



Design of Concept Map for Promoting Conceptual Integrated Approach in Technical Education

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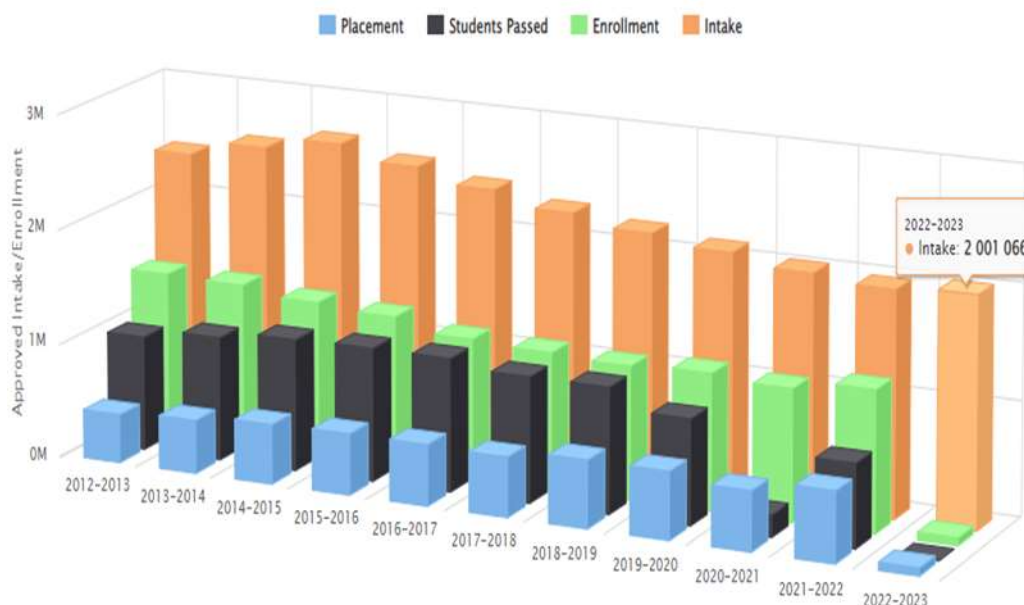
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| Article History | Abstract |
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| Received: 06 June 2023 Revised: 05 Sept 2023 Accepted: 02 Nov 2023 | <p><i>This study is a humble attempt to explore “design of concept map for promoting integrated approach in Technical Education”. This study is an attempt to identify “the effect of concept map for integrated approach on real life problem solving skills. It also shows the concept map has capacity to promote the integrated approach in technical education in India. Through the study, it seems that there is hard separation between engineering subjects and their teaching pedagogy. Now days, conceptual integration of core and elide course with their practical approach is crucial goal in technical education. The present study aims to design concept map in engineering physics for promoting integration of core course with social value and environmental issue on real life problem solving and critical thinking skills among engineering graduates. The study indicated that designing concept map in engineering physics significantly integrated with other course content. It is also reveal that Concept map was significantly effective for integrated approach of teaching as well as assessment tool. The study has suggested for orientation of faculty members of technical education for making them skilled in designing concept map for promoting integrated approach which is initial stage of STEM education in technical education of India.</i></p> |
| CC License CC-BY-NC-SA 4.0 | Keywords: <i>Concept Map, Integrated Approach, Technical Education, STEM Education</i> |

1. Introduction

The National Education Policy (NEP) 2020 Government of India, is a framework of education that aims to reconstruct the entire education system in India. NEP-2020 emphasis constructivist approach in teaching learning process in all levels of education. NEP-20 establishes the quality education through skill and practical knowledge development. It aims to integrate theoretical knowledge with practical skills for holistic development of young minds. Prof Yashpal committee also reported in “Report of the committee to advise “our technical undergraduate and graduate program are two theoretical and implication being that they are divided of practical experience.

To overcome this, it would be necessary that the university adapt a curricular approach which treat knowledge in a Holistic manner and create exciting opportunity for different kind of interface between the discipline which is unthinkable Today in most of the university and Institution of Higher Learning. “It is important that universities relate to the word outside and the walls of disciplines are Porous enough to let other voice be hard. It would also be necessary that the University education is seen in its totality and subject area not to be designed in isolation.”(Renovation of Higher Education 2008 ,page 11-12)” In present scenario India has 5911 engineering Institute and 2001066 students are enrol in session 2022-23(AICTE).



