

Integration of Different Branches of Science in the Curriculum of Environment & Science under WBBSE

Chiranjit Dutta¹ & Kamal Krishna De²

¹Research Scholar, SVCMMRES, Ramakrishna Mission Sikshanamandira,
Belur Math, Howrah, West Bengal, India.

²Former Professor, Ramakrishna Mission Sikshanamandira,
Belur Math, Howrah, West Bengal, India.

Abstract

Recent trends have shown that integrated science has gained popularity and it is being accepted for the first ten years of schooling or at least for the first eight years of schooling. The application of an integrated curriculum is the most powerful way to communicate and transfer scientific knowledge. The purpose of this study was to find out, integration of different branches of science in the curriculum of 'Environment & Science' under WBBSE. To achieve the purpose of the study, a self-made tool was used constituting 45 items which were constructed from Physical science, Life Science & Environmental Science equally (15 each) from the book 'Paribesh O Bignan' (in Bengali) & 'Environment & Science' (in English) of class VIII. For conducting the research, the data were collected from five randomly selected schools from randomly selected five districts of West Bengal. The tool was distributed to the class VIII students providing general instruction; after the completion of stipulated time as mentioned in the tool the answer sheets (data) were collected from students; from each school twenty (20) students were selected randomly. After collecting the data, the answers of the students were evaluated. The evaluated scores (i.e. achievement in- Physical Science, Life Science & Environmental Science) were put in MS Excel and through descriptive statistics the data were analyzed. The result showed that 'Environment & Science' of the upper primary stage under WBBSE involves integration. It was also found that the students have higher achievement in Environmental Science in comparison to Physical Science and Life Science.

Keywords: Integration in Science, Correlation, Curriculum, Environment & Science.

INTRODUCTION

Development of Science curriculum, down the ages in schools in India with particular reference to WB

In colonial India there was hardly any scope of science teaching-learning in school in India and, not to speak of Bengal. The science education was in a mess even in the 19th century in England which was then a lighthouse for Indian scientific culture. School science in UK was then shaped to cater the necessity of technicians. In Bengal, science education started with a few elective subjects from the Intermediate stage (now +2 stage). So science education was neglected in secondary and lower stages. It took almost a decade to start science as general science in a secondary school as a half paper. In HS schools, the common science course was designated as core science which comprised activities and some descriptive topics on physics, chemistry and life science devoid of any intellectual fervor. Thereafter WB & India have come across different types of science courses in upper primary and secondary levels. In West Bengal, especially Junior High Level, the science curriculum was evaluated and reformed in this way: General Science (1952), Physical science (integration of Physics and Chemistry) & Life science (1974), Environment & Science (Paribesh O Bignan) (2011).

In 1998, **NCERT** published the book ‘Science’ for class VI of CBSE Board where it is described, “We have also tried to give you several connections between what you read in science textbooks and what you observe around you in nature. Many of the processes you see in nature are not classifiable as chemistry alone, or only physics or purely biological. They are at once all of these. When the polar bear hibernates in the Arctic winter, its action is biological. During this act, it must be surely thankful for the stored fat and its properties! For the physical property of the fat – that fat is a bad conductor of heat – which aids the bear in keeping warm; for the chemical property of the fat – its lower oxygen content makes it an energy-rich fuel, better than carbohydrates; and for the biology of being able to make and store the fat in its tissues.” Learning a subject will be fruitful when its ideas will be integrated with the ideas of other subjects. As for example, Chemistry is an important part of studying Anatomy and Physiology. The cells of our body are composed of chemicals and in all of our body’s movements and cycles, chemical reactions are involved (Zamboni, 2017). Integrating biology with physics and chemistry is essential as they are inter-dependent. Physics and chemistry influence the field of biology very much, so the biology teachers should integrate physical science into the lessons of biology (Mitchell, 2017). The mathematical problems related to science and

