

**Concept Mapping- An Effective Mode to Impart Content Knowledge for
Elementary Student Teachers**

Submitted by

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Abstract

Students hold many misconceptions in school science. Research reveals that teachers themselves, at times, are one source of misconceptions among students. A good number of such misconceptions, carried on to the next generation via school, are held by teachers; from their own school days and kept uncorrected even after their teacher education course. Teacher educators observe that student teachers show “inadequate” “insufficient” “marked deficiency” in the content knowledge. Despite this, there is no room in the present elementary teacher education curriculum for enhancing their content knowledge. The only way to impart content knowledge - pedagogic analysis - is a ‘ritual’ in almost all institutions. Therefore, student teachers must get a chance for brushing up science concepts they ought to teach. Concept mapping is a strategy that can be used to impart content knowledge with sense within a limited span of time.

Teachers, Students and Misconception in School Science

Research in science education indicates that students hold many ideas that are different from those generally accepted by scientists. These different conceptions are called alternative conceptions (Arnaudin & Mintzes 1985) or misconceptions (Cho et al. 1985). Not only students, but also pre-service (Trumper, 1999) and in-service teachers have misconceptions in science. Research on student teachers in Kerala also revealed that they have many misconceptions that can affect their teaching of topics in elementary classes (Gafoor & Shyni, 2009). In such situation, it is no surprise that, students when they reach high school have serious misconceptions in specific science topics (Gafoor & Akhilesh, 2008); with concrete concepts demonstrating comparatively low rate of misconceptions and abstract concepts showing comparatively high error rate. Hence, it is not exaggeration to argue that teachers themselves are one of the leading sources of misconceptions among students.

The argument that teachers are sources of misconcepts for students may look wrong in this age of constructivist and critical education practice. Teachers, parents and students are in favour of the constructivist curricular practices in Kerala, but they all experience multiple

problems in their own way in relation to present school curriculum (Gafoor, Farooque & Jouhar, 2011). According to the student teachers, the present curriculum is leading to lack of basic knowledge and lack of theoretical knowledge. For students, the present curriculum is overloaded; teachers are not active and it results in making learning silly or fun, makes way for partiality; some subjects become boring and there is more homework, and for others learning has become more of a play. Teachers reveal that classroom practice continues its inclination towards behaviourist practice and the desired shift from behaviourism to constructivism has not taken place (Gafoor & Akhilesh, 2010).

Teacher educators observe that in spite of high marks at +2 stage, teacher students show “inadequate” “insufficient” “marked deficiency” in the content knowledge and also show “poor academic performance” (Gafoor & Ragisha, 2012). Teacher educators feel that vast majority of student teachers are the throw-outs of competition for other professional courses like medicine, engineering and administrative services and hence, student teachers consider the training programme as a mere ‘passport’ to a job in schools. As planning for instruction, quality of classroom transaction, style, and evaluation all depends upon the content level of teachers; student teachers need have a thorough basis in the content knowledge. Only when teachers have thorough knowledge of content, they can be trained in processing the content knowledge for pedagogic purpose.

Pedagogic Analysis for Elementary student teachers

While deficiency in content knowledge of future teachers is accepted, teacher education curriculum gives no space for content and hence the programme focuses only on methodology part. The curriculum is crowded with written works and teachers don't get enough time to concentrate on improving content knowledge (Gafoor & Ragisha, 2012). As there is no space for content knowledge in the present syllabus, the only way to impart content knowledge is through pedagogic analysis. Many teacher educators admit that they are doing the content analysis of one or two chapters, obligatory for practice teaching, only. The situation is worse where the student teachers just copy down analyzed content from the previous records. This adds to the tendency of some teachers to “dictate” the facts and concepts to their students.

Elementary student teachers are supposed to teach all subjects in the upper primary classes, irrespective of their subject combinations at +2 level. But teaching student teachers on all the contents up to 10 or plus two level is not possible, as the TTC (Teacher Training Course) curriculum is already congested with lack of time and overload of written works. So a new strategy or method that can do the brushing up of the basic concepts within a limited time becomes the need of the hour. If it is possible to understand the basic abstract concepts of science it will be a great help to student teachers. Studies indicate that the lack of content knowledge affects their performance in the class room, as teaching requires ‘what to teach’ along with ‘how to teach’. Improving this situation requires deliberate and planned provision of opportunities for brushing up and reorganizing of content knowledge that future teachers have from +2 level. To provide for this in a cost and time effective manner, content can be given along with pedagogic analysis as ‘inbuilt’, with no extra time.