Source: <https://www.aicte-india.org/>

Engineering Institutes are the largest and most important institutions in the higher education in India, and are thus the focus of this study. But relevance of conceptual understanding, practical skills and collaborative learning are significant issue as to a gap between what is taught in college and what is demand in real life. These problems faced by technical Institutes could be overcome by introducing alternative approach in teaching learning by adapting student – centred, problem-solving activity based approach. We know that constructivist approach learner oriented approach in which learners motivate to interact with real life situations, and according to their experience, they construct their own conceptual understanding about the facts and content. This approach is construct a bridge of connectivity between information collected by learner and existing knowledge.

Concept Map

Concept map is considered as meta –cognitive strategy which promotes conceptual learning. Concept Map is the form of teaching strategy which was developed by Joseph. D. Novak in Cornell University in 1980s (Monika Verma 2021). Conceptual framework based on Ausubel’s meaningful learning theory which main emphasis on the connection between students’ new knowledge and already existing knowledge. Concept map plays very significant role in the representation of knowledge in the classroom. It is not only a useful strategy for teachers as it is an effective tool for organization of knowledge. **Monika Verma (2021)** analyse and review the nature of concept map in her Ph.D. thesis (page20-21)

As a Learning Tool

“Concept mapping allows students to think deeply about the topic by helping them to organize and understand what they learn and retrieve information more effectively (Kilis and Cakmak 2013). It classifies knowledge into concepts and sub-concepts so that it can be easily learned and retrieved. Its hierarchical nature follows to the general assumptions that the cognitive representation is structured in order (Tergan, 1986). It develops students’ problem-solving phases of generating alternative solutions and different possible options (Henderson, Yerushalmix, Heller, Heller & Kuo, 2003)”

As a Teaching Tool

“Use of concept maps is helpful for teachers to be aware of the key concepts of topics and relationships between them. It provides a clear picture of the topics for teachers to convey students (Rani and Dhillon, 2011) . CM provides the information regarding to students’ understanding and misconception. It helps to teachers to identify, understand, and organize topics for teaching (Kilis and Cakmak 2013)”..... (page20-21)

As an Assessment Tool

“Concept mapping is one of the most powerful assessment tool encouraging students to use meaningful-mode learning patterns”. Novak (1989) In present study, researcher adopt all three aspects of concept map for promoting integrated approach in physics course of engineering program.

Integrated Approach

Integrated approach in teaching learning process indicates combination of learning experience and real life. This approach motivates to get a collaborated view of reality, and enhances learners' capability to acquire real –life skills (Candy Cuenca 2016). There is integration when learner is able to connect what they are learning in one course to a related content in another course content. For instant, concept of HOOKES Law learned in physics may be used by the learner with related concepts and skills in core mechanical and civil engineering course. The Quality of learning outcomes increases as learner are able to integrate information across course instead of acquiring them in isolation. The use of unifying themes and real-life activities could lead to more relevant learning (Dewey, 1938; New, 1992).The integrative approach in the teaching process is more realistic and is related to the life problems that students face in their lives (Moder Sabah Abd 2020) .Al-Haddabiu Al-Jaji, (2008: 106) defined it as the approach that presents its concepts and vocabulary so that the unit of thinking between the different subjects increases the subject of the study clearly, so that the learner can perceive the overall picture of the topic and thus employ it to reach the unity of knowledge. Author classified the types of Integration according to their nature and scope. A. X- axis one-dimension integration: This is relationship between the different areas that make up the curriculum, whereby attention is focused on topics with common elements between the related fields. B. Y – one-dimension axis integration: If integration allow to subject to subject but level is increase and advancing it in depth and breadth and interfering in the branches of science and life whenever the student rises in a class. C. XY- Two dimensional integration: This is both directional relationship.

