Preparing Students For PISA 2021 : Scientific Literacy

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ABSTRACT :

An Agreement has been signed on 28 Jan 2019 between India and the Organization for Economic Cooperation and Development (OECD) for India's participation in Programme for International Student Assessment (PISA) 2021. PISA is a triennial international survey (every three years) which aims to evaluate the education system worldwide by testing the skills and knowledge of 15-year-old students. Indian Government is hopeful that learnings from participation in PISA will help to introduce competency based examination reforms in the school system and to move away from rote learning. This paper examines the opportunity and challenges confronting India's decision of participation in PISA- 2021.This paper provides understanding, and encourage discussion about assessment and benchmarking done for Scientific Literacy under aegis of PISA. Central Board of Secondary Education, New Delhi has also announced a Creative and Critical Thinking (CCT) Weekly Practice Programmeto enhance critical and creative thinking and to generate curiosity in students by connecting learning with real life situations. *CCT skills are essential for students who plan to work and excel in the 21st-century workforce.* Constructivist believe that a child should be treated as a natural learner, and knowledge as the outcome of his own activity. *This paper aims to define CCT Skills in a way that would be useful for School Science teachers responsible for inculcating CCT skills in their students to enhance grades for Scientific Literacy in PISA.* The practices cum exercises presented in this paper have a theoretical basis drawn from Bloom's Taxonomy of Educational Objectives and its application in a Science Classroom.

1.Introduction

All our knowledge begins with the senses, proceeds then to the understanding, and ends with reason. There is nothing higher than reason.----Immanuel Kant (1724-1804)

Modern theory of knowledge was introduced by the famous philosopher Immanuel Kant with his 'critical system'(Kant, 1929).The above quote well justifies the power of reason in organising the Knowledge and suggests the need to recognise the child as a natural learner, and knowledge as the outcome of the child's own activity.An understanding of science and technology is central to a young person's preparedness for life in modern society driven by Paytm to Virtual Classrooms and Artificial Intelligence to Artificial organs. This understanding is need of the hour to empower individuals to participate appropriately in understanding public policy related to issues of Science and Technology.

With technological advances in recent past, Science as a discipline has undergone revolutionary changes but Teaching of Science remains largely uninspired and conservative in the classrooms. It is thus, hardly, surprising that "most students in the Junior Secondary

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and Higher Secondary grades appear to be unenthusiastic when asked to design projects for JNNSMEE (organised by NCERT) and National Children Science Congress (NCSC, organised by Department of Science and Technology), thereby undermining the value and personal relevance of their science learning. In Classrooms with average class size lying in range of 35-40 students, learning Science by doing is compromised by "rhetoric of conclusions", a collection of "facts" to be memorized, and later forgotten. Science Process Skills are either ignored or trivialized by standardized Multiple Choice Exams emphasizing content recall, and cook-book laboratory exercises. Is it fault of our teachers only? Are they incapable or struggling with some other fear?What I felt teachers are themselves trained through 18th century skills and are required to instil 21st century skills in students, So they are not able to cope up with pace of adaptation to new changes.There have been significant changes in the past decades in the field of education. Whereas earlier the teacher was at the center and the emphasis was put on what to teach, today's education involves teaching how to think, and in particular, how to be a critical thinker. Critical thinking is necessary in every profession, and it allows one to deal with reality in a reasonable and independent manner (Harpaz, 1996,1997; Lipman, 1991).Henceforth, readiness of teachers to change their style of working / teaching-learning practices in view of 21st century skills will decide the fate of creative and critical thinkers in our Classroom.