technology are to be given in abundance in the content of mathematics so that the integrated method of teaching may be more interesting and attractive (Chel, dnf). Connecting more than one subject is not only important but it's possible too. The teachers usually convey their strong convictions about the importance of connecting mathematics and science instruction and comment about the natural overlaps in mathematics, science and real-world events (Frykholm, & Glasson, 2005). The new TL method of integrated teaching was found to be more effective than the traditional one in the field of the medical curriculum also (Kate, Kulkarni, Supe, & Deshmukh, 2010). A contingency table analysis confirmed substantial changes in teaching and learning processes when the topics studied were outside the teacher's specialist discipline area. It was concluded, for the sample studied, that informational approaches were twice as likely to be encountered when the teacher was teaching outside his discipline area and that this increase was at the expense of more effective problem-solving and inquiry approaches (Hacker, & Rowe, 2007). Teaching-learning will be meaningful when it is integrated with the ideas of other fields of subjects (Bigge, 1962). Recent trends have shown that integrated science has gained popularity and it is being accepted for the first ten years of schooling or at least for the first eight years of schooling (Sood, 1989). Application of an integrated curriculum is the most powerful way to communicate and transfer scientific knowledge (Harrel, 2010).

Construction of Science Curriculum

Arrangement of the content may be broadly divided into two ways: logical and psychological. The logical arrangement is followed when the students are at the formal level of operation. At the sensorimotor stage, it would be the better if curriculum is organized psychologically. Among the psychological arrangement, the most favorite is the integrated science curriculum.

Bigge. (1962) mentioned the term 'non-teachable subjects'. In his idea, a subject is non-teachable if it cannot be correlated with other subjects or with some alien ideas. When a Teacher teaches a subject e.g. Language, Mathematics, Science etc., teaching-learning will be meaningful when it is correlated with the ideas of other fields of subjects or even of Life. When the subject matters are correlated in this way they can be enclosed in a common enclosure. This enclosure indicates Integration. If there is no correlation, there can be no Integration.

An untrained science teacher or a teacher specialized in one subject may not be always able to present lessons with correlation. Similarly, if the science curriculum is not sufficiently correlated,

teachers as well as the students can't integrate knowledge. So correlation and integration are the two sides of the same coin (i.e. curriculum). If the environmental issues and the corresponding scientific principles go hand in hand, many problems of life can be solved easily.

Types of Integration

NCERT, Dept. of Education in Science and Mathematics (DESM) suggested three types of integration in Science – i) Integration in Content, ii) Integration in Process & iii) Integration in Objectives. **Content Integration** means the capture and movement of content between systems, applications and processes; regardless of the form. To enable the movement of content, transformation is often required. In **Process Integration**, subjects having similar processes of acquiring knowledge can be integrated; e.g. Life science & Chemistry based on the style of experiment, observation & inference. **Integration in Objectives**- Physics and Chemistry have similar aims & objectives, so are liable to be integrated. This integration was followed in the erstwhile curriculum of Physical Science under WBBSE.

Environmental Education as infused in NCERT Syllabus for classes I to XII as per NCF 2005: “The topics related to environment were suitably infused with different science and social science subjects at all school stages. Understanding of the environment in its totality, both natural and social, and their interactive processes, the environmental problems and the ways and means to preserve the environment were one of the General Objectives of Education as per National Curriculum Framework 2000.”

Correlation

The word correlation means a close or mutual relation of two subjects related to each other. As for example, we can say that teaching Physics is highly related to Chemistry, Mathematics, Biology etc. So many new areas are coming nowadays which are highly correlated with their main subjects e.g. Biochemistry, Biophysics, Biotechnology correlate Biology and Physics or Chemistry or Technology. The important point is that subject boundary have no meaning and while discussing one subject it needs examples from different subjects. As a science teacher, we should see a correlation among the various school subjects and at different stages in education.

Emergence of the Problem

Under the orders of the apex court (2002) of India, Environmental Education was introduced in the schools of India right from Primary school. It was introduced as a separate subject claiming separate teacher, separate time, separate classroom and thus loading the school bag of the children. The consequence of the inclusion of environmental education could not fetch the superior result in the scenario of school education because it was treated as a burden in the existing load of the curriculum. In the revised curriculum with effect from 2011, science i.e. both Physical and Life science were integrated with Environmental Education and thus three subjects- Physical Science, Life Science and Environmental Science were converged into a single subject under the title “Paribesh O Vignan” (in Bengali) and, “Environment & Science” (in English) in upper primary level. It was published as a single subject in a single book. Whether the quality of curriculum, science textbooks developed and teaching techniques followed conforms integration is yet to be ascertained.

