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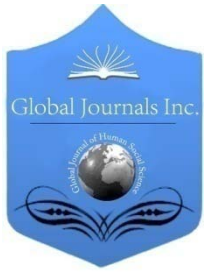

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Nurturing and Assessing Thinking Skills: An Evidence-based Approach

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This paper draws on global policy debates, discussion papers and conceptual frameworks proposed by different groups. It analyses relevant conceptual frameworks in order to evaluate significance of component sub-skills. It highlights the issues associated with evidence-based teaching-learning and assessment of thinking skills; and suggests strategies to deal with the issues.

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Nurturing and Assessing Thinking Skills: An Evidence-based Approach

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Abstract- Discourses at all major academic forums, huge concern have been raised regarding lack of readiness for social and professional life in school and college pass outs. Education systems around the world realized need to reorient education towards learning skills for work and life, invariably referred as core or generic or 21st century skills. Thinking skills predominantly occupy the suggestive list of skills required for success in 21st Century. Growing emphases on thinking skills necessitated to design innovative school curricula, integrated teaching-learning processes and a technically robust assessment system.

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I. Introduction- A Thinking Perspective

Learning and high performing education systems around the world define their educational goals as – What a student (or learner) can know, can do and can think, after spending a specific number of years in the system. The degree of attainment of these goals is measured through well defined processes of assessments, using different tools. Analogous to physics or chemistry experiments conducted in most of school science laboratories, the entire process revolves around pre-determined expected outcomes or objectives. It is not an exaggerated statement that defining learning outcomes is pivotal in outcome based education systems. After going through a learning experience of few days or say months, a group of students, say 10-20% may be able to achieve mastery in titration or microscopy skills and the associated concepts. Another group, say 80-90% may achieve a satisfactory level of performance. But, to interpret with the same level of objectivity that 10% of the class has achieved mastery level of logical reasoning is challenging.

- Are knowledge and skills related goals independent of thinking education goals?
- Which educational goals are more (or less) important- knowing, doing or thinking?
- Which of these goals would have (or have had) greater impact on way of life?

Answers to such questions may be explored through some revolutionary examples or set of examples from History.

Example 1: Aristotle (384-322 BC) said that a hundred pound ball falling from a height of one hundred cubits hits the ground before a one-pound ball has fallen one cubit. Galileo said they would arrive at the same time. How could people find out that who was right?

Example 2: Copernicus in the sixteenth century tentatively suggested that the Sun was at the centre of the Universe and that the Earth and other planets revolved around it. Before, it people could not think that a heavy body with mountain and water could also revolve. Copernicus, too, did not arrive at this conclusion through observation or any experimentation. He did so by thinking.

Example 3: Lamarck's theory of inheritance of acquired traits was based on observations like Giraffes stretch their necks to reach leaves high in trees that results in strengthening and gradual lengthening of their necks, and also offspring with slightly longer necks. A flamingo's legs get longer because it is always stretching up to avoid contact with water. These ideas led him to evolutionary theories that individual efforts during the lifetime of the organisms drive adaptation and the acquired adaptive changes pass on to offsprings.

Example 4: Darwin and Wallace both were of similar opinion about evolution and were co-discoverers of the natural selection. But, they differed in their approach. Darwin's conclusions about origin of species were largely drawn from detailed observations and evidence of facts made during his voyage of discovery. Wallace enjoyed reading widely, spent years in Amazon basin, exploring and collecting samples. Was it mere observation or reading or something else that demystified the process of evolution?

How did scientists' or common men's thinking about the evolution of life change from Lamarck to Darwin? How did people decide which was more relevant? What is similar in all above examples is that individual thinking challenged and changed the way people think and changed the existing body of knowledge. These examples are just a few illustrations

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of power of thinking, but how difficult it would be to rank who was a better thinker- Lamarck or Darwin or Wallace? Magic of thinking is felt in the memoirs of Richard Feynman 'Surely You're Joking, Mr. Feynman!'