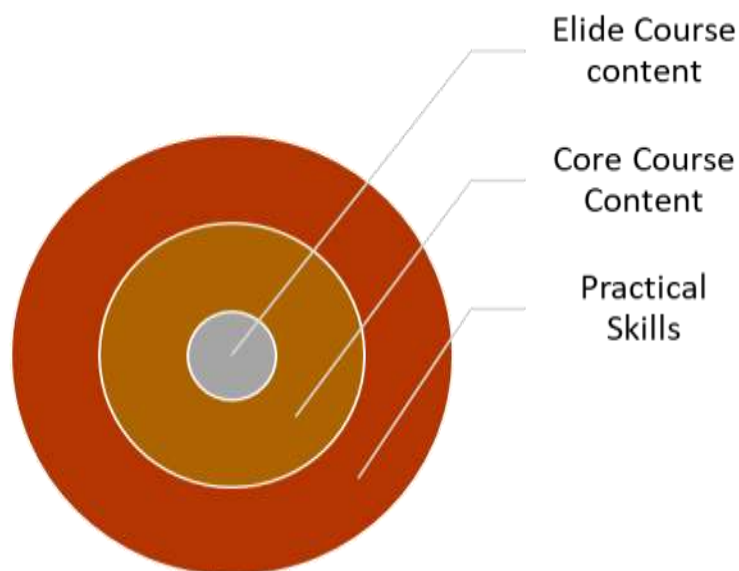


Figure 1: Conceptual Framework of Integrated approach in content

Concept Map and Integrated Approach

As we discuss earlier that concept map is considered as a group of graphics which are arrange and represents individuals' knowledge about a subject or topic. It creates with a main concept or fact and then branch out to show how that the main concept can be connected, related and divided into specific concepts (Verma, Monika 2021). integrated approach in context of education also establish that there are no boundaries between the field of knowledge, including technical and vocational education. In technical education core and elide subjects taught in curriculum have comparatively self-determining in terms of concepts methodology and research. But the same time they all have strong interconnection of concepts and applications. I

n facts concepts across the various sub disciplines of technical education are never isolated from each other rather they are complementary and supplementary in nature (Nitu Kaur 2019). This opportunity provides an integrated approach in teaching learning process. This accelerate the transfer of knowledge from one subject to another to enhance the student's problem solving, and critical skills (Zukhra & Dustnazar,2020). As a result of the transformation of the interconnectedness of scientific knowledge in the technical education, integrated knowledge and skills create students' creative abilities and their professional orientation. But the integration of content is very crucial obstacle in technical education. The relevance of conceptual knowledge, skills and practical experience acquired in the course of training and production practice, their relevance to the level of professional

motivation; the scientific and systemic nature of the training material; the logic of utterance; readability for students; taking into account age and individual characteristics of students are play very vital role for success of integration (Zukhra & Dustnazar,2020). By this reason researcher argued to find a scope of integrated approach in core and elide course in engineering program with technology. Concept map is one of the appropriate strategy to overcome this barrier. In concept map can be obtained from the visual representation of knowledge based on relevant concepts, facts and principles. It is also used to show relationships within a concept, facts and interconnection, relation and application of different subject or subjects. The relevance and connectivity of learning in this technique, promote students learn any topic through establishing among connectivity and relevance of concepts rather than remembering concepts separately. It leads to different forms of learning and associated with other aspects of different subjects in a collaborated form. It means that same concept can be represents in different ways with integral form of different subjects for the individuals. Based on the analysis of research and studies for designing integrated approach in technical education, researcher found that, there is one most appropriate algorithm for creating course is concept map.

Previous Study and Finding

Monika Verma (2021) conducted her study on effectiveness of concept mapping. Study explore that concept mapping is more effective strategy for problem solving skills. Tyagi and Arora (2019), Candan (2006) concluded that uses of concept mapping in teaching of science increases conceptual understanding and develop interest in science. Few researches conducted by Ahmed (2016), Kumuda (2016), Bot and Eze (2016), Filgona, Sababa and Ndatuwong (2016), Ogonnaya, Okafor, Abonyi and Ugama (2016), Enlogen (2016), Sakiyo and Waziri (2015), Nwoke, Iwu, Uzoma (2015), Ibitomola (2015), Emmanuel (2013), Cheema and Mirza (2013), Udeani and Okafor (2012), Egolum (2012), Awofola (2011) and Asan (2007) showed in their research work that it is an effective teaching strategy to improve students' achievement. Researchers found that concept mapping is more effective strategy as compare to students taught using regular method or any other strategy of teaching. Research of Alhomainan (2015) revealed that concept mapping has positive impact on speaking English. Auta (2015) found that concept mapping strategy was not only improves students' performance as well as it improves students' creativity in physics. Akeju, Rotimi and Kenni (2011) concluded that concept mapping effectively promotes learning skills of students. According to Ibitomola (2015), Luchembe, Chinyama and Jumbe (2014), Ajaja (2011) and Radhamani (2009) students show positive attitude towards concept mapping. Similarly, various study conducted to find out the impact of integrated approach in education. Nitu Kaur (2019) Behsat, Nuray, Ayfer (2012), Mayurakshi Basu & Mohalik(2020)concluded that integrated approach is an effective cross interdisciplinary approach for developing conceptual understanding. integration (Zukhra & Dustnazar,2020)) showed in their research work that integrated content design is very useful for vocational education but designing of content ,knowledge and skills in integrated form is such a major task. Moder 2021 study identified that adopting modern strategies like integrated approach to increase student achievement and develop capabilities, motivation and knowledge. Al Badayer's (2017) Study identified the effectiveness of the blog within scientific missions in learning and academic self-efficiency for intermediate second grade students in physics.