In the year 2011, the new science curriculum merged the two separate science subjects under one umbrella i.e. ‘Environment & Science’. The books were prepared by 2013. A question is inevitable in this connection that what the degree of correlation is and hence the scope of integration in the science curriculum, over the years. Since no report is yet officially available, it might be incumbent upon the science teachers to verify the extent to which the correlation (and hence integration) has taken place among the science subjects and environment in the present science curricula. Moreover, the spirit of UEE demands that an upper primary must meet the demand of the students who will leave the school at the end of upper primary. So upper primary science curriculum should cater to the needs of a layman. The science curriculum up to class VIII should be integrated. With this point of view, a study might be arranged to estimate the correlation and hence integration among the science curriculum. This may be done in two ways:

1. to compare the content of the total syllabus with component science subjects,
2. to find the correlation between the achievement of the upper primary school students in different science subjects and science subjects in totality.

The extent of integration would be estimated by the correlation among the understanding of the concept of Physical Science, the concept of Life Science & the concept of Environmental Science.

The bivariate correlations will show the necessary integration.

Statement of the Problem

In the arena of science teaching, the domination of disciplinary approach and integration have been in different times and places. In the school curriculum at the secondary level sometimes disciplinary approach and sometimes integrated approach have been recommended in curriculum revisions after the independence of India. But up to upper primary stage integration is given priority in most of the situations. At present WBBSE has introduced Environment and Science under the same cover. The decision regarding the inclusion of science subjects has not yet been ascertained beyond doubt. The different science subjects included in the school curriculum have similarities in (i) objectives of teaching-learning, (ii) content area, and (iii) method of acquiring knowledge. Now it is incumbent upon us to verify the extent to which the integration has been taken place. Out of different science subjects we consider here three disciplines like Physical Science, Life Science and Environmental Science to find their correlation and subsequent integration to explain the daily-life experiences and life-problems. For the present study, the investigators considered the integration among Physical Science, Life science and Environmental Science portion of the above subject (i.e. Environment & Science) and their integration with the daily experience of WB people. The topic for the investigation may, therefore, be stated in the form, Integration of different branches of Science in the curriculum of Environment & Science under WBBSE.

Objectives of the Study

The following objectives were taken for the present inquiry:

O₁ : To study the integration between Physical Science and Life Science by correlation of scores achieved by the students in those branches of science.

O₂ : To study the integration between Life Science & Environmental Science by correlation of scores achieved by the students in those branches of science.

O₃ : To study the integration between Environmental Science & Physical Science by correlation of scores achieved by the students in those branches of science.

Hypotheses

(Null hypotheses)

H₀ 1 : No significant correlation is achievable between Physical Science & Life Science.

H₀2: No significant correlation is achievable between Life Science & Environmental Science.

H₀3: No significant correlation is achievable between Environmental Science & Physical Science.

Significance of the Study

The findings of the study will help,

- i) to know whether there is integration among different branches of science in the curriculum of 'Environment & Science' at the upper primary level under WBBSE or not.
- ii) to review the existing curriculum under implementation and develop a new curriculum.
- iii) to provide information to the curriculum developers in Continuous improvement of the education system.
- iv) in social changes and social development, as today's children are the future's citizen.

Definitions of Integration & Operational Definition

Definitions of Integration:

Integrated science presents the essential unity of science in truly unified courses, it presents science as a whole.

Integrated Science teaching can be said to cover all those approaches to science teaching in which (a) concepts and principles of science are presented in such a way as to express the fundamental unity of scientific thought, (b) which emphasizes the processes and methodology of the scientific outlook and (c) which presents a scientific study of the environment and the technological requirements of everyday life.

Similarly, integrated science has been defined as those approaches in which the concepts and principles of science are presented to express the fundamental unity of scientific thought and to avoid premature or undue stress on the distinctions between the various scientific fields.

