INVESTIGATING THE LEARNING DIFFICULTIES OF PHYSICAL SCIENCE AT SECONDARY SCHOOL LEVEL

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Abstrct:

This study explored some of the difficulties students face when learning physical science in the secondary school. The study was prompted by the students' poor performance in their examinations. The main purpose of the study therefore, was to identify some of the difficulties the students face when studying physical science and also look at the practices that would enhance their study of the subject. The study was also aimed at finding out whether the Science school had adequate facilities and equipment that would help to promote effective learning of the subject. Another target was finding out whether had any impact on the study of electro magnetism and carbon compounds. Not only that but also the study sought to identify whether the use of practical activities by students to learn physical science assisted them to understand concepts which were complex.

KEY WORDS: Learning, Secondary school, Physical Science, Difficulties.

INTRODUCTION:

Science always plays a tremendous role in human life. It changes the entire existence of human beings in such important aspects as health, communication, transportation, and power. To visualise the effect of scientific development just look around in a modern room. For example, the curtain and carpets tinted with dyes, which are not natural products the chemists have prepared these from coal tar. From the same coal tar, fountain pen ink is produced. The artificial silk fabric of sofa covers has been made from wood pulp. The electric light, nickel-plated door fittings, etc. are all feats (important achievements) of science. The modern world itself is made and Kothari commission has remarked, "Science is universal so can be its benefits. Its material benefits are immense and far-reaching - industrialization of agriculture and release of nuclear energy are two examples - but even more profound is its contribution to culture" (Report of the Education Commission 1964-66, 1966).

THE NATURE OF SCIENCE

In the last three decades some attempts have been made to understand the nature of science. *Joseph J. Schwab (1964) and Bruner (1962*) have explained the nature of science in technical terms, which is based on the idea of the structure of knowledge or structure of disciplines. According to this idea, the nature of science comprises.

1. Substantive structure of science and

2. Syntactical structure of science.

The Substantiate structure of science represents the major conceptual schemes which constitute the basic knowledge used in science. The substantive structure of science contains different classes of statements, such as definitions, knowledge statements, etc., we may call them 'key concepts' or 'major ideas'. Examples of such major concepts have been given in all major science curricular projects developed in the USA, namely, Physical Science Study Committee (PSSC), CHEM Study, etc.,

The syntactical structure of science is concerned with the so-called processes of scientific inquiry, means by which scientific knowledge is acquired and verified. These processes can be further divided into simple skills so that pupils can practice them without any difficulty. Some of the processes of science are as follows.

Observation, measurement, classification, formulating a hypothesis, experimenting etc., At this stage it is easy to infer that the nature of science has two aspects, that is, concepts of science that build the substantiate structure of science and the processes of science which build the syntactical structure. Both are equally important.

Recently a third dimension to the nature of science has been added which has been recognized by workers. This is known as the social aspect of science.

Science has been taken as a human activity which influences society and is being influenced by society. The applications of science to society and its impact on human lives are first as important as learning content and skills. Some science educators have strongly recommended a new emphasis on science teaching that includes social, moral-ethical aspects of

science. In other words, many of the science technology is based on social issues that have moral, ethical and social relevance, such examples are as follows.

Pollution, Acid rain, Nuclear Energy, Bio-Engineering, etc.

1.2.3 CHARACTERISTICS OF SCIENCE

Besides the nature of science, explained in the previous paragraphs, it has specialized characteristics which we do not find in other disciplines Showalter and others have described the characteristics of science in the following words.

1. Science grows through the processes of science. Scientific knowledge grows through processes of science or inquiry approach or methodologies of science. These processes of science are from simple to complex. Similarly, inquiry approaches are also from simple i.e., stable inquiry to difficult, that is fluid inquiry.

2. Scientific knowledge is tentative. It is subject to change. In other words, science is uncertain and its knowledge is consistently changing in the light of new evidence. We can say that "if science is knowledge, it is dynamic knowledge".