"… So the guy says, "What are you doing? You come to fix the radio, but you're only walking back and forth!" I say, "I'm thinking!" Then I said to myself, "All right, take the tubes out, and reverse the order completely in the set." (Many radio sets in those days used the same tubes in different places--212's, I think they were, or 212-A's.) So I changed the tubes around … He fixes radios by thinking!" The whole idea of thinking, to fix a radio--a little boy stops and thinks, and figures out how to do it…"

(pp6, Feynman, 1985)

II. Thinking Skills as Educational Goals – what has Changed and why

Emphasis on thinking skills in education is not a new paradigm. It was always emphasized by the educationists, especially by those from constructivism school of thought (Dewey, 1938; Piaget, 1936, 1957; Vygotsky, 1978, Bruner, 1985). John Dewey (1916, 1938), one of the most influential education philosophers and reformers in the 20th century advocated education that would fulfill and enrich the lives of students as well as prepare them for the future. According to him, the purpose of schooling was to allow children do things and live in a community which gave them real, guided experiences that could foster their capacity to contribute to society. Jean Piaget (1936, 1957) was surprised to deal with the reasons children gave for their wrong answers for the questions that required logical thinking. Vygotsky (1934, 1978) established a strong correlation between thinking and speaking process. Bruner (1985) argued the curriculum should not center on accumulating factual knowledge like it does today but rather focus on enabling the students to understand acquiring several big ideas.

What's actually new is the changed sociocultural and economic context that requires different skill sets for development of individuals and societies that the skill sets needed in 20th Century. Frank Levy and Richard Murnane (2004) attributed it to one of the key difference between two centuries:

"Declining portions of the labor force are engaged in jobs that consist primarily of routine cognitive work and routine manual labor—the types of tasks that are easiest to program computers to do. Growing proportions of the nation's labor force are engaged in jobs that emphasize expert thinking or complex communication—tasks that computers cannot do…" (pp. 53–54)

The economist duo emphasized the need of expert thinking. One may argue that there are examples of thousands of successful persons possessing these novel skills - either innate or acquired, in earlier centuries. But, in global communities striving to achieve goals of equity and sustainability, these skills must become universal. Today we cannot afford a system in which opportunity for acquisition of such skills is confined to the few. Policymakers began to believe that as survival skills in a society change, educational needs change considerably. This resulted in education reforms in different parts of the world, which marked a remarkable shift from "skills that are novel" to "skills that must be taught deliberately and effectively".

But this shift is not going to be so smooth. It would necessitate a revamping of the way we plan and think about content and curriculum. The Partnership for 21st Century Skills (2004) has identified five key learning and thinking skills crucial for success in today's world: critical thinking and problem-solving skills; communications skills; creativity and innovation skills; collaboration skills and contextual learning skills; and, information and media literacy skills.

These skills are significant because employers prefer these skills in their human resource. A survey "*Are they really ready to work*" conducted by the P21 consortium revealed that about three fourth employers seek abilities like critical thinking, problem solving, innovation and creativity in their human capital, but these abilities were found to be deficient in about 70% school pass outs (Lotto and Barrington, 2006). Transformation of today's school students into tomorrow's effective workforce demands bridging the gap between: what kind of workforce is needed and what is being produced.

Inclusion in school curricula and emphasis on teaching and assessing these skills in regular classrooms is a recent phenomenon. This makes it crucial to clearly articulate that what are the component skills and sub-skills and how do students of a specific age group demonstrate them.

III. Conceptual Frameworks: Where are we Today

Researchers and cognitive scientists had established significance of thinking skills and defined them in the latter half of 20th century (Watson and Glaser, 1980; Ennis, 1985; Mayer, 1992; Paul, 1995; Mayer and Wittrock, 1996), but it was only in 21st century when policy makers and educators felt the need to operationalise the construct of these skills to facilitate teaching and assessment in the classroom (OECD, 2004; P21, 2009; Binkeley *et al*, 2010; OECD, 2013). Thinking processes mentioned in these conceptual frameworks may differ, but there are many commonalities like -

- the need to make thinking skills like critical thinking, creative thinking and problem solving explicit component of school curriculum
- going beyond thinking abilities to include affective domain, social skills and dispositions

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- inclusion of metacognitive perspective
- linking thinking skills to social and technological aspects like collaborative learning, computer mediated learning, etc
- widening the scope of thinking curricula to thinking classrooms and thinking schools or systems.