According to another definition, integrated science has been taken as an attempt to bring all science subjects together in a single course in which scientific concepts are approached uniformly in spirit and method. -**Sood. (1989)**

Operational Definition:

Integration among different subjects:

Two or more subjects might be integrated if there is a significant correlation among the ideas of those subjects. These subjects therefore may not be taught separately but as an integrated subject with any suitable name.

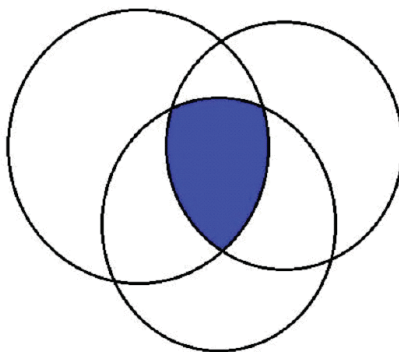


Fig. 1: *The common area of the three circles indicate an effective integration*

Two school subjects might be termed as integrated if there is a significant correlation among the concepts, processes, and objectives of those subjects (or experiences).

Delimitations of the Study

The study is delimited to-

- *Location:* West Bengal (only), a state of India
- *No. of Schools:* Five schools only (from five districts of West Bengal selected randomly)
- *No. of Students:* 100 only
- *Class:* VIII only
- *Medium of Instruction:* Bengali medium only
- *Component Subjects:* Physical Science, Life Science & Environmental Science only.

Test of integration among the subjects is based on the inter-correlation among the achievement scores of the students.

Identification of the Research gaps & Critical appraisal

From the review of related literature, the following research gaps were identified:

- i) No study at the state level is known to have been done to find the inter-correlation among Physical Science, Life Science & Environmental Science.
- (ii) No report was available as to the opinion of the teachers and guardians regarding the curriculum, textbooks and teaching-learning techniques.

So a study is necessary to find the extent of integration in curriculum, textbooks and science teaching in the upper primary stage where the integration of science is the gateway to the disciplinary approach in secondary level and higher secondary level.

METHODOLOGY OF RESEARCH

To achieve the purpose of the study, quantitative research (explanatory study) was done, where Science Education was identified as the broad area of the research and integration of different branches of science (Physical Science, Life Science & Environmental Science) was selected as the specific area.

Population and Sample

The present researchers considered the Bengali medium school-students of class VIII under the West Bengal Board of Secondary Education (WBBSE) as population. To constitute the sample, the researchers selected one hundred students from five schools from five districts of West Bengal randomly.

Variables

Three variables were selected for the study;

- Achievement in Physical Science,
- Achievement in Life Science,
- Achievement in Environmental Science.

Tools

To conduct the study, a self-made 'Tool' was used constituting of 45 items. Each item contained four options, among them one was most appropriate. Each item carried one (1) mark for the correct answer and no negative marking was there. Those items were constructed from Physical science, Life Science & Environmental science equally (15 each). The items of different areas were kept in the 'Tool' in a heterogeneous manner.

Standardization of the Tool

Validity & Reliability: For the validity and reliability of the 'Tool', the researchers formulated 56 items. To check the content validity of the items, the expert rating was done. The experts were asked to rate each item concerning three categories viz. perfectly suitable, nearly suitable, and not suitable. Three experts were selected for the rating purpose. Those items were rejected which were rated as not suitable by anyone of the experts or rated as nearly suitable by any two of the experts. Through this process, 45 items for the 'Tool' were made ready.

Procedure of Data Collection

For conducting the quantitative study, the data were collected from five randomly selected schools from randomly selected five districts. First, the 'Tool' were distributed to the students providing general instruction. After the completion of the stipulated time as mentioned in the 'Tool', the answer sheets (data) were collected from students. From each school twenty (20) students were selected randomly.

ANALYSIS AND INTERPRETATION

Presentation of Data:

All the raw data were tabulated in MS excel.