3. Scientific knowledge is unique as it differs from other areas of knowledge. It is distinguished from other realms under the nature of knowledge and its procedure in generating new knowledge.

4. Scientific knowledge is humanistic because it is a product of human effort to find out the unknown things of nature. All this knowledge is related to human beings and the scientific concepts are the products of culture.

5. Science has its values of objectivity, rationality, neutrality and humanity. Science is one of the approaches truly based on philosophical, sociological, psychological and moral dimensions. It depends on those values which are common to all human kind-freedom, liberation, happiness, speculation, and imagination

1.2.4 SCOPE OF SCIENCE:

Science is a body of knowledge obtained by methods based upon observation. Observation is authoritative and that it is only through the senses of man that observations can be made. Thus, anything outside the limits of man's senses is outside the limits of science. In other words, science deals with the natural world, the realm of nature and matter and energy.

Science employs several instruments to extend man's senses to the extremely minute to the very vast, to the shorts-time duration or long-time duration, to the dilute or the concentrated and so forth which does not alter the conclusion that science is limited to that which is observable. Thus, as in any other discipline contemporary experimental techniques set up some practical limitations but these are not to be confused with the intrinsic limitations inherent in the very nature of science.

The practice of science is a human activity. Therefore such concepts as beauty and love for example, are very real to scientists, as they are to all human beings, even though strictly scientific interpretations and understandings of such concepts are impossible within the limits of science.

Today the discipline of science and social science are drawing into each other. Behavioural zoologists study the sociology and psychology of animals. Archaeologists derive new insights from the rapid advances in chemical and physical analysis. Biology draws on chemistry, physics and geology. Science has brought about a change in such important aspects as health, communication, transportations, etc.

Objectives of the Study

The objectives of the study are to:

i. Identify students' problems in learning physical science.
ii. Use activity and practical/laboratory methods of teaching physical science effectively.
iii. Use the technological tool, in teaching electro magnetism and carbon compounds.
iv. Determine whether the facilities available for teaching and learning physical science are adequate and in good condition.

Significance of the Study

The outcome of the study will be very important in the teaching and learning of physical science in the Science secondary school. First of all, it will identify the problems associated with lack of understanding the pre-requisite concepts of students which make it difficult for them to study physical science at secondary school levels. It will also assist teachers and students to take

appropriate steps that will enable them teach and learn physical science effectively. The study will also inform the teachers to use the technological, visualizing tool to make teaching and learning of physical science easy.

Limitations

The Science secondary school level were far from each other and this made accessibility difficult. The resources and time frame for the study conducted could not permit the researcher to involve all the science at secondary school.

Delimitations

The researcher, due to insufficient time, could not use other parameters to determine their low grades in physical science but depended solely on results from their examinations. Also, only twenty-five secondary school were involved in the research and the results of the study may not be considered as the findings from all the 25 secondary school.

METHODOLOGY

Population: A total of one-hundred and forty-nine (149) student's secondary school level formed the population for the study. Out of this, a total number of one-hundred (100) secondary school students made up of thirty (30) girls and seventy (70) boys students made up of were sampled.

Sample: A sample is a small proportion of a population selected for observation and analysis for a particular study. The present study is confined to Bhadradri Kothagudem district in Telangana State. Hence some schools and working teachers in secondary schools are to be selected for the study undertaken. The stratified random sampling technique is adopted for the study. Some mandals are randomly selected from each Revenue District. Secondary schools of selected mandals are taken for the study.

Standardization of Tools:

Standardization is a common procedure to avoid chance the chance and other factors. A weak tool cannot evaluate what the researcher experts to evaluate. Hence exposing to systematic statistical procedures and establishing reliability and validity of the present tool has worked out with great cautions.