The partnership for 21st Century Skills Framework (2006) and other P21 publications visualize thinking skills from college and workforce readiness angle (P21, 2009). The framework developed by the Committee on the Assessment of 21st Century Skills, National Research Council (NRC) has also categorized the knowledge and skills from college and career readiness point of view into cognitive, interpersonal and intrapersonal skills (NRC, 2011). Compared to these two, Assessment and Teaching of 21st Century (ATC) Skills Organization has based its framework on the model of knowledge, skills and dispositions to place 21st century skills under four groups- ways of thinking, ways of working, tools for working, and living in the world (Binkley *et al*, 2010).

OECD framework (2005) includes life plans, defending rights, interest and has specified that these skills are contextual. For instance, what is expected from the students in a democratic country in the twenty first century is the ability to analyze responsibilities of a democratic government as well as the rights and responsibilities of the citizens of a democratic government. They must understand nation wealth in its true sense, not only in terms of GDP, but in terms of its resources, including quality of human life and resource. They should be able to manage conflicts among experimental evidence and common sense and find different ways to evaluate the ways in which one can acquire reliable knowledge from media.

These approach is deeply embedded in the National Curriculum Framework of India (NCERT, 2005) and skills like commitment to democratic values, independence of thought and action, learning to learn, sensitivity to other's well being, ability to participate in democratic processes and societal changes, aesthetic appreciation and creativity, have been grouped under the construct of individual and social well being. The framework underlines the need to foster thinking skills like application, analysis, critical thinking, problem solving, reasoning and metacognitive skills like self awareness, introspection, and reflection among school students. Affective components like collaboration, motivation, interest, curiosity, joy of learning find a prominent place in the framework.

IV. Challenges of Implementation

1. What is missing in these frameworks is evidence that how do students (or people) of a specific age group demonstrate these behaviour. This poses difficulties for teachers and teaching practitioners to adapt their classroom curriculum and practices.
2. Given that the curriculum is already loaded, a major challenge is what to deprioritize and why, to enable students achieve mastery of thinking skills.
3. Beyond curricular issues, classrooms don't have capacity of 21st century learning and teaching, primarily because many of the high-stakes tests like curriculum exit examination or entrance examination to tertiary education do not assess competencies that link knowledge and understandings to real world situations. Abilities to effectively utilize various forms of mediated interaction are typically not assessed.
4. Lack of professional development is another reason 21st century skills are underemphasized in today's schooling.

The list is a mere illustration that what need to be worked. Setting right standards and assessments to improve learning can be seen as the starting point(s) for a learning culture motivated to thinking skills among its citizens.

V. Setting Standards to Support Evidence based Assessments

Standards have the ability to inform the stakeholders- what do we expect from students to know, to do and to think (i.e. content standards), and how much (i.e. performance standards. They facilitate teachers plan learning experiences, and help to decide the appropriate evidence for a learning outcome. Once standards are right, assessments provide information on

- how much of the standards have been achieved by the students and what more students can do to improve their learning
- evidence of effectiveness of teaching strategies and modification, if needed
- what parents, teachers and students can do in order to support the student improve further in these areas of learning

