ISSN: P-2455-0515
E- 2394-8450

Educreator Research Journal

OPEN ACCESS

VOLUME–IX, ISSUE– III

MAY – JUNE 2022

Original Research Article

CROSS-NATIONAL COMPARISION OF THE LEARNING OUTCOMES IN PRIMARY SCIENCE

** Rajendra B. Deshmukh & ** Dr. Mary George Varghese*

**Assistant Professor & Research Scholar, Pillai College Of Education and Research.*
*** Assistant Professor & Ph.D. Guide, Pillai College Of Education and Research.*

Abstract:

This study analyses the learning outcomes of primary science mentioned in the intended curriculum documents of USA (NGSS), Australia (ACARA), Cambridge primary program (CP) and India NCERT (CBSE). The focus of the study is the science strand-Matter and material properties. The study involves intended curriculum document analysis based on Bloom's Taxonomy and the reliability check with inter coder percentage agreement & Fleiss' Kappa. The results of this study indicate that the science content, grade placement and cognitive level of learning expectations related to selected topic vary markedly across documents. Thus, these differences in learning outcomes result in striking differences in content students learn and emphasis with respect to the cognitive domain levels.

Key words: *learning outcomes, Cross-national, Science Curriculum documents.*

Introduction:-

"It is science alone that can solve the problems of hunger and poverty, of insanitation and malnutrition, of illiteracy and obscurantism of superstition and deadening customs, of rigid traditions and blind beliefs, of vast resources going to waste of a rich country inhabited by starving millions…The future belongs to science and those who make friends with science."- Jawaharlal Nehru, 1937.

Only innovators and science- technology experts can take the country on the path of progress by generating novel useful products and increasing employment opportunities When people in communities are employed and earning sufficiently, their quality of life and standard of living not only improve, their poverty level also diminishes. Overtime, the gap between the rich and poor narrow and eliminated.

The greater influence of international education systems in India and their popularization demands comparative studies of international curricula and their strengths and weaknesses needs to be accessed. Cross-national comparisons of education systems are important, as our students are competing with students from all over the world for the available opportunities.

Review of related literature

Masoud Kabiri, 2013. The study's primary goal was to examine the projected science curriculum. The number of grades in which each topic is repeated in the curriculum is one facet of the proposed curriculum. The study shows no relationship between the students academic achievement in science and the recurrence of topics in the curriculum.

ISSN: P-2455-0515
E- 2394-8450

Educreator Research Journal

VOLUME–IX, ISSUE– III

MAY – JUNE 2022

Original Research Article

Fang Huang 2010. The People's Republic of China and the United States of America are compared in terms of elementary scientific content standards and curriculum coherence in this study. This study looks at three characteristics of curricular coherence: subject inclusion, topic duration, and curriculum structure. This research focuses on the following research questions:

1) In each country, what science knowledge is intended for primary students?
2) For how long will each topic be covered in the curriculum?
3) What is the order of these issues and how do they relate to one another?
4) Finally, what does this mean for the construction of primary science curricula?

Cai & Chen 2009. This study examines learning expectations for grades 1–8 algebra in a number of U.S. states as well as high-performing TIMSS Asian countries and areas such as Singapore, Taiwan, and Japan. Only one issue inside the strand is thoroughly described in order to narrow and focus the inquiry. The findings of this study, based on official curriculum documents, show that the mathematics content, grade placement, and cognitive level of learning requirements associated to a certain topic differ significantly between publications.

Graham & Sainsbury 2008. According to the researchers' analysis of the curriculum materials, only one country (Chinese Taipei) expected more in the area of "Materials and their Properties," whereas three countries did so in the area of "Physical Processes" (Chinese Taipei, Latvia and Ontario).

Based on the above review the research expects to find the focus of the selected curriculum documents using the Blooms taxonomy of action verbs through document analysis with respect to a selected topic i. e. Matter and Material properties.

Research question

To what extent are learning expectations associated with the Science strand- Matter and Material properties similar or different in emphasis with respect to cognitive domain levels and grade placement in USA (Next Generation Science Standards), Australia (ACARA), Cambridge primary program (CP) and India NCERT (CBSE) as described in their official science curriculum documents?

Documents:

The intended curriculum documents analysed in the study are as follows:

USA NGSS:-DCI Arrangements of the Next Generation Science Standards (NGSS) [2017]
CP:-Cambridge Primary (CP) Science Curriculum Framework (with codes) [2013]
ACARA:- Australian Curriculum, Assessment and Reporting Authority (ACARA):-The Australian Curriculum [2016]
CBSE:- [National Council of Educational Research and Training (NCERT)] / Central Board of Secondary Education (CBSE):- Learning outcomes at Elementary Stage [2017]

Table-1 Curriculum Documents

ISSN: P-2455-0515
E- 2394-8450

Educreator Research Journal

VOLUME–IX, ISSUE– III

OPEN ACCESS

MAY – JUNE 2022

Original Research Article

Research Methodology

The document analysis of the intended sciences curricula of the selected countries/Boards tracked following steps.

