Relationship between Environmental Awareness and Intellectual Development of School Children

Elisabete G. Castellano, Fazal H. Chaudhry
Associação de Escolas Reunidas/ University of São Paulo, São Carlos, SP, Brazil

Abstract
This paper studies the environmental awareness of primary school students from two public schools in urban areas with different socioeconomic conditions in the city of São Carlos, São Paulo, Brazil. One hundred students of ages between 6 and 16 were selected for the investigation employing various tests. The students were submitted to tests based on symbolic representations to determine their awareness of environmental responsibilities. The context of a watershed and water pollution was chosen for preparation of the symbolic representations. Piagetian tests were also applied to determine intellectual development of the children and to establish its relationship to their moral development. The results show that children below age 11, while undergoing intellectual development, show little awareness of environmental norms. Large majority of children above 11 present heteronomous moral attitudes in obedience to prescribed norms. No case of autonomous moral development as related to environmental questions was observed in the survey sample. It is hoped that the results obtained in this study are useful in developing ideas for environmental education of school children as well as in planning environmental science courses for engineering degree students.

Introduction

Although one may argue that industrial production and technological progress have brought about the present day environmental crisis, it is the lack of social awareness and moral consciousness with regard to the environment which hold the clue. The resolution of environmental questions involves not only direct measures of political, social, scientific and technological nature but also actions dealing with the ethical and moral attitudes of individuals and the society as a whole. Environmental education is considered as an essential instrument towards creating a new universal ethic and consciousness in favor of society's harmonious relationship with the environment. As the educational institutions and the society align themselves and embrace discussion of the problems, the environmental idea shall blend itself into the workings of the social system[1].

It is generally agreed that the main objective of the educational process, besides teaching, is to prepare creative persons capable of interacting critically with the surrounding environment in spite of the variations in individuals and the environments. This evolution takes the child from a lack of norms (anomic) to submission to pre-established values (heteronomous) and lastly

to a cooperative attitude (autonomous). In general, younger children either through respect or coercion accept the determinations of the adult understanding that obedience is the correct behavior. In the heteronomous phase, justice is also the prerogative of the older and as such not discussible. The autonomous conscience develops through interaction with equals or in an environment of mutual respect, which help the child to construct moral values of higher order such as justice, fairness and cooperation[2].

Given the importance of environmental awareness to engineering education, Ministry of Education introduced in late 70's a compulsory introductory course called Environmental Science in all the engineering degree curricula. Experience in teaching this course reveals that there are large differences in the student's capacity to embrace the environmental ethic and to construct ideas with respect to posed scenarios. It is suggested sometimes that this difficulty of engineering students owes itself to the lack of adequate preparation of the school students for university level education. This study is aimed at verifying this hypothesis by studying the environmental awareness of and intellectual development of school students.

Environmental education aims at promoting comprehension of the relationships of interdependence between the ecosystems and the social system, of preservation of natural resources and of their studied exploitation. In the case of water resources, such relationships are best focused on the basis of local hydrographic basins or watersheds that represent a universally recognized concept being incorporated into the legislation around the world. This paper studies the social interaction of primary school children as regards their moral development in the context of a watershed with water quality problems by Piagetian clinical method. As adequate moral judgments depend upon the general intelligence of a person, cognitive development of these children is also studied through standard Piagetian tests.

Background

This work follows the theoretical framework of Jean Piaget, hence a brief introduction to Piaget's theory of cognitive development of children is presented. Piaget argued on the basis of his observations that development of intelligence in children exhibits four chief stages and the sequence is everywhere the same, the ages in the stages of development may vary from culture to culture. He starts by defining thinking as an action, a sot of manipulation. It begins as an operation upon material things and objects – water, air or a ball. These operations are then interiorized. The slow gradual and sequential evolution builds necessarily upon existing structures to construct new ones.