Table: 1 - Descriptive Statistics of Achievement scores of the students, in
“Physical Science”

Achievement in Physical Science	
Mean	6.88
Median	7
Standard Deviation	2.840116657
Kurtosis	-0.328523349
Skewness	0.391270307

Table: 2 - Gradation of Achievement scores of the students, in
“Physical Science”

Achievement	Marks	Percentage
Low Achiever	0-5	32
Moderate Achiever	5-10	57
High Achiever	10-15	11

Table: 1 shows that the mean achievement score in Physical Science of the students is 6.88 (out of 15). It is also found that Median is 7, SD is 2.84, Kurtosis is -0.33 & Skewness is 0.39, from the descriptive statistics of achievement scores in Physical Science. **Table: 2** reveals that 11 students (out of 100 students) are high achievers in Physical Science.

Table: 3 - Descriptive Statistics of Achievement scores of the students, in
“Life Science”

Achievement in Life Science	
Mean	7.43
Median	7
Standard Deviation	2.543579757
Kurtosis	-0.089901522
Skewness	0.451452691

Table: 4 - Gradation of Achievement scores of the students, in
“Life Science”

Achievement	Marks	Percentage
Low Achiever	0-5	22
Moderate Achiever	5-10	65
High Achiever	10-15	13

Table: 3 shows that the mean achievement score in the Life Science of the students is 7.43 (out of 15). It is also found that Median is 7, SD is 2.54, Kurtosis is -0.089 & Skewness is 0.45, from the descriptive statistics of achievement scores in Life Science. **Table: 4** reveals that 13 students (out of 100 students) are high achievers in Life Science.

Table: 5 – Descriptive Statistics of Achievement scores of the students, in
“Environmental Science”

Environmental Science	
Mean	9.26
Median	10
Standard Deviation	2.638564042
Kurtosis	0.57606135
Skewness	-0.8367962

Table: 6 - Gradation of Achievement scores of the students, in
“Environmental Science”

Achievement	Marks	Percentage
Low Achiever	0-5	9
Moderate Achiever	5-10	53
High Achiever	10-15	38

Table: 5 shows that the mean achievement score in the Environmental Science of the students is 9.26 (out of 15). It is also found that the Median is 10, SD is 2.64, Kurtosis is 0.58 & Skewness is -0.84, from the descriptive statistics of achievement scores in Environmental Science. **Table: 6** reveals that 38 students (out of 100 students) are high achievers in Environmental Science.