Reliability and Validity of the Tools:

The value of any psychological and educational measuring instrument depends upon the reliability and validity of that instrument. If the reliability and validity of that instrument. If the reliability and validity conditions were not satisfactory the device will be misleading and useless. In the construction of an instrument these two measures viz., reliability and validity have to be satisfied. Hence the question of establishing the reliability and validity of the questionnaire constructed in the study was given due importance.

3.9.1 Reliability:

Reliability is the consistency of a test yielding the same results in measuring whatever it does measure. A test is reliable if it measures efficiently what it proposes to measures or what it does measure. A reliable test is a trustworthy test. It is accurate. It is consistent. If the test measures exactly in the manner each time. It is administered, if the factors that affect the test scores affect them to the same extent every time the test is given, the test is said to be high in reliability.

The reliability of a test depends upon the consistency, which it gauges the abilities of those to whom the test has been applied.

According to Garrett [Garrett, (1981), P-337] "A test score is called reliable when we have reasons for believing the score to be stable and trustworthy".

According to Anastasi (Methods of Teaching physical science , 2005, P-232) "The reliability of a test refers to the consistency of score obtained by the same individuals on different occasions or with different sets of equivalent items".

According to Guilford (Guilford 1950) "The concept of reliability underlines error of measurement of single score whereby the range of fluent nation likely to occur in a single individual score as a result of irrelevant chance factors can be predicted.

The following are the methods of determining test reliability.

The test-retest method.

The split-half method.

The method of rational equivalence.

The alternate or parallel form method.

For finding reliability of the test scores the investigator adopted the split-half method by using Spearman-Brown prophecy formula for estimating reliability from two comparable halves of the test.

Validity:

A tool used for selecting data must produce information that is not only relevant but also from systematic errors. That is, it must produce valid information, i.e., the information that is required. It includes-value, truthfulness and worth wholeness. The validity of a test depends upon the efficiency with which it measures what it attempts to measure. Unless a test is valid, it serves no useful function. A tool which is useful in making one decision in a particular research situation, may have no use at all for different situations.

Data Collection Procedure

Research questions were answered through separate questionnaires for students. Each questionnaire had items on the following: Biographic data, learning difficulties faced by physical science students, chemical representation using technology, students' alternative conceptions in physical science , acquisition of students' practical skills, organization of physical science practical activities, availability of facilities and communication problems arising from language.

The recovery rate was 100% in both cases. This was because the questionnaires were handed over personally by the researcher and collected after students had finished responding to them the same day.

Data Analysis Technique

A descriptive analysis using simple percentages was used to address the five (4) research questions. Data were analyzed by making use of the research questions. This was done systematically by selecting research questions using the responses from the questionnaires. This continued until all the research questions and responses for both questionnaires were exhaustively dealt with.

Each questionnaire was given a code name or number to facilitate easy identification. For example students' questions were coded from S_1 – S_{100}. The questionnaires were subjected to quantitative analysis using SPSS. The information obtained from the responses was put into the package for easy analysis.

DATA PRESENTATION AND ANALYSIS

In this part, responses to students' questionnaire were presented followed by the responses given by their tutors. The responses are dealt with in different sections based on the five research questions.

Responses of Students

Responses of the students are presented based on the items in the questionnaire under the five research questions.

What problems do students encounter in learning physical science?

The above question was designed to find out problems students encounter in learning physical science and if possible give suggestions to address the problems.

Eight items were grouped to enable the above research question to be answered. Each item had four options to be chosen from.

The first item under this question demanded students to indicate whether physical science is perceived to be difficult. The responses are represented in Table 5 below.