Designing of Concept Map

For selecting any instructional tool, it is necessary to analyze the whole subject under consideration. Under this process subject is divided into topic, sub-topic, subsub-topics, procedures, process, principles, rules, law, concepts, facts and information. Such analysis helps to identify the instructional need of the topic from learning point of view. The subject of physics in engineering under graduate contains five module. Among five module researcher has selected Module of general properties of matters, becoase Energy is the basic topic of physics but their application and conservation of energy are not so easy to grasp. Hooke's law is the most important energy transformation concept which can only be defined in term of other concepts (stress & stain, types of energy,elastic constant,young modulus), abstract properties and mathematical relationship.Conceptual understanding of application and practical skills ,allows students to corelate the change of stiffness and length of spring according to requirement. Young modulus ,change in parameter, number of oscillations, matter of spring and conservation of energy to verified Hooke's law is also very important and integrated concepts of Mechanical and civil engineering .These concepts not only related to core engineering course but also integrated with fulfilment of program outcomes in terms of engineering attributes.

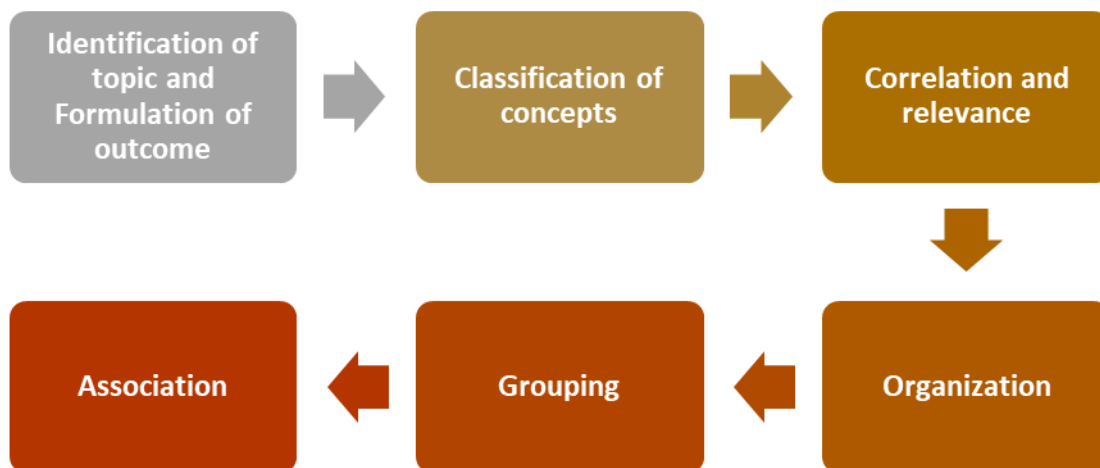


Figure 2: Process of Designing of Concept Map

Table 1: Formulation of Learning outcomes

| Dimension of Integration | Learning Outcomes |
|--|--|
| Course content –to – Previous or future Course content Integration | State the time period in term of spring constant Differentiate between frequency and time period in term of SHM Differentiate various forms of energy and obtain their interconnectivity Explain the process of spring oscillation State the law of conservation of energy in term of spring oscillations |
| Course–to- other course Integration | Identify hard and soft spring in terms of property of matters Establish the relation between Stress and Strain Example of Application restoring force in real life Relation between displacement and amplitude Identification of Young Modulus of different matter Relation between material deforms under an externally applied load |
| Practical Skills | Application of Hooke's law in Real Life Identify suitable matters in reference of young modulus for building and engine materials List of production unit of local Area Classification of Matters with their elastic constant and application |
| Social Value , and Environmental integration | Analyse the effect of stress in human body Explain the significance of energy and balance factor in social life |

