USE OF ANALOGY IN SCIENCE TEACHING – A CONSTRUCTIVIST APPROACH

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This paper examines the role of analogy in teaching of science. Analogy is finding similarities between different concepts and utilises learner's previous knowledge to construct new knowledge. Such construction of knowledge using analogy thus supports and follows premises of constructivism. Constructivism asserts that knowledge is actively constructed by learner based on his previous experiences. Science and scientific concepts are abstract in nature and difficult to understand. Analogy can be used effectively to elucidate and facilitate understanding of scientific concepts. In this paper, examples are discussed where DNA translation is taught using analogy.

Introduction

Analogy is the process of identifying similarities between different concepts. Finding similarities between concepts is a cognitive process, as it involves figuring out the familiar in unfamiliar. Thus, analogy is also about building new knowledge on previous knowledge. As it is a well-established fact that learning based on previous knowledge is more effective, such learning which takes place through analogy is multi-directional and multi-dimensional. It involves creating knowledge by borrowing and making comparison from knowledge in different, varied directions. Analogy thus utilises learner's previous knowledge to understand new concepts. Since analogy borrows familiar aspects from different directions, there can be multiple understandings hence multiple interpretations and construction of knowledge gets easier and richer.

Analogy in Line with Constructivism

Such construction of knowledge using analogy thus supports and follows premises of constructivism. Constructivism asserts that knowledge is actively constructed by learner based on his previous experiences. Constructivism is an epistemology, a learning or meaning making theory. It states that individuals construct their own understanding and knowledge through the interaction of their previous knowledge and the new ideas or events result in multiple realities. Each and every student is taken as a unique case with his own set of realities, experiences, values and culture. Thus, this approach focusses on students and how they should be taught. Constructivism emphasises that students should be taught in natural settings and classrooms should provide multiple representations of reality and vast and varied experiences. The local understanding should be encouraged since every child is unique with his bank of knowledge, experiences, values, culture and background peculiar to him alone, which should be honoured and taken care of while providing new information. The opportunities to explore, observe and discuss should be provided to students. Activities should be student centred and ideas should be presented holistically, students should be encouraged to ask questions,

carry out analogies and reach conclusions and draw inferences. Students should be encouraged to work in groups, discuss their ideas with each other, and communicate their views. Negotiation of outcomes is equally important so that students can compare their reality with that of other students and correlate their knowledge with the outside world, resulting into productive useful knowledge which would provide them with basics to continuously learn and adjust in society. Every individual has a life space and science should fit in that and have utility value in their life. This would enable them to become "life long learner".

Constructivist Learning

In constructivist learning, there is spiral growth with emphasis on all three, past, present and future. The students are actively involved in construction of knowledge, reflect upon old and new knowledge and in ever evolving new learning things. They also learn from mistakes as well. Thus, a student learns, relearns and even unlearns during the learning process and involves knowledge with others throughout making it a collaborative process.

In a constructivist classroom following are encouraged–

- *Enquiry:* Students are encouraged to ask questions.
- *Multiple Intelligence:* Students are encouraged to give their interpretations and express their views and ideas leading to multiple realities.
- *Collaborative Learning:* Students work in groups and learn from each other, discuss their outcomes with their peers and teacher as well and all learn as a result.

Constructivism in Science: Constructivism in science has emerged as an approach against positivism. It rectifies the fault of positivism which views science as an absolute truth. Positivism focuses on justification of inquiry and only believes in one single reality, which can be studied in parts, constructivism on the other hand emphasises on the importance of experiences. It treats every case as unique and believes in multiple realities which explains the formulations of new theories and discoveries. It views knowledge as whole, where in inquiry leads to another inquiry. Scientific knowledge as per constructivism is therefore, an inductive inquiry which can be constructed in totality, by describing multiple realities and mutually shaping interactions leading to emergence of theory. According to this approach, knower and known cannot be separated hence emphasises on mutual causal relationship.

Analogy in Science Teaching

Science and scientific concepts are abstract in nature and difficult to understand. Analogy can be used effectively to elucidate and facilitate understanding of scientific concepts, as it allows the learner to find similarities, cause and effect relationships, promotes inductive thinking and reasoning thereby leading to analysis and prediction. Since it encourages inductive thinking, it also motivates learners to think creatively 'out of box' and also in multiple directions, observe their world, find similarities, explore, hypothesise and come up with solutions and novel ideas. Thus, analogy helps in inculcating and developing scientific skills in children. Use of analogy also makes learning interesting and easier and since students start with what they already know they are more

confident and ready to explore. It is also true that not everything that has to be learnt will be with student; some changes have to be made to make learning easier. Secondary school teachers often resort to using analogies to facilitate understanding (Glynn, 1997; Venville and Treagust, 1997). There use is less in primary school (Glynn and Takahashi, 1998) as it is argued that young children are assumed to have limited knowledge base hence cannot draw analogies.

Story and poems are two very effective mediums which can be used for analogy learning.

The use of non-literal language to explain scientific concepts has been the subject of pedagogic research since early 1960s (Kuhn, 1962). Cameron (1996) suggests that the more prosaic use to which analogies are put in the sciences lies on a cognitive continuum that has their poetic use in the arts at the other end. Lakoff and Johnson (1980) also assert that we come to understand the world around us through the analogies we use. Churchland (1989) argues that both the extremes of the continuum can co-exist even when the poetic is seemingly at odds with the prosaic. The comparison between moon and lover is understood by astronomer also.

Storytelling is an effective medium through which analogy can be drawn between story, its theme and characters and various scientific concepts. This medium was used effectively during practice teaching session of B.Ed. students wherein pupil teacher taught difficult and abstract concept of DNA Translation and Transcription with the help of a story based on production of candies.

DNA Translation, Transcription and Candy Factory: The teacher narrated the story of production of candies and drew similarities between the process of candy manufacturing and DNA Translation and Transcription.

"David is the owner of candy factory where he makes yummy candies. He also has a library of all the recipes of candies. Like David has recipes of candies, similarly DNA is the boss of cell and has recipe for proteins. Now, as candies are produced in a factory, similarly proteins are also produced in protein factories called Ribosome. David sends a messenger, his peon with the recipe to the factory, in the same way mRNA is the messenger which carries information about protein manufacturing to Ribosome. The cooks prepare the candies in factory, similarly tRNA help in making of proteins, it gathers the amino acid which is the ingredient in proteins manufacturing. Thus, Translation is a process by which proteins are made through flow of information from DNA-mRNA-tRNA –Protein."

Poem is also an effective medium to learn scientific facts easily and in a playful manner. These mediums serve dual purpose, not only they help in understanding the concept in an interesting manner, but also enhance the aesthetic sense of learners, thereby nurturing the affective domain, which is said to be neglected in science teaching. Poems help in developing a sense of rhythm and music, appreciating of nature, increasing vocabulary and helps instilling values in student.

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