Table 1. Students' perception of physical science as a difficult Subject

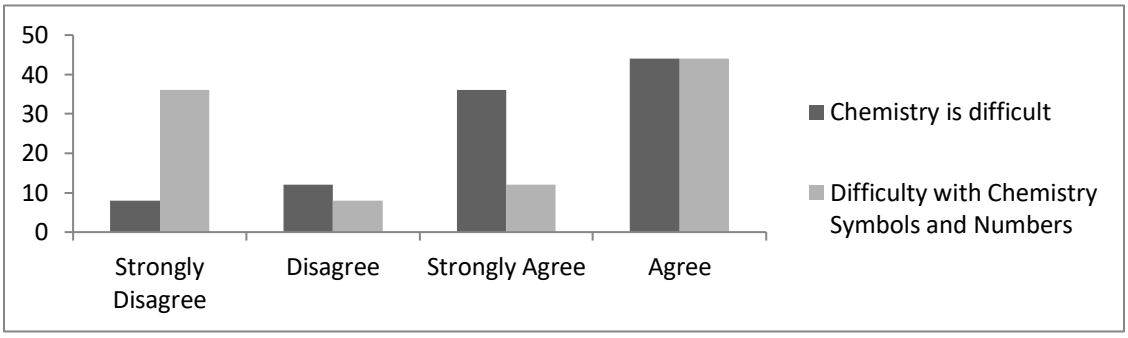
Option	Frequency	Percentage (%)
Strongly Disagree	8	8.0
Disagree	12	12.0
Strongly Agree	36	36.0
Agree	44	44.0

Total	100	100

Source: Field Data

From Table 5, Majority of the students representing 44% agreed physical science to be a difficult subject. Also, 36% of the students strongly agreed to the statement. It is clear from the table that 20% disagreed that student's perceived physical science to be a difficult subject. It shows from the table that majority of the students representing 80% perceived physical science to be difficult. The perception of the majority of the students that physical science is difficult may have negatively affected the way the subject was studied, since their interest may not be there.

Figure 1. View of Students who see physical science as well as physical science y Symbols and numbers as Difficult



How can students be helped to use practical activities to learn physical science?

The second research question was designed to find out whether the use of practical activities in the laboratory would help students to study and understand physical science .

Four different test items were grouped to answer this research question. In item 1, it was demanded from respondents to indicate whether physical science concepts could easily be understood when the activity method is used to teach it. The responses are presented in Table 2.

Table 2. Understanding of physical science concept by the use of practical activities

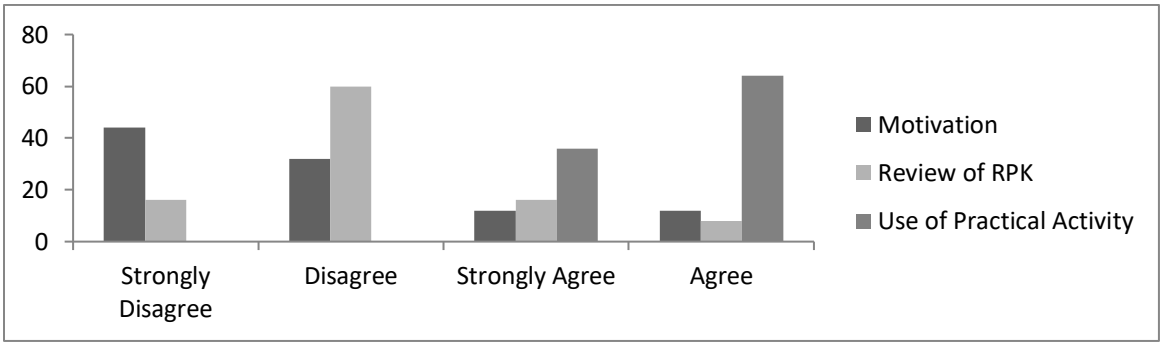
Option	Frequency	Percentage (%)
Strongly Disagree	0	0.0

Disagree	0	0.0	
Strongly Agree	36	36.0	
Agree	64	64.0	
Total	100		100.0

Source: Field Data

From Table 2, 64% of the responses agree that Chemistry concepts can easily be understood when practical activities are used to teach them. Also, 36% of the students strongly agree to the statement. It is clear from the table that all the students (100%) agree that physical science concepts can easily be understood if practical activities are used to teach it.

