Exploring the Creative Schema of the Secondary Grade Children in Construction of Scientific Concepts using Prefixes and Suffixes

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Abstract: In consideration of word assessment as an imperative tool in the process of teaching-learning transaction, secondary level Class IX and X students of (CBSE affiliated) English Medium and Hindi Medium schools were given a sheet containing 20 prefixes and 20 suffixes (in both languages) respectively: each of the prefix and suffix was followed by four blank lines for their responses. The students were asked to write the terms (or words- scientific or non-scientific) that knocked their mind upon looking at the concerned prefix or suffix in the order of priority. The student’s responses highlighted their insight understanding of the two languages and the corresponding impact of the same in construction of scientific concepts. It was followed by an open ended questionnaire to perceive the latent stimulus behind the different responses of the same grade students with similar prefixes and suffixes. The students’ retorts revealed some groundbreaking observations that subtly unveil the vitality of linguistic skill development in prospective science teachers. The Study comprising of 115 samples (with approx. 9200 responses- blank and filled) promotes a discerning idea for instructional restructuring in secondary school science education.

Keywords: Creativity, Language, Linguistic, Prefix, Science, Suffix

1. Introduction

“We are learning the language in which God created life.”- Bill Clinton

The Almighty God, the creator of the universe, is the supreme-mind who possesses the finest creative abilities. He has molded all of us and all that is revealed in nature. We are fortunate to be entitled as His most intellectual creation- an intricate component of the divinity. Therefore, every one of us ought to possess creative abilities. Every one of us is a unique creation, but does not own the same creative ability as his peers. Some of us are endowed with high creative talents and contribute to advancement in the fields of art, literature, science, business, teaching and other spheres of human activity, and are liable for propounding new ideas and conveying about social and cultural changes.

The creative process is any process by which something new is produced- an idea or an object including a new form or arrangement of old elements. The new creation must contribute to the solution of some problems (Wilson et al., 1974). A product may be a creative one if it is new or novel to the individual involved; if it is his creation, it should be expressive of himself rather than dictated by someone else. It is not a mandate to be useful or unique, its social recognition and cultural impact may be zero, but if it is a unique personal experience, it is creative (Maslow, 1970). Creativity is an innovative approach from the stereotyped, rigid and unidirectional thinking. It encourages and stresses upon complete liberty to consent and express the multiplicity of responses, choices and lines of action. Creativity as an urge inspires and persuades the individual to create something unique and acts as an impetus for expression. Wallas (1926) described the creative process as consisting of four stages: preparation, incubation, inspiration and verification. It was his belief that a student in his academic tenure undergo this four stages in order to properly design a creative thought regarding any concept- be it scientific or literature.

Many Schools of Psychology has tried to enthral the bird of Science with the feathers of Creativity. Creative process draws on the whole brain; it displays a dynamic interplay of the various zones that resides in the brain- consciousness, emotions, processing. While on the other hand, the process of learning science takes place at different levels, depending on the prior experience of the learner, his/ her intellectual ability and the presentation of materials. According to A.R.John Wilson (1974), the science learning process can be categorized in three levels, viz., association, conceptualization and creative self-direction. The creative self-direction is the highest level of learning and under ambient learning conditions, people are able to progress from association formation, through a process of conceptualization, to a kind of learning that characterizes the creative artist. The motive power comes from the affective domain of learning. When a student has successfully touched this condition of learning, it is expected that he/she can work independently on his/her own initiative.

Since ages, languages have been the conduit to build the foundation of communication. Not only restricted to communicative arena, language always proved to be the medium to exhumes the mental images of anything and everything that we see or feel around us. Language is a process of free creation, its laws and principles are fixed, but the manner in which the principles of generation are used is free and infinitely varied. Even the interpretation and use of words involves a process of free creation (Noam Chomsky, 1955).Noam Chomsky always believed that Language has been the thread to fabricate an apposite communication,
unveiling the mental thoughts residing in an individual’s mind. Chomsky’s language acquisition device is a completely hypothetical tool in the brain that is considered to be assistive to the children to learn and introspect languages. It is better defined as an instinctive mental capacity which enables a child (precisely infant) to acquire and produce language - definitely influenced by the surrounding. This school of thought was been grossly exploited in the present research study.

Studying Science is not only about the linguistic skills of cramming the pedantic bookish concepts by the student, but discerning the concepts and conveying their knowledge to the society is equally imperative. Years ago, Behaviorist Skinner argued on the novice concept of “Learning by Classical Conditioning” where he presented the world with the concept of practical learning wherein a student will engage herself/himself to build the cognitive concepts influenced by events occurring near them. Ausubel’s School of thoughts- his theory of Cognitive Subsumption- supports the investigators of the present paper in their pursuit. Ausubel (1960) proposed a theory of meaningful verbal learning based on a concept of cognitive subsumption. He defines a generalized set of concepts capable of subsuming subsequently presented specific facts as an ‘advance organizer’. An ‘advance organizer’ is a generalized statement presented prior to presentation of specific facts relevant to the statement. In the present approach, such advance organizers were modified in the form of prefix and suffix which stimulated the students to pour out the inner creative schema about various facets that they explore and experience in their day-to-day life. Added to that, the bilingual approach (Hindi and English) helped the investigators to summon a proper conclusion regarding the ideas that reside in the minds of same grade children about comparable prefixes and suffixes (in both languages).