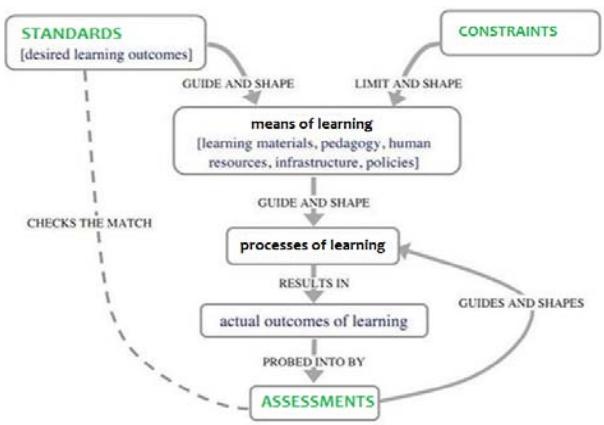

Figure 1: A Typical Learning Cycle Guided by Standards

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A system led by standards relies heavily on evidence and encourages students to monitor their own progress demonstrate what they have learnt. It can be seen in Figure 1 that evidence based learning systems have two major components – evidence based standards and evidence based assessments that work in a coordinative manner. Gathering evidence of students' learning, analyzing the evidence to generate information to estimate the current status of the student (without judgement) and help them plan and follow the developmental journey – is the fundamental premise of evidence based developmental teaching and assessment.

a) Considerations in Evidence-based Standard Setting for Thinking Skills

The main challenge in measurement of thinking skills is that several of them are demonstrated as a dynamic interaction between cognitive and non-cognitive domain. These skills have remained ignored for number of years by the educationists and educators and still assumed to be immeasurable aspect in educational assessments. Fortunately, potential exists today to produce assessments that measure thinking skills and are also reliable and comparable between students and schools—elements integral to efforts to ensure accountability and equity (Silva, 2008). But efforts to assess these skills are still in their infancy.

The standard-setting process for thinking skills will require deliberate and thoughtful integration of policies, principles, research and practices (Figure 2).

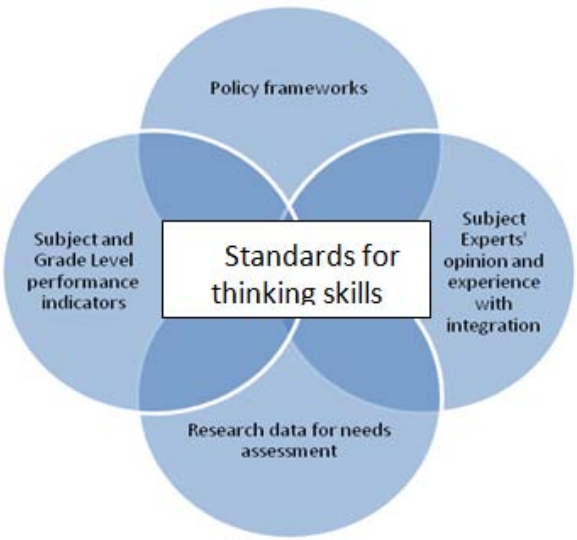

Figure 2 : Integrated Model of Evidence-based Standard Setting

The process must draw on policy claims related to performance indicators through systematic research to guide content experts. These performance indicators need to be aligned to subject specific standards at different levels. Research suggests that efforts to improve thinking are most successful if embedded in school curriculum, rather as a separate programme or project. Performance indicators for thinking skills cannot be seen in isolation.

VI. Strategies of Evidence-based teaching-Learning and Assessment

Evidence based teaching is a challenge for leaders, thinkers and educators, too. There is need to

- describe what does it mean to grow in each of the domain/criteria (content standards) more clearly so that the teachers, students and parents have a shared understanding of what they need to do to improve,
- determine the areas of proximal development on the continuum, where interventions to nurture these skills could be most effective
- develop exemplars of behaviour that students of a specific age group demonstrate
- determine the develop exemplar learning and assessment tasks

This would enhance chance of getting more consistency in the assessment of thinking skills across the schools and across the systems. It would enable and encourage students to self assess where they lie on the developmental continuum and what they need to do to move along, enabling them to own their learning. This challenging task may be achieved in following exemplar steps (that are not necessarily distinct and progressive)

Step 1: To identify and ascertain key skills, say critical thinking, innovation, creativity, decision making, communication, collaboration and empathy, on the basis of policy documents and research

Step 2: To describe and map holistic performance levels in terms of how do students demonstrate these skills vis-à-vis subject specific competencies

Step 3: To identify assessable component skills and map progression of observable behaviour against each. It is necessary that performance levels are directly observable, so that.