2. Critical and Creative Thinking (CCT) Skills

The complex environmental, social and economic pressures of today's technological world – requires young people to be motivated, innovative, enterprising and adaptable. The key skills that we are looking in our students as 21st century Skills are as follows:

Learning Skills	Literacy Skills	Social Skills
Critical Thinking Creativity Collaboration Communication	Information Literacy Media Literacy Technology Literacy Cultural & Civic Literacy Financial Literacy Numeracy Literacy	Flexibility Leadership Curiosity Persistence Initiative Productivity Tolerance and Objectivity Citizenship Ethical Behaviour

(CBSE, 2019)

From above, It is clear that to prepare students for lifelong learning, teaching critical thinking should be core business. However, there are four interrelated Thinking domains (based on Philosophical and Psychological approaches) as shown below :

Key Words : PISA, Creative Thinking, Critical Thinking

Types of thinking	Purposes	Thinkings Skills	Realtions between them
Critical Thinking	Evaluating the opposite states or clarity of ideas	Defining states or ideas, analyzing opposite views, evaluating evidences	Critical thinking is needed for all thinking skills.
Creative Thinking	Producing new ideas and products	Determining ideas, restructuring the problem, determining the possibilities	The newly-created product which has been produced through creative thinking is evaluated by means of critical thinking.
Making A Decision	Making an informed decision	Thinking the information, defining the alternatives and making a decision	Critical thinking is one of the basic processes necessary for making a decision
Problem Solving	Finding one or more solutions for a problem	Defining, explaining, choosing, implementing and evaluating a strategy,	While problem solving starts with a problem, critical thinking encompasses evaluation of all information, ideas and events that one comes across.

Source: Demir, (2006:43).

In pursuit of teaching students how to think, more planning is needed on behalf of teachers for their Pedagogical strategies. They need to give students repeated opportunities to :

- Ask questions in classrooms which are connected to real life to build curiosity in students.
- Facilitate discussions amongst students to build the skills of collaboration and problem solving.
- Explore solutions to problems about which there is conflicting scientific evidence.
- Practice transferring their skills and knowledge from one context to another.
- Engage parents and the community at large in student's learning process

If students can transfer skills and knowledge from one context to another in the classroom, they will certainly be able to replicate this challenge outside the boundaries of the classroom

in the real-world situations. (CBSE, 2020).

3. Nature and Structure of PISA-

India and Organization for Economic Cooperation and Development (OECD) signed agreement on 28 Jan 2019 to enable India's participation in Programme for International Students Assessment (PISA) to be held in 2021(PIB, 2019). Government is hopeful that Learnings from participation in PISA will help to introduce competency based examination reforms in the school system and will help to move away from rote learning.The Indian Plan for PISA includes :

- The CBSE and NCERT will be part of the process and activities leading to the actual test.
- Field Trial (FT) --to be conducted in April 2020;
- For FT, Schools run by Kendriya Vidyalaya Sangathan (KVS), Navodaya Vidyalaya Samiti (NVS) and schools in the UT of Chandigarh will participate.
- Total 25 schools x 36 students each = 900 students to be assessed
- PISA 2021 –official Survey will be conducted in April 2021.
- Students will be assessed across three domains: reading literacy, mathematical literacy and scientific literacy.
- Test items include each domain not merely in terms of mastery of the school curriculum, but in terms of important knowledge and skills needed in adult life. The assessment of cross-curriculum competencies is an integral part of PISA.
- Pencil and paper tests will be used, with assessments lasting a total of 2 hours for each student.
- Test items are a mixture of multiple-choice test items and questions requiring the student to construct their own responses. The items are organised in groups based on a passage setting out a real-life situation. (available @https://diksha.gov.in/get/dial /R5Z7P5 or navigate towww.cbseacademic.in)
- Test items are adapted to the local context and language, pilot tested and validated before being used for the test. OECD have agreed to contextualize the questions for Indian students.
- Participating students will complete a two-hour paper and-pen assessment.(CBSE, 2019)

4. Scientific Literacy Framework :

The PISAFramework defines Scientific Literacy as-

- Knowledge of Science - refers to the knowledge of the natural world across the major fields of physics, chemistry, biological science, earth and space science, and science-based technology.
- Knowledge about Science - refers to the knowledge of the means (scientific inquiry) and the goals (scientific explanations) of science. (Thomson et.al, 2013)

The PISA scientific literacy assessment items require students to identify scientifically oriented issues, explain phenomena scientifically, and use scientific evidence These three

competencies were chosen because of their importance to the practice of science and their connection to key cognitive abilities such as inductive and deductive reasoning, systems-based thinking, critical decision-making,transformation of information (e.g. creating tables or graphs out of raw data), and thinking in terms of models and use of science. Sample Question papers are available for reference @https://diksha.gov.in/get/dial /R5Z7P5 or navigate to www.cbseacademic.in.