2. Objectives and Motivation of the Study

According to English Literature, prefixes and suffixes are syllable stems, which when added to the beginning (prefix) or to the end (suffix) of the ‘root’ part of a word shape the meaning of the word in its entirety. If words (prefixes and suffixes) are to be used for learning about students’ conceptions, we must know how they represent their conceptions through creative construction of words. As the creative skills in Science underlie the ability to communicate results in terms of observations and inferences, it is therefore necessary to examine the extent to which secondary school students use the creative skills to communicate their scientific knowledge with the help of languages. The investigators were interested to explore how secondary students represent their creative conceptions in constructing scientific and non-scientific words. Students’ responses will be seen as contextualized in pictorial (referring to the picture of the certain concept in the child’s mind) conventions and students’ conceptions will be seen as contextualized in conceptual framework with a focus on the scientific forum corresponding to the language coliseum. The main question to be considered was use of proper explanation during Classes regarding the individualized meaning of the prefixes and suffixes, confirming impact on students’ understanding and how the students build the creative schema relating language with Science and finally both to their experiential learning. Secondly, is students’ understanding differ as per languages wherein both the things mean almost same. Whenever, science is being taught in classes, teachers repeatedly instruct the students to rote memorize the “big” scientific terminology to ease the process of earning marks in the examination- the sole goal of teaching-learning process. The age-old belief that science and language are completely different disciplines with science being superior creates a hidden void in the provinces of language in the sphere of Science Education. The motivation for the conduct of the present research was to understand the right time when teachers should take charge to elicit the scientific creativity in students and also to understand how students react to the words- are the responses completely book-driven or subject-driven or influenced by their immediate surroundings.

3. Materials and Methods

The study was conducted in Raipur district of Chhattisgarh state of India. Four sample schools (all CBSE affiliated) were selected using simple random sampling technique. Out of four schools, two were English medium and two were Hindi medium. The four selected sample schools had a population of 115 students of which 55 were from Class- IX and 60 were from Class- X. In a better discretion, 30 students were taken from Class- IX of English medium School who answered in English and 25 students were taken from Class- IX of Hindi medium School who answered in Hindi. Similarly, 32 students were taken from Class- X of English medium School who answered in English and 28 students were taken from Class- X of Hindi medium School who answered in Hindi.

For the study, 20 prefixes and 20 suffixes were chosen both in English and Hindi language. Since this study was conducted during September- October 2017, all the schools had already covered the most of the chapters in Science.

In consultation with the Principals of respective schools, the dates were fixed for the study. Two days before the study dates in different schools, the investigators interacted with students. The students were asked to go through the chapters which have been covered recently in Science. In order to avoid any parasitic factors, students were told to bring their own writing materials and given certain basic instructions-like- ‘no’ use of whiteners, ‘no’ use of pencil writing.

On the study day, each student received an A4 sized paper and was told to read the prefixes and suffixes for first five minutes. At the same time students were given following instructions: “We would like each of you to write the words that first strike their minds upon looking at the concerned prefix and suffix. Whatever be the word that approaches their intuition- scientific or non-scientific, completely bookish or commonly used, restricted to particular scientific discipline or interdisciplinary- should be reflected under the corresponding prefix or suffix. Added to that, it was also instructed that once you write the word, it should not be corrected, erased or replaced. You need not to think about grammatical or phonetic mistakes- just you have to write the first-on-first word. You will be given 70 minutes i.e. two
periods and we believe that it is enough for completing the worksheet. This is not an examination but is a part of research study which involves many students of your age.”

The following words were chosen for the study:

**ENGLISH PREFIXES-**
- Auto-
- Bio-
- Cyto-
- Chloro-
- Derm-
- Homo-
- Hyper-
- Hypo-
- Micro-
- Macro-
- Pseud-
- Hemo-
- Gluco-
- Ichthy-
- Immune-
- Lact-
- Endo-
- Exo-
- Epi-
- Meso-

**ENGLISH SUFFIXES-**
- tion
- cide
- -crine
- -crine
- -dactyl
- -emia
- -form
- -logy
- -graph
- -ysis
- -meter
- -pathy
- -phobia
- -stasis
- -tonic
- -trrophic
- -version
- -scope
- -opia
- -philia

In addition to above, to collect data, the study employed a close ended questionnaire. The questionnaire was used to investigate the problems students encounter when making or creating the words. The questionnaire aimed at investigating the source from which students were taught the word, if the word was mentioned in the book, if the work is having any common life social relation. The items were structured in a simple form requiring the respondents to tick either ‘YES’ or ‘NO’.