Figure 2. Pictorial View of Ways at Improving Students' Interest in physical science



What technological tools can be used to support learning electro magnetism and carbon compound structures of compound?

This research question was meant to find out what technological tools could be used by the students and how the use of these tools could support them in the study of electro magnetism and carbon compounds. Three test items were grouped to answer this research question.

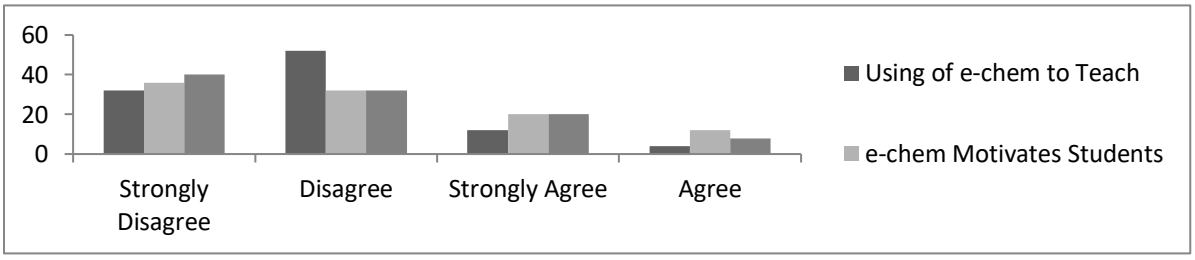
In item 1, students were required to indicate whether their teachers used physical science when teaching electro magnetism and carbon compounds. The responses to this item are presented in Table 3.

Table 3. The use of physical science by tutors in teaching electro magnetism and carbon compounds

Option	Frequency	Percentage (%)
Strongly Disagree	32	32.0
Disagree	52	52.0
Strongly Agree	12	12.0
Agree	4	4.0
Total	100	100.0

Source: Field Data

From Table 3, it could be seen that 84% of the students agreed to the fact that teachers did not use physical science when teaching electro magnetism and carbon compounds whiles 16% agreed that their teachers used physical science when electro magnetism and carbon compounds . It is clear from the table that majority of the tutors did not use the technological tools physicalscience.



What facilities are available for the effective teaching and learning of physical science?

The fourth research question was designed to find out the facilities that were available for effective teaching and learning of physical science in the secondary school. This was to enable the researcher to find out whether or not the facilities available had any influence on studying physical science.

Five items were selected to enable the above research question to be answered.

The first item under this research question was to find out how often students had access to physical science laboratory to perform practical's. Responses given are presented in Table 4.

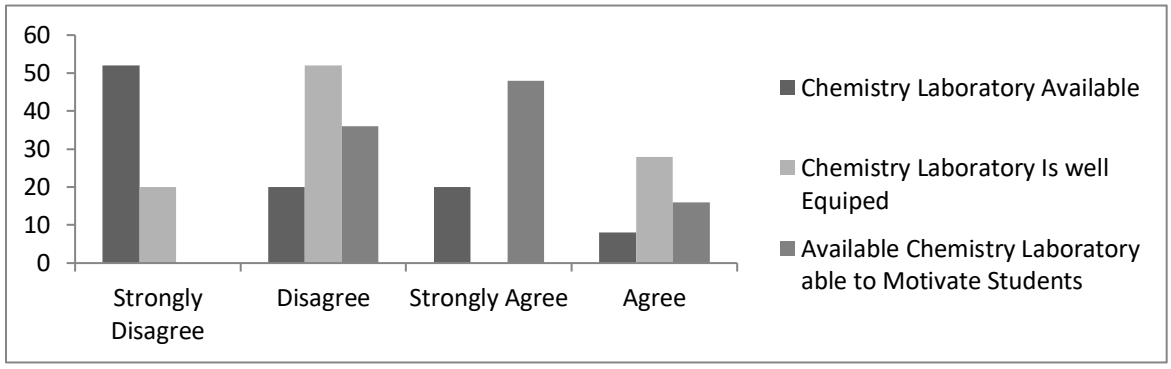
Table 4. Students often have enough access to Chemistry laboratory