Recommendations for Science Teachers :

Teaching CCT skills can be achieved easily without needing much equipment in terms of technology and physical conditions. It can be implemented by all Subject teachers having the principles and methods of it. They have to shift their traditional instructional approach to Modern Approach as given below :

Criterion	Traditional Approach	Modern Approach
Principle Learning Theory	Behaviourism	Constructivism
Student Participation	Passive	Active
Student Involvement in Outcomes	Decreased Responsibility	Increased Responsibility
Student Role	Direction Follower	Problem Solver
Teacher's Role	Director/Transmitter	Guide/Facilitator
Curriculum Goals	Product Oriented	Process Oriented
Teacher's Role	Director/Transmitter	Guide/Facilitator

(NCF, 2005; Holbrook, 2000; OECD, 2010; Hitchcook, 2018; Essay 2018)

Thus, a mental transformation is needed that will help to avoid that famous “role of teacher” who tells, who asks close-ended questions, who asks for what s/he tells, who expects quietness, good behaviour, obedience and submission, who sometimes shouts and reprimands, who knows everything and all the time. (Gurkaynak et.al., 2003)

Teachers should lead their pupils to become autonomous thinkers by teaching school subjects in a way that brings out their cognitive structure and that encourages and rewards discussion and argument. On part of students role their readiness and direct participation in teaching activities will develop their Self Evaluation Skills and will contribute to Student’s Socialisation.

Thus, Learning Cycle demands -

- It starts with the teacher introducing an engaging experience. This can be anything from a relevant YouTube video or a story to a class discussion.

- Students then explore the content through a lab experience. This exposes students to the content without specifically telling students the information.
- Next, the teacher explains the content through direct instruction. This can take the form of a Power Point Lecture or class discussion.
- Finally, the teacher can introduce an extension exercise followed by an evaluation. The evaluation may be a formative or summative assessment.

For Example , Writing Assignments in Biology to Encourage CCT Skills

Writing Exercise	Description	Critical Thinking Components
Scientific Proposal	A formal proposition of experiments to be conducted	Use of inductive reasoning to formulate hypotheses
Laboratory Report	Highlights the objectives, background information, methodology, outcomes, and conclusions of a scientific experiment	Use of inductive reasoning in formulating hypotheses; deductive reasoning to draw conclusions based upon analysis of results.
One-Minute Paper	Informal writing on any topic; may encourage students to synthesize or evaluate a particular topic .	Synthesis, evaluation, and application of information learned in class.
Position Statement	Informal or formal writing assignment where students take a particular stance on an issue; can involve the evaluation of claims related to the issue.	Construction of an argument; Evaluation of claims
Concept Map	Diagram that joins various concepts together to depict how they are interrelated .	Synthesis of information
Case Study Analysis	Concepts applied through a particular case or Scenario.	Application of information.
Problem-Based (Learning	Exercises where students are given an ill-defined problem that could have a variety of	Synthesis and evaluation of research related to the

Reflection and Solution)	solutions and must step through the process of solving the problem; students can create an informal reflection describing the processes they utilized to come up with the solution and a formal writeup of their solution.	topic; deductive reasoning to generate a solution.

(King & Ahlquist 1990;OECD,1999; Coombs, 2009; Wood, 2015)

Reaffirmation :

This paper supports the notion that critical thinking is context-dependent, can become habitual (a patterned way of thinking), and can be developed and nurtured in the disciplinary classroom. PISA is a welcome change. We need to look at PISA as an intervention that will not only make our education more relevant for current times but also make it future ready. Henceforth, Teaching in Consonance with new Evaluation system needs to be re-modelled to incorporate CCT skills.

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