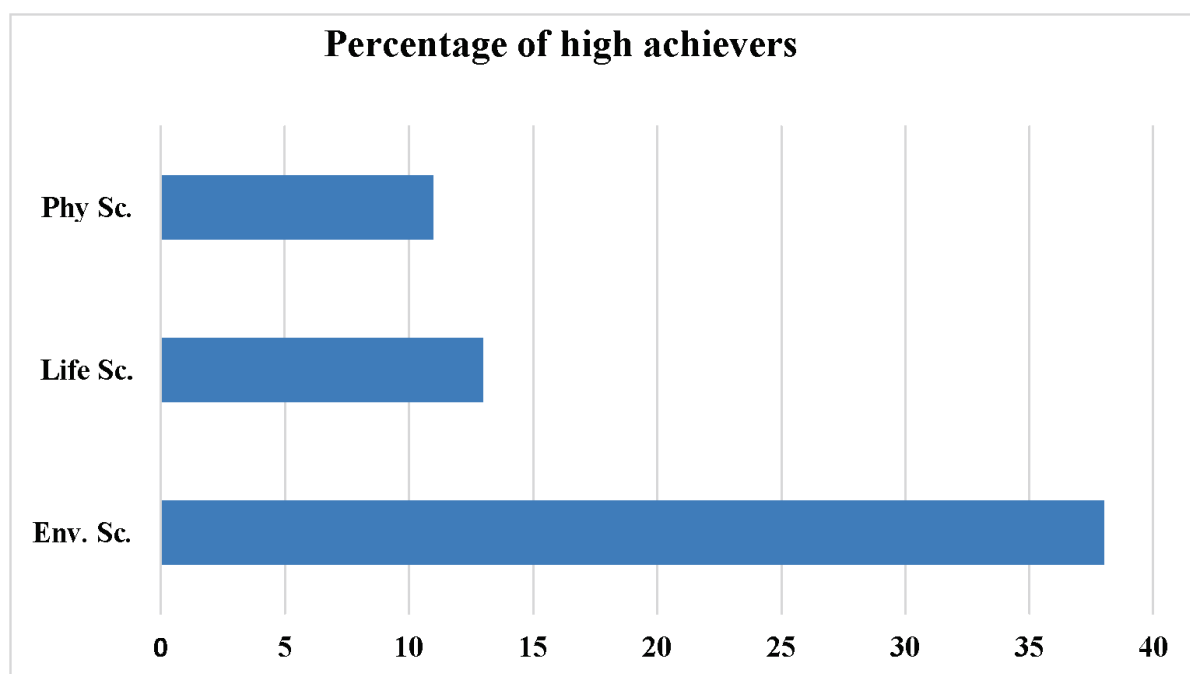


Fig. 2: Graphical representation of high achievers of different science subjects

From the graphical representation of high achievers of different subjects, it is observed that the decreasing order of the percentage of high achievers is- Environmental Science > Life Science > Physical Science.

Table: 7 – Correlation coefficient at 0.05 significance level among different subjects;

with degrees of freedom (df) = 98 (N-2), where Sample size (N) = 100 (no. of students)

Achievements (<i>Branches of Science</i>)	Achievement in Physical Science	Achievement in Life Science	Achievement in Environmental Science
Achievement in Physical Science	1	0.607062037	
Achievement in Life Science		1	0.407598465
Achievement in Environmental Science	0.544717504		1

Analysis and Interpretation

The researchers took 100 samples (N) for conducting their research work.

So degrees of freedom = $(100-2) = 98$

1. With df_{98} the calculated value of r (correlation coefficient) = 0.607 (from Table: 7) is greater than the critical value of $r = 0.205$ at 0.05 level of significance. Hence 'r' is significant. So, H_01 is rejected.

Thus, there is a significant correlation between Physical Science achievement & Life Science achievement of the students of class VIII of upper primary schools.

2. With df_{98} the calculated value of r (correlation coefficient) = 0.407 (from Table: 7) is greater than the critical value of $r = 0.205$ at 0.05 level of significance. Hence 'r' is significant. So, H_02 is rejected.

Thus, there is a significant correlation between Life Science achievement & Environmental Science achievement of the students of class VIII of upper primary schools.

3. With df_{98} the calculated value of r (correlation coefficient) = 0.544 (from Table: 7) is greater than the critical value of $r = 0.205$ at 0.05 level of significance. Hence 'r' is significant. So, H_03 is rejected.

Thus, there is a significant correlation between Environmental Science achievement & Physical Science achievement of the students of class VIII of upper primary schools.

MAJOR FINDINGS

Table: 8 – Findings of integration among Physical Science, Life Science & Environmental Science in the curriculum of 'Environment & Science' of the upper-primary stage under WBBSE

Fate of Hypotheses	Statistical Test	Major Variable	Categories for comparison	Findings
H01 is rejected			Physical Science & Life Science	Exists significant integration
H02 is rejected	Correlation coefficient measurement	Achievement in different science subjects	Life Science & Environmental Science	Exists significant integration
H03 is rejected			Environmental Science & Physical Science	Exists significant integration

DISCUSSION

Cognitive Dissonance: Through analysis of answers given by the students against the questions-set it was observed that - only 10%-15% of students can answer all the related questions (items) corresponding to these three subjects. So, a large number of students were able to answer one question of a particular subject but failed to answer the related questions set under the other two subjects. It is expected that from an integrated content if a student is able to answer a particular item of Physical science, he will also be able to do justice to other questions belonging to Life science and Environmental science.

The above trend only gives us the signal that the integration of knowledge or content in the 'Environment & Science' is only partial though the correlation among the content is significant statistically. By only integrating the content in a science curriculum we cannot always ensure the integrated knowledge among the students as found from the above pieces of evidence. The integrated

curriculum requires textbooks written among the views of integration and the teaching should be process-oriented, out of textbook activities and out of the school activities.