Option	Frequency	Percentage (%)
Strongly Disagree	52	52.0
Disagree	20	20.0
Strongly Agree	20	20.0
Agree	8	8.0
Total	100	100.0

Source: Field Data

From table 4, it could be observed that, 72% of the students disagreed they often had access to their physical science laboratory. However, 28% of the students agreed that they often had access to their physical science laboratory. It became obvious that majority of the students representing 72% did not have access to their physical science laboratory. It implies that majority of the students may not be performing enough practical activities in the laboratory and this can adversely affect their performance in physical science.

Figure 4. Availability and Condition of physical science Laboratory as well as its Effect on Students



Summary of Key Findings

Summary of the findings from the study are presented based on the five research questions.

These findings showed that:

Students studying Science in the Colleges of Education really perceived Chemistry to be difficult as a result of the way they studied the subject. Students learnt in abstract and memorized concepts without understanding them.

It was also found out that students did not understand meaning of some Chemistry terms used in teaching. There was only little motivation coming from their tutors.

However, it was found out that students' prior knowledge, when considered during teaching and learning, coupled with lots of practical activities would enhance the way Chemistry is studied.

Students performing practical activities enabled them to develop a lot of process skills like: observation, manipulative and predictive skills that were helpful to them. Moreover, their teachers discussed practical activities with them before they were carried out.

It was found out that majority of the students were not able to translate between symbolic and carbon compounds using physical science terms. This was due to their teachers not being familiar with the use of physical science. However, the use of physical science by the students enabled them electro magnetism and carbon compound.

Lack of adequate facilities like physical science laboratories and equipment in some secondary school made the studying of physical science to be difficult though many practical activities were conducted by their teachers. This implies that students would only acquire some process skills whiles in secondary school. This will affect their performance in practical lessons with their pupils after completing college.

Students, generally, were not happy about the way some challenging topics like mole concept and chemical bonding were taught. However, tutors were putting lots of teaching strategies in place to enable them overcome those learning difficulties.

Conclusions

Based on the findings made in this study, the following general conclusions are made:

1. Physical science must be used by all students to enhance the teaching and learning of electro magnetism and carbon compounds.
2. Both tutors and students were faced with inadequate facilities that often impeded academic work in the secondary school.

Some of the constrains indicated include; lack of laboratories, apparatus and reagents and these put undue pressure on both students and teachers. Hence, it could further be concluded that though the training of physical science teachers for basic schools has started in the designated Secondary school, much needs to be done to improve the quality of training of teachers.

Recommendations

The recommendations to this study are presented based on the findings from the study and research questions used. It is recommended that:

Students selected to offer elective science and for that physical science should be students who offered elective science in the secondary School.

Students with good grades should be selected to undertake the programme.

Government should, as a matter of urgency, complete all the building projects of the various science laboratories and stock them well with equipment to enable practical activities be carried out in a friendly environment. This should be done in order to equip the teacher trainees with those skills that would enable them to fully grasp the skills involved to help them practice it after training.

The technological tool, physics and chemistry should be used by chemistry tutors to enable students understand the formation of compounds through chemical bonding and, also, to allow their students to construct, visualize and carbon compounds.

Finally, tutors should not only impart knowledge but rather serve more as facilitators of activities to enable trainees come out with their own findings.

Implication for Education

Since physical science teacher education forms one of the top priorities in the development of human resource base of this nation, the major stake holders in education such as

the Government of Ghana, tutors, and students would be awakened to the challenges identified in this study. Physical science would be taught in a more practical way than emphasizing the theoretical aspect. Development of practical skills among students would be intensified in secondary school to make teaching and learning of physical Science at the basic school level more practicable.

The use of physical science should be established in the secondary school using the state of the art science and computer laboratory and other technological tools.

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