Concept Maps-An Efficient Means to Organize Knowledge

In this technological era, students are required to process huge amount of information to create understanding. However, access to information does not guarantee the creation of knowledge because information and knowledge are not the same in nature. Information is the mass product of raw data and knowledge is the creation of individual minds drawing on individual experience. In other words, meaningful knowledge is generated by mind through the process of meaning making. In generative learning, learners have an active, participatory role in order to interpret and construct meaning. Construction of conceptual relationships is a key to knowledge generation. Concept mapping is one powerful strategy to support the process of meaning making. Concept maps are graphical tools for organizing and representing knowledge. A concept map is defined set of interconnected propositions, each of them consisting of two or even more concepts connected by labeled links. Thus, any construction of concept map needs a translation of relevant cognitive structures into an external network. This allows an interpretation of knowledge coherencies. It can be simultaneously employed as a learning strategy, a method to capture the most significant aspect of a topic, and a resource with which to represent a set of conceptual meanings included in a structure of propositions.

Value of visual organization and connected understanding

In the field of education, some of the most useful models that address cognitive processes suggest that knowledge must be organized to be accessible from long term memory. According to such models, expertise is attained by developing rich, accurate, relevant and accessible sets of organized knowledge (Marshall, 1995). That is, expertise requires “connected understanding”- understanding of both concepts and connections among concepts (Schau & Mattern, 1997). Science education often deals with complex issues and requires multiple approaches in order to reach a long-term understanding. The acquisition of adequate conceptual knowledge involves an interconnection of basic scientific concepts from different disciplines such as biology and physics. Subject- integrated approaches promote the cross- linking abilities of learners. Learning via interdisciplinary lessons leads to more complex thinking and improved reasoning abilities. In the more complex science education knowledge domains, retaining long- term conceptual knowledge is essential. Consequently, implementing authentic learning activities and cooperative learning in a ‘real life’ context, possible through concepts maps, promotes a multiple regrouping of knowledge and hence the chance for constructing interdisciplinary concepts. However, for successful interdisciplinary learning in complex knowledge domains learners will need instructional support.

Graphic organizers provide visual scaffolds that encourage students to extract and represent key details in their texts. Of these the concept map is a particularly useful graphic because it requires students express in writing how two linked concepts are related. This relating of concepts may aid in reading comprehension, since expository texts are often embedded with relational structures, including comparative, causative, explanatory and sequential. For example, a student may be more likely to comprehend the embedded causative relationship between low potassium and high blood pressure, if they are encouraged by the graphic organizer to read for how these concepts might be related and write “results in” between them. (More simplistic graphic organizers might only require students to connect these concepts or group them in a visual display, with the precise nature of the relationship remaining undefined or implicit at best).

An illustration of concept mapping for student teachers

Concepts in upper primary science can be represented in a few concept maps. As an illustration, this paper chose two units each from 5th, 6th and 7th standard science and by analysis the major concepts underlying each topic were found out as listed in Table 1.

Table 1

Units in upper primary science and the major concepts included

Unit No.	Major concept(s)
1	Food production (photosynthesis)
2	Components of healthy food (vitamins, minerals, carbohydrate, fats and proteins needed for making a person healthy)
3	Light and its characteristics (mirrors and their applications in different instruments)
4	Cell (cell organelles and their functions)
5	Energy (especially kinetic and potential energies)
6	Heat, density and convection

These concepts can be put together in a single concept map and connections can also be made. This can be done as the following concept map illustrates (figure1).