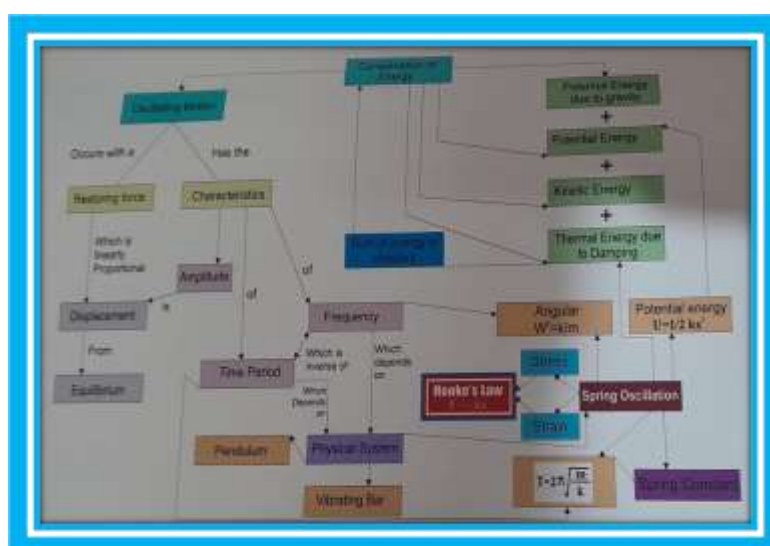


Figure 4: Design of Concept Map on HOOKE'S LAW

Module Of Lecture Plan

Following is an attempt to make a module of lecture plan for physics which can be integrated civil, Mechanical and other engineering core course and also cover social value and environmental issue through concept map.

Learning Outcomes of Lecture Plan

Cognitive domain: Students will be able to define the process of Spring oscillation. Students will be able to know about the process of Hookes Law Experiment. Students will be able to understand the underlying energy Conservation law. Students will be able to describe the relationship between Strain and Stress. Students will be able to distinguish between Young modulus and Rigidity. Students will be able to figure out the pendulum and restoring force.

Affective domain: Students will be able to realize the significance of Young Modulus in production and construction unit. Process skills: Students will be able to classify element on their elasticity property. Students will be able to predict the causes of basic requirements of good construction . Students will be able to predict importance of balance in terms of life, energy . Relation between material deforms under an externally applied load

Pedagogy: Integrated Approach through Concept Map (Figure 1.4). Key Concepts to be covered in Integrated Form: Hookes Law. Energy Conservation. Young Modulus. skin returns to its original shape removal of the load. selection of appropriate material for your projects with specification. Differentiation between deformation under external stretching, compressing, or bending Create a list Application of law of elasticity in your surroundings. Phase of Teaching and Learning: Depends on Teacher's capability. Assessment Tools: As per outcomes Feedback.

2. Conclusion

It is realised by researcher that engineering education can be more meaningful through appropriate conceptual and content integration. Many time technical course learning becomes a difficult task to be accomplished by the learner who is taught through Isolated approach. It is said a little learning sometimes lead to conceptual misunderstanding and a complete knowledge is the only rescue for getting rid of these misconcepts. Concept map is having a broad approach for learning and it ensure psychologically sound learning which provides a larger canvas for the learner's discourse and interaction with strong inter-linkages in between interdisciplinary themes and concepts. There can be many parallel existing competitive arguments which can establish the need of introducing integration into curriculum to deliver the knowledge with different forms but still faculty orientation is big challenge to achieve the goal. In conclusion, Integrated approach is a holistic and comprehensive approach to education that emphasizes the value of diversity, equity, and active participation in the learning process. Integrated approach in education is not just an educational philosophy; it is a reflection of our society's values and aspirations for a more inclusive and equitable future. It is an ongoing journey of self-reflection, collaboration, and adaptation and concept map will become an effective tool for that.

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