After getting the all quantitative findings present researchers attempted qualitative approaches to study the integration among different branches of Science in the curriculum of Environment & Science at Class VIII under WBBSE. Qualitative information was collected through the following strategies;

(a) **Content analysis:** Present researchers thoroughly analyzed the contents of the book 'Environment & Science' and found that there is enough integration among the science subjects i.e. Physical Science, Life Science & Environmental Science in most of the chapters in the mentioned curriculum.

(b) **Opinions of the Teachers (Corroboration):** It was important to discuss with the teachers also to understand their opinions regarding the integration of different branches of science in the current science curriculum of class VIII, 'Environment & Science' under WBBSE. A self-made opinionnaire was made to collect the information from them, who were taking classes on 'Environment & Science' (class VIII) under WBBSE. Taking into consideration of the teachers view the present researchers reached in these following conclusions;

i) In most of the schools, special subject teachers are taking classes on those particular separate subjects (Physical science, Life science) under 'Environment & Science' as they have no proper idea about integrated teaching.

ii) The aged teachers are not ready to accept this new integrated curriculum as they are habituated to teach in the previous manner i.e. life science teacher will teach life science and physical science teachers will teach physical science only.

iii) Of course, this new integrated curriculum of WBBSE is unique but not like the curriculum under CBSE or ICSE Board.

iv) Through the analysis of the teachers' opinions, it was found that the existing curriculum is integrated but not like the integrated curriculum of CBSE or ICSE. According to the teachers' view it was found that there are few chapters in the curriculum of 'Environment & Science' in class VIII under WBBSE, where proper integration does not exist. So curriculum evaluation and revision is essential & there must be a thorough investigation as to the integration effected in the textbooks and teaching-learning of science, in no time.

We have to prepare the teachers first to teach the learners in an integrated way. For this, teachers' training institutes have a vital role. Refreshers course, orientation course for the in-service teachers is also necessary. If teachers' views are changed towards this integrated curriculum, then only the implementation of this integrated curriculum will be easy.

Sood, K.J. (1989) in his "New directions in Science teaching" mentioned -

'The role of the Teacher is of great importance to implement the integrated science course. Integrated science teachers need not only the knowledge of the subjects but also attitudes to teach in an integrated manner and for establishing a high level of coordination and interaction among subject areas.'

Limitations of the Study

The limitations of the study include

- (1) Girls could not be included in the study.
- (2) The study could be distributed over different categorical variables - sex-wise, cast-wise, and habitat-wise. But the shortage of time was the barrier.
- (3) This extensive study sample should have been larger.
- (4) The principle of randomization could not be freely used in the study.
- (5) As this study is state-based (WB), no study except some reports was available.
- (6) Books on the Nuffield series (UK curriculum of the decade of sixty, 20th century) an important document in the integration of science were not available.

Suggestions for further Research

- i) The study may be conducted with increased sample size.
- ii) The study may be conducted with other classes of upper primary level under WBBSE.
- iii) The study may be conducted with Bengali, English and Hindi medium schools in West Bengal under WBBSE.
- iv) The study may be conducted with all types of schools like the schools under WBBSE, WBBME, CBSE, ICSE and all kinds of Missionary schools in West Bengal.

- v) The study may be conducted on the topic ‘How much integration is essential in the upper primary curriculum?’
- vi) The study may be conducted on the topic ‘Is integrated study essential at the secondary level also?’
- vii) The study may be focused on further research at the national level also.

CONCLUSION

As there is a significant correlation among the three subjects i.e. Physical Science, Life Science & Environmental Science; it can be concluded, *prima facie*, that ‘Paribesh O Bignan’ of the upper primary stage in WB involves integration. It is also found that the students have higher achievement in Environmental Science in comparison to Physical Science and Life Science. These findings also tell us to prepare the teachers first to teach the learners in an integrated way in their classroom. Secondly, the Teachers Training Institutes have to play an active role to introduce short term training programme and orientation courses for the in-service school teachers. If teachers view is changed towards this integrated curriculum, then the implementation of this integrated curriculum will be more easy and effective for our school students.

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