In the sensorimotor stage, from birth to 2 years, the child experiments with objects and connecting newer experiences with the older ones, the child can be said to be learning from experience. In the second preoperational level, from 2 to 7, objects of child's perception come

to be represented by words, which he now manipulates experimentally in his mind as he has previously experimented physically with concrete objects. In the third stage of concrete operation, from 7 to 12, his first logical operations occur, and he classifies objects by their similarities and differences. Only after about 12 years of age, with the onset of adolescence, does the power develop to deal with formal mental operations not immediately attached to objects. Only then theories begin to acquire real significance.

The variations in the intellectual development of children may be explained by various factors such as heredity and individual maturation, experience acquired by contact with the external physical environment, social interaction and instruction, and a feedback among all these factors. Piaget's later work attempted to describe the interaction between cognitive and emotional factors in his four stages of thought development.

Methods

In order to study the relationship between environmental awareness and cognitive development of children, 100 students between ages 6 and 16 were randomly sampled from two primary public schools in the city of São Carlos, São Paulo, Brazil , designated as School No. 1, located in the downtown and School No. 2, in the outskirts. The sampling was done in each of these 10 age intervals selecting 10 students in each. Two schools were considered in order to account for any possible differences in socio-economic conditions of the neighborhoods. Children's parents were invited to fill in a questionnaire furnishing general information including occupation of supporting family member and the number of children. These data provided a profile of the student and his family. Parents' occupation is considered to be a reasonable indicator of the students' access to the socio-economic and cultural opportunities of the environment. The socio-economic scale in Table 1, based on the modified Hutchinson's Prestige Hierarchy Scale[3] was used to interpret the parents' occupation.

Table 1. Scale of Occupational Categories (adapted from Gouveia and Havighurst, 1969)

Scale	Description
1	Higher executives, owners of companies, federal or state representatives etc.
2	Professionals
3	Lower supervisory positions not involving manual operations
4	Clerical positions
5	Lower supervisory positions involving manual work
6	Skilled worker
7	Unskilled worker

Two series of tests based on the theory of Piaget for evaluating the cognitive development of school children between ages 6 and 16 were developed: the first set containing 7 tests for the concrete operational stage and the second with 3 tests for formal logical operational stage.The

concrete operational tests included: Conservation of discrete quantities using colored cards; Conservation of mass using molding clay; Conservation of liquid volume; Classification of geometrical figures made from wood and cardboard with different colors; Inclusion of classes using fruits and plastic flowers; and Sequencing using wooden sticks. The students, who proved to be in concrete operational stage, were submitted to tests for formal operational stage. These included: Conservation of mass using molding clay, metal balls, liquid glasses; Combination of cards of different colors; and Oscillation of a pendulum. The students were also submitted to tests based on symbolic representations to determine their awareness of environmental responsibilities. The context of a watershed was chosen for preparation of thesymbolic representations in view of more modern concepts of water resources management and the related legislation. Greater emphasis was placed on pollution control in constructing these representations. Six questions were formulated dealing with perception of responsibility and fairness related to streams, groundwater, wastes, pollution and water supply.

The Piagetian clinical method used in this study consisted of individually investigating each student by the first author who presented him or her with some task or theme and offered arguments and contra-arguments in the form of a dialogue. Before starting the dialogue on a chosen theme, the child was engaged in conversation in order to determine the language compatible with his discourse. The child then listens to the investigator tell a small story involving intellectual or moral dilemmas which he should evaluate on the basis of his own opinions as regards the correctness or error of the stated decision. The dialogue offers the possibility to the child to justify his or her points of view and examine the circumstances being presented.

Three distinct stages of the cognitive development structure of the child could be detected in each of the tests. A score of zero is attributed to the first stage where the child does not yet have a given mental structure, 0.5 to the intermediary stage in which the child partially shows the structure and a full score of 1.0 is earned by the child who demonstrates having achieved the given mental structure. Thus a student may obtain an intellectual development level between 0 and 7 in the tests for the concrete operational stage. The student's responses on environmental problems were analysed to determine the status of moral development as anomic, heteronomous or autonomous with scores respectively of 1, 2, and 3.