**4. Results and Discussion**

The responses in forms of the words written by the students were as per scientific and linguistic authenticity. The responses were analyzed under following eight different categories:

1) Frequency of Types of words- Interdisciplinary, Life Sciences Based, Physical Sciences Based, Mathematics Based.
2) Frequency of Scientific and Non Scientific word construction.
3) Frequency of Word construction relative to the syllabus of the students.
4) Frequency of commonly used (influenced by cartoons and movies) and highly bookish words.
5) Frequency of blank responses with relation to language- English or Hindi.
6) Frequency of words with correct phonetics as per the intention of the students.
7) Frequency of blank responses with relation to prefixes or suffixes.
8) Frequency of more correct responses- with relation to English prefix and Hindi prefix, with relation to English suffix and Hindi suffix.

The letters 1 to 8 for various categories are used for different data presentation. The investigators chose these features because they are all important for evaluating not only the creative skills of students but also to explore the conceptual understanding of the scientific and linguistic disciplines. The results were analyzed by using standard statistical method i.e. percentage distribution. All the graphs are made taking into consideration the first response of the child.

Graph 7: Frequency of blank responses with relation to prefixes and suffixes

For Graph-1: Mathematics related: Hyperbola, Micrometer, Centimeter, etc.

Social Science related: Epicenter, Macroeconomics, Seismograph, etc.

Language related: Calligraphy, Autograph, etc.

For Graph-2: Non-Scientific word: Sympathy, Empathy, Cinematograph, Autograph, Autorickshaw, Microphone.

(For Graph-3: These words come under common uses)
Graph 4: Frequency of Word construction relative to the syllabus of the students

Graph 5: Frequency of blank responses with relation to language- English or Hindi

Graph 6: Frequency of words with correct phonetics as per the intention of the students

Graph 7: Frequency of blank responses with relation to prefixes and suffixes

Graph 8: Frequency of more correct responses- with relation to English prefix and Hindi prefix, with relation to English suffix and Hindi suffix

Graph 6: Students created words like Para-cyte where they intended to construct the word which is actually intended to make the word as Par-a-site. They even constructed words like examo-phobia, heighto-phobia, crowd-o-phobia, etc.- words who do not have such linguistic (phonetic) representation but exists in other forms like eno-chlophobia (fear of crowds), acrophobia (fear of height), and so on.

The Graphs-1 to 8 gave a clear reflection about certain aspects. Students were found to commit more mistakes in Hindi as compared to English.

Suffixes were more prone to mistakes than the prefixes. Moreover, the phonetic related mistakes that was seen in the students were likely in similar sounding words- like cyte and...
site. The close ended questionnaire session revealed certain important outcomes where it was found that 94% students saying that neither books nor teachers explain the epistemological origin of the words- describing the meaning of the prefixes and suffixes clearly. Stress was given rote- memorizing the doctrinaire bookish concepts- the terminologies of the respective disciplines. Students of Hindi medium Schools complained about not even clearly the specific prefix and suffix being engaged in the word construction.

5. Conclusion

Years after, through this study, we have tried to relate the theories of scientific-linguistic skills (given by Skinner’s and Chomsky’s schools of thoughts) taking into account students from four different schools of Chhattisgarh. Our findings strongly support the use of creative writing- providing prefixes and suffixes- as an epistemic practice not only in Science and Language but also in other branches of study and as a mandate activity for synthesis of understanding in addition to other forms of communication and assessment. Through the questionnaire session, the investigators realized that students can do much better if the prefixes and suffixes are discretely made clear to them. One of the reactions of the students was, “Logy means biology; what to know more about it!” When she was informed that “Logy means study”, she instantaneously comprehended that “It means parasitology is the study of parasites.” Such responses clearly supported the hypothesis meant for this study. Creative writings (Linguistic tests) as an additional form of assessment are needed to gauge students understanding of science concepts alongside a more traditional mode, such as long writing. With the goals for writing-to-learn in mind, the next step is to consider how to scaffold creative skills to meet those goals – that is, how can instructors provide a sequence of support that helps students to eventually achieve mastery of the skill on their own? It is beyond the scope of this study to propose teaching practices to support all of the diverse goals for drawing-to-learn. The investigators recognize the need for creative linguistic skills as a scientific practice to be taught in order for students to maximize their understanding of science. This study upon complete evaluation of 9200 responses raises a valid question, “When education is trailing to get back its charm, who we should be blamed with the burden of crime?”

References


Author Profile

Anirban Roy has completed integrated B.Sc.B.Ed. (CBZ) from Regional Institute of Education (NCERT), Bhubaneswar, Odisha and presently pursuing Masters of Science (Plant Sciences) with specialization in Cytogenetics and Plant Biotechnology from University of Bombay. He has done internship in Kendriya Vidyalaya No, 1 Bhubaneswar as PGT (Biology) where he has taught Biology to students of Class- XI and XII and Science to students of Class- IX and X. His research enterprise includes tadpole behavior with respect to cadmium exposure, ethnopharmacology of endemic plants of Maharashtra, ecological studies of Western Himalayas, understanding child cognition through their diagrams, learning about misconceptions in middle school children regarding naïve concepts of biological sciences.

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