Skill based teaching – learning Science implementing Metaphorical thinking

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Abstract: Education in its general sense is a form of learning in which knowledge, skills, and habits of a group of people are transferred from one generation to the next through teaching, training, research, or simply through autodidacticism. Generally, it occurs through any experience that has a formative effect on the way one thinks, feels, or acts. The present paper explains how Metaphorical thinking enables an individual to nurture higher order thinking skills (HOTS) essential for problem solving, analysis, and synthesis in teaching-learning science.

Keywords: – Higher order thinking, Metaphorical thinking, Autodidactism and Problem Solving.

I. Introduction

Thinking is at the heart of all learning. Thinking makes things that have yet to be perceived possible, thinking facilitates and enhances our ability to perform and produce and pass on such vital information to others who would then do the same. Higher order thinking is imperative to progress. No explorer ever discovered anything new by following in the footsteps of those who had been there before. If lower order thinking skills seek to learn and commit to memory knowledge and know how that somebody else has already acquired then Higher Order Thinking allows for the interpretation and reconsideration of such information so that other application may be used and alternative conclusions drawn. This exposes further fields of knowledge and knowhow which may again, be transferred, reapplied and collated to create a new and improved version. Higher level thinking, takes thinking to higher levels than restating the facts. Higher level thinking requires that we do something with the facts. We must understand them, infer from them, connect them to other facts and concepts, categorize them, manipulate them, put them together in new or novel ways, and apply them as we seek new solutions to new problems. Higher level thinking, like most skills, can be learned; and with practice, a person’s higher level thinking skill level can increase. The following model explains the characteristics of higher order thinking skills.

Figure: 1 higher order thinking skill model

Question and Discussion

Divergent questions asked by students should not be discounted. When students realize that they can ask about
what they want to know without negative reactions from teachers, their creative behaviour tends to generalize to other areas. Discussion is complimentary to questioning to be encouraged in the classroom. For e.g If the teacher is teaching about the concept of generation of electricity in a conventional chemical laboratory the following statements and questions would encourage the development of higher order thinking skill.

Potato juice contains many water soluble chemicals in the same way as in a Daniel cell. Can you explain that the chemical reaction taking place in potato juice is similar to the reaction in Daniel cell producing electricity?

What is the similarity between the indirect reversible redox reaction taking place in the Daniel cell and potato juice?

Why do we need a medium for the reaction to take place?

Does it have similarity to communication?

Compare the working of a battery with a Daniel cell, what happens to the flow of electricity?

Try different combinations of metal electrodes and find out why a particular electrode is called anode or cathode. Does it have similarity to flow of water down the hill?

Transfer of knowledge

“Argote & Ingram [1]” define knowledge transfer in terms of organizational context as “the process through which one unit of the organization transfers its knowledge to the other unit adopting best practices. Transfer of knowledge is related to question and discussion as it promotes understanding of learning preferences of both the sources and the receivers of knowledge, adapting knowledge transfer methods to accommodate multigenerational preferences and learning styles promoting active learning in the classroom. “Baldwin and Ford[2]” referred transfer of knowledge through questioning promotes reflection, Meta cognition among learners thus enabling them to assimilate complex concepts.

Categorization, characterization, compare and contrast of knowledge

Recent research studies in Cognitive neuroscience explains that there exists category specific neurons responsible for categorising characterising, comparing and contrast of knowledge which enables the learners to frame patterns corresponding to the knowledge perceived. Categorization is a salient feature in Science learning involving subjects like Chemistry, Zoology and Botony. “Cohen, H., & Lefebvre, C [3]”. “Hammer, Rubi [4]” proposed that learning occurs through progressive generalizing as the mind actively separates information that applies to more than one thing and enters it into a broader description of a category of things. This is done by schematizing. Therefore, an experienced science teachers’ knowledge of science is structured from a teaching perspective and is used as a basis for helping students to understand specific concepts. Comparing and contrasting is a fundamental to human thought has played an important, but sometimes mysterious, role in a wide range of problem-solving contexts. “Feldman, Jacob[5]” suggested that analogies and metaphors influence concept formation in teaching learning science based on the following three statements namely

- The strength of an analogy depends upon the number of similarities.
- Similarity reduces to identical properties and relations.
- Good analogies derive from underlying common causes or general laws.

Collate and create

In a formal educational environment it is necessary to capture, collate create and share knowledge to emphasize interdependence as well as socialization among the learners“Hofstadter.D[6]. Knowledge acquired by the learners could be strengthened by adopting the following measures “Powell”[7]

- Uploading the content by the teachers in their respective web portal so that the learners retrieve it as when required.
- To support twenty four hours on-line support
- To facilitate collaborative learning environment such as discussion forums.
- To enable learners develop positive input on the content.
Paper Title: Skill based teaching –learning Science implementing Metaphorical thinking

To plan evaluation in a systematic and open endeavour.

Prioritization, relevancy and judgement
In teaching –learning process it is necessary that the knowledge is prioritized according to the following steps

- Definition of the problem.
- Identification of the objectives.
- Collection of information
- Analysis of the problem
- Make the best choice.
- Implementation of decision

Implementation of the decision is best facilitated by the possible judgement action-plan interlinking all the six steps. The successful judgement plans depends on the analysis of the information and make a move to implement it.