Results

The general student profile data are analysed in terms of age, school year, number of children in the family and parents' profession. Figure 1 shows that there is a linear progression of students through the school years, there being a greater age dispersion in the first and last years of primary school. Figure 2 presents frequency distribution of number of children in

students' families; a large majority, about 82%, has between 2 and 3 children. The frequency

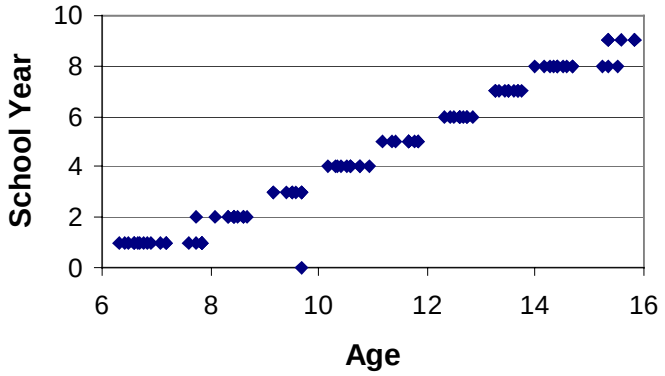

Figure 1. Relationship between student age and school year

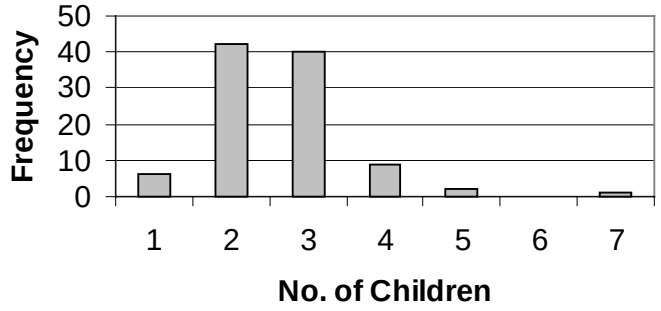

Figure 2. Number of children in students' family

of parent's profession for students in the two schools is shown in Figure 3. Although the schools were initially chosen as being situated in socially differentiated districts, the data in this figure show small differences in the socio-economic sectors of population served. School 2 in the outskirts serves greater proportion of family's of unskilled whereas School 1, those of skilled workers.

Figure 4 presents the cognitive development levels achieved by 100 students submitted to the 7 concrete operational stage tests, plotted against age. Although there is considerable dispersion, a threshold around age 11 is discernible beyond which no zero scores appear, indicating preoperational performance. Between 8 and 11 years, there is a mix of zero and

nonzero scores representing a transition stage between preoperational and operational stages. After age 11, one observes concrete operational behavior marked by large oscillations in intellectual development level. To assess the average performance of students in the studied sample, average development levels for each school are displayed in Figure 5. It is seen that