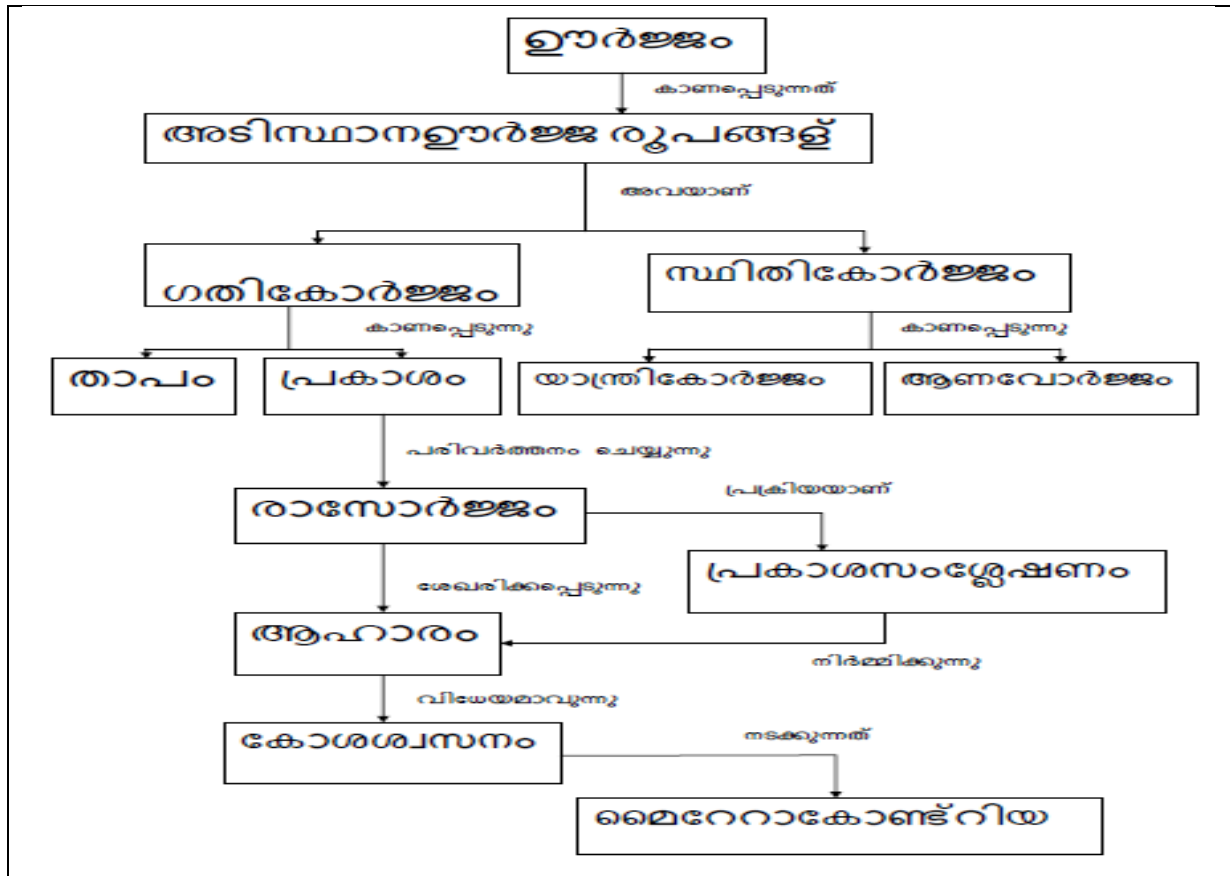


Figure 1. Concept Map Linking Major Concepts in Six Units in Upper Primary Science

The seemingly six different concepts in table 1 are linked in a concept map in figure 1. Using this main concept map and its six sub concept maps we can give an idea on basic concepts in science and make student teachers understand how these are interrelated. Students can understand the basic concepts easily. When they get what to teach in their hand they can easily contribute more on how to teach.

Conclusion

Concept mapping is the device that can be used to impart content knowledge with sense within a limited span of time. Technique of concept mapping can be employed as a learning strategy, as a method to capture the most significant aspect of a topic, and as a resource with which to represent a set of conceptual meanings in complex science education knowledge domains. This if applied in teacher education will turn an efficient and helpful means for future teachers to retain long- term conceptual knowledge and engage in more complex thinking and improved reasoning that in turn brings in qualitative improvement in school education.

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