If Rohit and Riya have been located at second level of performance for interpretation skills, both demonstrate same level of interpretation skills most of the times.

Whether they are judged by Mrs. Sen or by Mr. Agrawal, their achievement level remains the same i.e. at the second level.

Step 4: To define the developmental continuum after validating the progression in students' behaviour.

For example, interpretation, reasoning, evaluation, analysis, decision making and empathy, the key processes required for critical thinking may be mapped as Figure 3 (Sharma, 2013).

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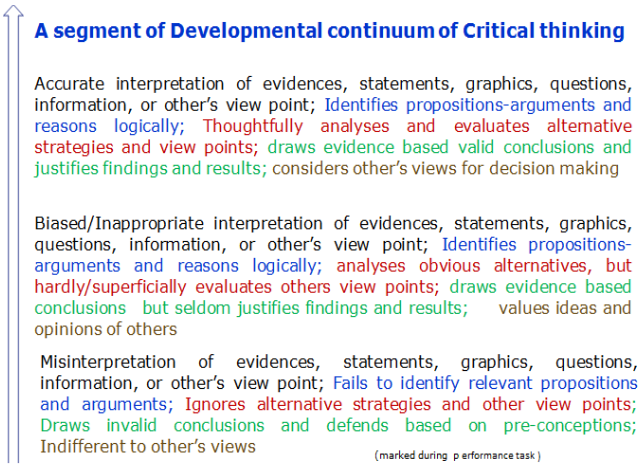

Figure 3 : A segment of developmental continuum of critical thinking

Creativity is another significant skill set that is a combination of cognitive skills and skills of affective domain, accompanied with a high degree of sociocultural context. Creative people respond to situation in an innovative and novel way and belief in their ability to generate new and meaningful ideas (Beghetto and Kauffman, 2010; Sternberg, 2010). Although creativity is a set of core skills, it entails both domain specific and domain neutral components.

Step 5: Using developmental continuum to guide classroom strategies. Such strategies provide opportunities to the teachers for

- designing **evidence-based personalized learning strategies** for the different clusters (groups) of students on the basis of their location on the developmental continuum
- gathering evidence of learning and estimating performance level through questions, projects allowing teachers' observation, problem based learning, inquiry learning, group discussions, assessment of final product or portfolios- collection of sample of evidence by the students, etc.
- engaging students in peer assessment, self assessment, review and reflection.
- reporting and monitoring students' performance and growth in a meaningful manner. Developmental continuum provides a point of reference for reporting and monitoring.

Here it is worth mentioning that

1. all students don't follow exactly the same path
2. it is not necessary that a particular student would be at second level for each of the assessment criteria
3. all students may not display all of these behaviour at any single time.

These paths represent typical pattern and individual differences need to be always respected, accommodated and adapted. Multiple observations and evidence are needed before making judgement about the performance level of a learner. Therefore, teacher expertise remains the main link (often considered as weakest link) in implementation of reforms

In nutshell, these skills are manifestations of a complex and dynamic interaction between cognitive knowledge and skills and noncognitive as well as metacognitive components of learning; and have domain specific as well as domain independent components. All these pose severe problem in measurement of these skills. Ambiguity of the constructs is another big challenge. The key to success is to design learning and assessment tasks pitched at an appropriate level of difficulty and complexity; ensure that these tasks are contextualized in real-life scenario; and, provide students with ample opportunity to demonstrate their thinking processes.

VII. Way Forward

Critical issue is not teaching students how to think, what to think, or how to think and work in group to improve output. The issue is to design a better curriculum, better teaching, and better assessments to realize the goals of education reforms, aspiring to cultivate thinking skills required for survival and success in 21st century. Efforts to create more formalized common standards would help address some of the challenges by focusing efforts in a common direction. Simultaneous improvement in curriculum and assessment would be crucial. All these in turn require a sustainable model of professional development of teachers and an enabling environment.

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