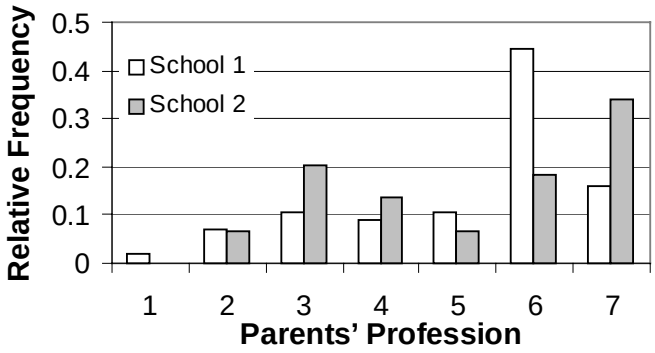

Figure 3. Relative frequency of parents' profession in the two districts

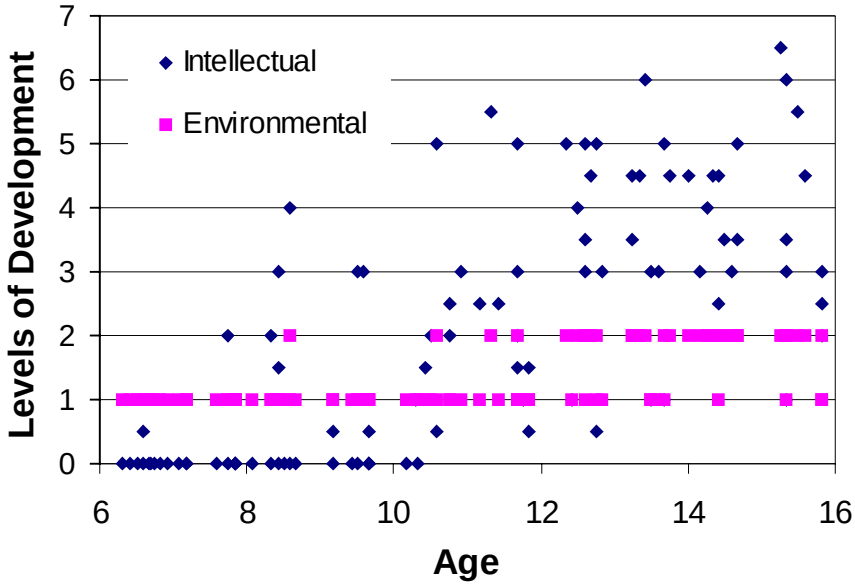

Figure 4. Evolution of cognitive and moral development of school children with age

there is a steady growth of cognitive development from 4th school year, which corresponds to ages between 10 and 11, onwards. The exception is the 9th year corresponding to first year at

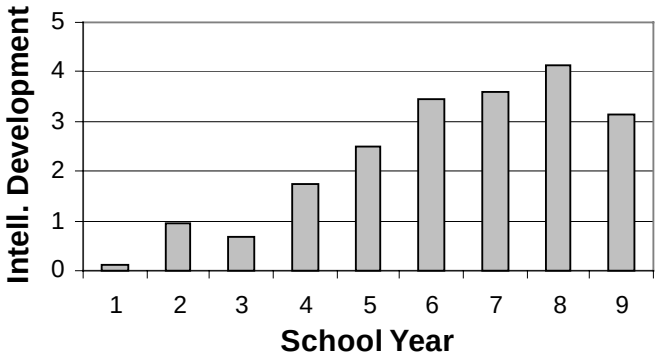

Figure 5. Evolution of average scores for cognitive development as function of school year

the secondary school. Application of further tests showed that none of the students in concrete stage proved to be in formal operational stage. It shows that the primary school students in our sample had not yet developed the ability to think in terms of hypotheses, to deal with formal mental operations not immediately attached to objects. The results obtained on moral development in terms of environmental awareness are also presented in Figure 4. Although anomie (level 1) prevailed over all ages, the heteronomous attitudes (level 2) appear from age 11 onwards. No student showed to be autonomous (level 3).

No correlation was found between the moral and cognitive development of school children and the parents' social status as represented by their professional classification or the number of children in the family. To illustrate any sex differences in intellectual development or environmental awareness, Figures 6 and 7 show relative frequencies of development levels for boys and girls. There are no clear differences except that girls seem to show slightly greater

