportunities for future generations, will find cures for diseases, and are needed by the country to become developed.
5. New technologies will make work more interesting, and Science and Technology make our lives healthier, easier and more comfortable.

In general, the student responses indicate a positive attitude towards future jobs, environmental protection, school science, Science and Technology, and new technologies.

More than 80% of students had the following out-of-school experiences: using ruler, measuring tape/stick; taking medicine to cure illness; watching nature programs on TV/film; reading about nature/science in books or magazines; and using dictionary/encyclopedia on a computer. Using ruler is, perhaps, done in homework. Measuring tape is used in buying cloth, sewing, and carpentry. Taking medicine to cure illness is done even in poor families. the country. The other student responses need to be validated by interviews, since mass media and instructional resources cited are more accessible to middle class and rich students who constituted a minority of the sample.

If the student respondents were scientists, the top researches they would do were on stars, planets, black hole, space travel; diseases and medicine cure; environmental research; inventions; and computers or new technology. The reasons for these top choices could be varied, from the relatively unknown astronomy topics, challenges of inventions, useful medical and environmental concerns, to current technology developments.

From the student ratings, six factors were derived from 26 item on issues they considered important to future jobs: creative use of talents and abilities (5 items), getting rich and in control (5 items), working for enjoyment (4 items), working with and for people (4 items), Science and Technology (5 items), and independence (3 items). The Filipino respondents, in their last year of high schooling, were likely to be aware of job market skills needed in careers of their choice. Getting rich is a common aspiration in a developing country like the Philippines. Working with and for people reflects the Philippine culture and concern for human relationships.

Gender and School Type Differences

There was no significant difference between boys and girls in the topics that they wanted to learn about. The girls significantly ($p < .05$) considered more people-oriented future jobs than the boys did. This result can be validated in studies on female versus male psychology.

In attitude towards school science, there was no significant difference between boys and girls. Maybe this finding reflects the almost equal participation of boys and girls in science classes, for example, in recitation and group work. Girls had a significantly ($p < .001$) more positive opinions about Science and Technology than the boys had. Student interviews are needed to determine reasons for this significant difference.

For school type differences, there was a significant difference between public and private schools in the topics that students wanted to learn about, in favor of public schools for Biology ($p < .05$), Chemistry, Physics, and Earth Science ($p < .001$), in favor of private schools for Space Science ($p < .05$). There was no significant difference between the public and private schools for Nature of Science and Technology topics. Probing student responses for the explanations of these results is recommended.

Private schools' mean rating on factors important to future jobs, namely, 'getting rich and in control' and 'working for enjoyment' were significantly ($p < .001$) higher than that of public schools. Perhaps, this is a reflection of the higher socio-economic status of students in the private schools.

Public school students had a significantly ($p < .001$) more positive attitude to school science than those in private schools. This may imply a number of teaching conditions, such as greater teacher enthusiasm and higher student involvement in class.

However, there was no significant difference between public and private schools students, on the average, in their attitude to science and technology. This finding may be

influenced by the attitude of society in a developing country on the critical importance of science and technology to economic development.

Correlations of Topics, Interests and Experiences

The most popular topics that Filipino students wanted to learn about, the Biology topics, correlated significantly ($p < .001$), positively, and moderately with Science-and-Technology-related and people-oriented issues considered by the students to be important to future jobs (Table 1).

Table 1. Correlation Between Biology Topics that Students Wanted to Learn About and Their Interests/Experiences

Topic	Interest/Experience	Pearson Correlation Coefficient
Biology Topics Students Want to Learn About	Issues Important to Future Job (Science & Technology)	0.441**
- do -	Issues Important to Future Job (People)	0.406**

** $p < .001$

As a whole, the overall student attitude to school science had only a moderate but significant, positive relationship with overall opinion about Science and Technology, in particular, the importance of Science, and out-of-school science-related experiences (Table 2). These findings have implications on

Table 2. Correlation Between Students' Interests and Experiences

Interest	Experience	Pearson Correlation Coefficient
Overall attitude to school science	Overall opinion about Science & Technology	0.376**
Overall attitude to school science	Opinion about Science & Technology (Importance of science)	0.550**
Overall attitude to school science	Out-of-school science-related experiences (interaction with nature)	0.389**

** $p < .001$

how school science is taught, how parents, teachers and mass media can contribute to out-of-school science-related experiences, and their relationship to the students' overall opinions about Science and Technology.