Interpreting and understanding
Learner acquires the skill of interpreting and understanding the concept by the way of observations, including those obtained by concrete experiences. It enables the learner to engage in analysing, synthesising and evaluating the information which in turn develops critical thinking as well as problem solving skills. Further it could be stated interpretation and understanding skill develops the following characteristics among the learners.

- Work positively and ethically
- Manage time and projects effectively
- Multi-task management ability
- Participate actively, as well as be reliable and punctual
- Present oneself professionally and with proper etiquette
- Collaborate and cooperate effectively with teams
- Respect and appreciate team diversity
- Be accountable for results

How metaphorical thinking promotes skill based teaching-learning
Metaphorical thinking promotes associative and analytical mode of thought which enables the learner to seek subtle relation between the items that may not be casually related “Burton[8]”. In analytical mode of thought the learner focuses his/her attention in analysing cause/ effect relation between the items under study. For e.g “water cycle”. “Runco[9]” “Quitadamo etal[10]” suggested that both associative and analytical mode of thought are controlled by the executive control of the brain arising through interactions among different parts of the brain. Metaphorical thinking promotes genuine learning in an individual enabling him/her to transform existing knowledge into higher-order modes of thinking that resolve the conflict and contradictions engendered by the experience of novel events. Implementing metaphorical thinking in the teaching-learning process enables the students construct knowledge through action, then it becomes important to provide students with an opportunity to engage in the types of action that will allow them to construct for themselves the knowledge at hand. The most common way for a student to apprehend a new concept is through the application and extension of existing concepts. Hence, practice of metaphorical thinking attempts to prompt the construction of novel understandings or skills by identifying the student’s current level and form of understanding of the concepts in question. Learning occurs as a process of bridging the gap between the student’s current level of understanding and the next most proximal level of skill or understanding. Therefore, practice of metaphorical thinking promotes active learning like other techniques used in teaching –learning process namely: Collaborative learning, Co-operative learning as well as problem solving or inquiry based learning.

Research Questions

- Does metaphorical thinking nurtures skill based learning?
- Is there any relationship between metaphorical thinking and higher order thinking skills?
- How does the proposed teaching –learning model help in promoting skill based learning?

Hypotheses

- There is no significant difference in academic performance of students in science before and after
implementing skill based teaching –learning model integrating metaphorical thinking.

- Gender difference do play significant role among students developing skill based learning.

**Methodology**

The experimental study was conducted on 70 boys and girls in the age group 13 to 15 years to find how metaphorical thinking nurtures higher order thinking skills among learners by adopting teaching –learning model that develops higher order thinking skill in learning science. The experimental group comprises 18 boys and 17 girls and the control group comprises 17 boys and 18 girls. Experimental group of students were trained by the teacher adopting the higher order skill attaining teaching –learning model in the classroom by carefully designing the lesson plan according to sequence mentioned in the model following clock-wise direction for a period of six weeks. To ascertain the significance of the model pre and post test science achievement scores were collected from the sample. Statistical analysis carried out revealed the following results.

Table 1: to show the Science aptitude of the sample implementing higher order thinking skill model

<table>
<thead>
<tr>
<th>S. No</th>
<th>Variable</th>
<th>Type of test</th>
<th>Type of group</th>
<th>N</th>
<th>Mean</th>
<th>S.D</th>
<th>“t”</th>
<th>L.S</th>
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<td>1</td>
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<td>Control</td>
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<td></td>
<td>Post test</td>
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<td>Experimental</td>
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<td>1.81</td>
<td>3.49*</td>
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N.S = Not Significant

Table 2: to show the Science aptitude of boys implementing higher order thinking skill model

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N.S= Not Significant

Table 3: to show the Science aptitude of girls implementing higher order thinking skill model

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N.S = Not Significant

Table 4: to show the Science aptitude of boys and girls implementing higher order thinking skill model

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(14)
Discussion

Lesson plan implementing metaphorical thinking statements promote applied thinking, and adaptations for diverse student needs. Scaffolding (giving students support at the beginning of a lesson and gradually equipping students to operate independently) helps students develop higher order thinking skills. Skilful learning strategies include rehearsal, elaboration, organization, and meta cognition. Lessons should be specifically designed to teach specific learning strategies namely Questioning, transfer of knowledge, categorization, collation, creation, prioritization, correct judgement, interpretation, good understanding. Some of the listed activities to enhance higher order thinking skill integrating metaphorical thinking are:

- Teacher creating a challenging learning environment.
- Suggesting new problems relevant to the concept.
- Providing corrective feedback to the ideas generated.
- Encouraging verbal analogies relevant to the problem.
- Promoting logical deductive and inductive reasoning.

References


Findings

From the table 1, 2 and 3 it was shown that experimental group nurtured higher order thinking skills compared to control group considering the sample as such, as well as boys and girls separately. The table 4 shows that there is significant difference among boys and girls’ nurturing higher order thinking skills in experimental group as the mean for girls was found to be greater than boys.

![Graphical interpretation of the results](image-url)