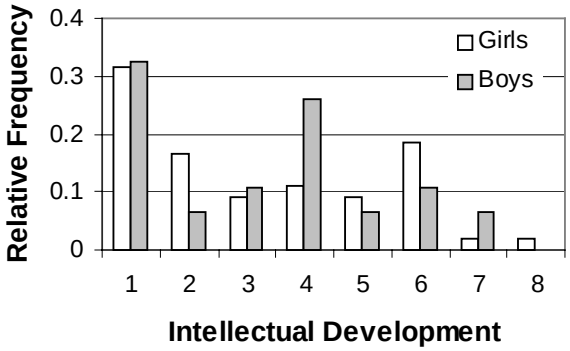

Figure 6. Relative frequencies of intellectual levels observed in boys and girls

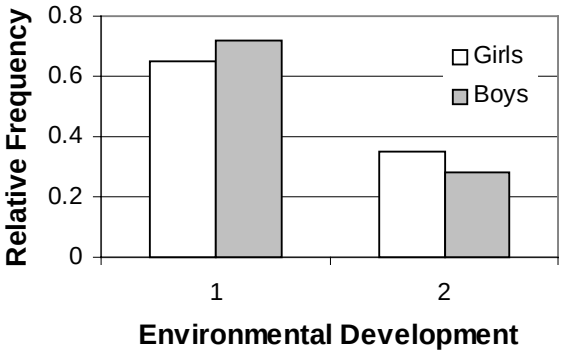

Figure 7. Relative frequencies of environmental awareness in boys and girls

environmental awareness. Similarly, Figure 8 presents relative frequencies of intellectual scores of children from the two schools under study which shows that the outskirts school students excel at higher scores. Figure 9 displays the environmental awareness of children

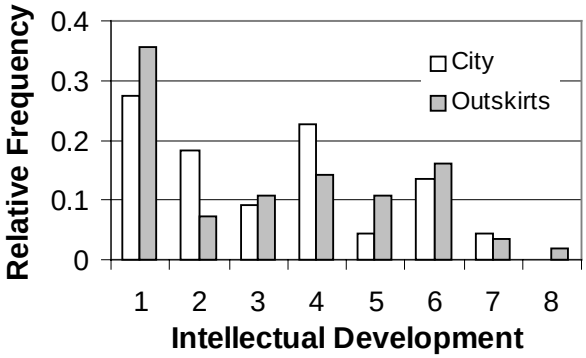

Figure 8. Relative frequencies of intellectual development levels in the two schools

from the two schools. The children from the outskirts of the city, being subjected to precarious sanitary conditions, are more sensitive to water problems.

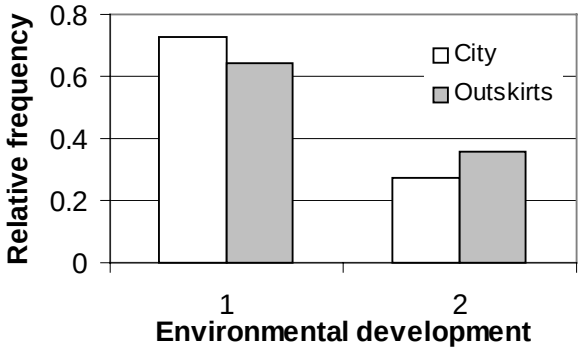

Figure 9. Relative frequencies of environmental awareness of children in the two schools

Conclusion

This study of primary school children indicates that age of 11 years represents a threshold for their intellectual and moral development. Children below this age were found to be in preoperational stage of cognitive development and showed little awareness of environmental norms. The intellectual performance of children between ages 11 and 16 corresponds, at best, to the concrete operational stage. Students in our sample lacked the ability to perform formal mental operations, characteristic of this age group. Perhaps for this reason, they presented only heteronomous moral attitudes in obedience to prescribed norms. No case of autonomous moral development as related to environmental questions was observed in the survey sample. It can be concluded that the primary school education examined in this study is not attaining the goal of developing autonomy of thought in children so that they can form values of justice and fairness. This result should serve as a cue to the engineering faculties to tailor environmental science introductory course teaching to the clientele that has not developed yet its thinking in an autonomous manner. We hope that the results obtained in this study are useful in developing ideas for environmental education, as well as general education, of school children in order to improve their ability in concept formation and notions of responsibility.

References

1. Seara Filho G., "What is Environmental Education?" In Castellano E.G., and Chaudhry F.H., *Sustainable Development: Problems and Strategies* (ISBN 85-85205-33-4), São Carlos School of Engineering Publications, São Carlos, SP, Brazil, pp. 287-303, 2000.
2. Castro A.D., "Psychopedagogy of Environmental Education" In Castellano E.G., and Chaudhry F.H., *Sustainable Development: Problems and Strategies* (ISBN 85-85205-33-4), São Carlos School of Engineering Publications, São Carlos, SP, Brazil, pp. 337-347, 2000. (Portuguese)
3. Gouveia A.J., and Havighurst R.J., *Secondary Education and Development*, University of São Paulo Press, São Paulo, Brazil, 1969.