ROSE Ratings of Philippines and Other Countries

Among the eleven countries, the Philippines ranked 1st on ROSE items on importance of Science and Technology for society, and new technologies making work more interesting. The country ranked 2nd on seven items: greater opportunities for future generation due to Science and Technology, greater benefits of science than harmful effects it could have, having as much science as possible in school, liking to get technology job, and important for future jobs – working people rather than things and working with machines as tools (Sjoberg and Schreiner, 2006).

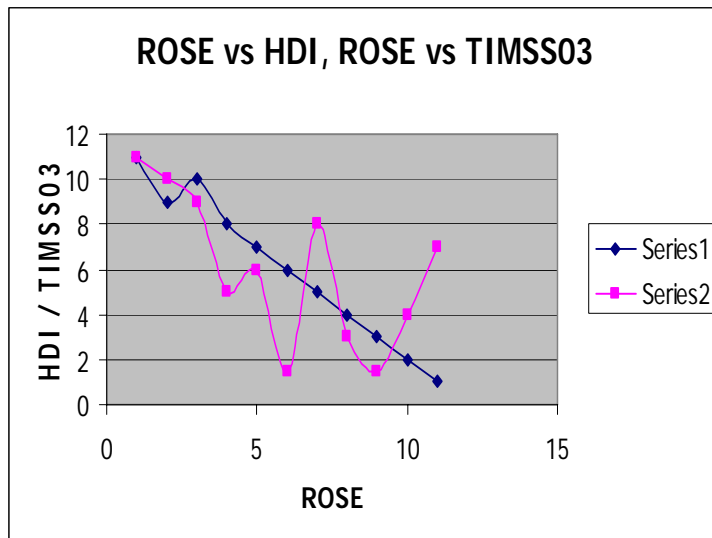
The lowest rank of the country was 3rd, in the item on liking to become a scientist. Overall, the Philippines ranked 2nd in the ten selected items among the eleven countries. The general positive science-related interests and experiences of Filipino students are, perhaps, indicative of the hope of society in Science and Technology as a major tool in economic development. For science teaching purposes, the positive attitude is a good beginning and springboard for increasing student achievement nationally and internationally.

ROSE Rating, HDI and TIMSS Score

For the eleven countries, the overall ROSE rating had a significant ($p < .000$) negative, very high, relationship with HDI (Table 3 and Fig.1). The correlation of the ROSE rating with the TIMSS science score was also significant ($p < .022$) and negative, but moderate in value. A positive attitude towards science is expected to be associated with high science achievement. The reasons for the negative relationship need further investigation.

Table 3. Correlation Between ROSE Rating and HDI, and TIMSS Science Score

Variables (Ranks)	Spearman Rho Coefficient	Degrees of Freedom	Level of Significance
ROSE Rating & HDI	- 0.991	11	0.000
ROSE Rating & TIMSS Science Score	- 0.624	11	0.022



Series 1: ROSE vs HDI
 Series 2: ROSE vs TIMSS

Figure 1. Correlation Between ROSE Rating and HDI, and TIMSS Science Score

The negative, high relationship between science-related interests and experiences and the human development index, a composite index, calls for an in-depth study. For instance, have students in countries with high HDI like Norway taken the benefits of Science and Technology for granted, since these benefits are part of their daily life?

Conclusion

The Philippine results showed more than 90% of students indicating positive science-related interests and experiences. Out of eleven countries, the Philippines, on the average, ranked second on ten selected items in the ROSE questionnaire.

Significant gender differences, in favor of girls, were in opinions about Science and Technology and considering more people-oriented issues as important to future jobs. School type differences favoring public schools were significant in attitude to school science and topics in Biology, Chemistry and Physics that students wanted to learn about. Private schools had higher mean ratings in Space Science topics that students wanted to learn about and in getting rich and in control, and in working for enjoyment in future jobs.

Correlations between attitude to school science and the following variables were significant, positive, and moderate: opinion about S&T and out-of-school science-related activities. A similar relationship was found between interest in learning Biology topics and opinion about issues important to future jobs.

The ROSE rating had a significant, negative correlation with HDI (very high) and with TIMSS science score (moderate).

The recommendations of the study include using students' high interest in school science, S & T, environmental challenges as a starting point and context to improve science achievement. The students' science-related interests and experiences need to be sustained or enhanced in class and Science Club activities. Further studies can examine why Biology topics are most popular & how other topics can be equally interesting to learn. The top topics that students wanted to learn about can be given emphasis or included as enrichment topics.

Reasons for gender differences and school type difference in topics and areas of interest and experience can be investigated, including instructional strategies that can reduce such differences. Finally, an intensive study to include student interviews can seek to determine explanations of negative correlation of ROSE rating with HDI, and with TIMSS science score.

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