1. Grouping learning outcomes of science and content strand (Matter and Material Properties) as per grade.
2. Ascertaining the cognitive domain level of each learning expectations as per the Bloom's Taxanomy Action Verbs. Four research Scholars (Coders) assigned Level to each learning expectation based on the document-Bloom's Taxonomy of Measurable Verbs made available by **Utica College, Central New York as follows:**

Cognitive Domain	Level
Knowledge	1
Comprehension	2
Application	3
Analysis	4
Synthesis	5
Evaluation	6

Table-2 Cognitive Domain levels as per Bloom's Taxonomy of measurable verbs

A sample of how learning expectations were coded and assigned cognitive domain level as per the above tool is given below:

Learning Expectation (LE)	Curriculum	Grade	Action	Cognitive domain level
Construct an argument with evidence that some changes caused by heating or cooling can be reversed and some cannot.	USA(NGSS)	1	Construct	5
exploring different ways to produce sound using familiar objects and actions such as striking, blowing, scraping and shaking	ACARA	2	Exploring	4
Know that condensation occurs when a gas turns into a liquid and that it is the reverse of evaporation.	CP	3	Know	1
groups objects, materials, activities for features/properties such as shape, taste, colour , texture, sound, traits etc.	CBSE/NCERT	5	Group	4

Table 3 A sample of how learning expectations coded

ISSN: P-2455-0515
E- 2394-8450

Educreator Research Journal

VOLUME–IX, ISSUE– III

MAY – JUNE 2022

Original Research Article

3. This study used two measures of reliability: (1) percent agreement between coders, and (2) Fleiss' kappa to ensure inter coder reliability.

Average Pairwise Percent Agreement

Average pairwise percent agr.	Pairwise pct. agr. cols 1 & 4	Pairwise pct. agr. cols 1 & 3	Pairwise pct. agr. cols 1 & 2	Pairwise pct. agr. cols 2 & 4	Pairwise pct. agr. cols 2 & 3	Pairwise pct. agr. cols 3 & 4
86.364%	86.364%	86.364%	90.909%	86.364%	86.364%	81.818%

Fleiss' Kappa

Fleiss' Kappa	Observed Agreement	Expected Agreement
0.833	0.864	0.185

Table-4 Average pairwise percent agreement and Fleiss'kappa

The average pairwise percent agreement in this study is 86.364%, which is between 0.81–1.00 and considered as almost perfect agreement. The Fleiss' kappa value is 0.833, which is between 0.8-1.0 and considered as almost perfect agreement.

4. Tabulating the number and percent distribution as per the cognitive domain level of learning expectations in each curriculum document. The number and percent distribution of Les in science subject and the focus of study strand Matter and Material properties is given below.

Table 5 Number and percent distribution of learning expectations in science

Curriculum	*learning expectations in science, grades 1-5	LEs in Matter and Material Properties strand	LEs in other science strands
USA(NGSS)	65	29 (44.62%)	36 (55.38%)
CP	104	57 (54.81%)	47 (45.19%)
ACARA	128	39 (30.47%)	89 (69.53%)
CBSE/NCERT	43	7 (16.28%)	36 (83.72%)

* Excluding scientific enquiry

ISSN: P-2455-0515
E- 2394-8450

Educreator Research Journal

VOLUME–IX, ISSUE– III

OPEN ACCESS

MAY – JUNE 2022

Original Research Article

Analysis of the learning expectations related to the selected topic

The intended curriculum documents of various boards vary greatly with respect to grouping of the LEs. The strand organization in the curriculum documents involved in the study is as follows:

Curriculum	Grades	Strand organization
USA (NGSS)	1 & 4	Waves and their Applications in Technologies for Information Transfer
	1,3,4 & 5	From Molecules to Organisms: Structures and Processe
	1 & 3	Heredity: Inheritance and Variation of Trait
	1,2,4 & 5	Earth's Place in the Universe
	2 & 5	Matter and its Interactions
	2,3 & 5	Ecosystems: Interactions, Energy, and Dynamics
	2 & 3	Biological Evolution: Unity and Diversity
	2,3,4 & 5	Earth's Systems
	2 & 5	Engineering Design
	3 & 5	Motion and Stability: Forces and Interactions
	3,4 & 5	Earth and Human Activity
	4 & 5	Energy
CP	1 to 5	Four content areas: Scientific enquiry, Biology, Chemistry and Physics. Scientific enquiry is about considering ideas, evaluating evidence, planning investigative work and recording and analysing data. The Scientific enquiry objectives underpin Biology, Chemistry and Physics, which are focused on developing confidence and interest in scientific knowledge.
ACARA	1 to 5	Science Understanding: Biological sciences, Chemical sciences, Earth and space sciences, Physical sciences Science as a Human Endeavour: Nature and development of science, Use and influence of science Science inquiry skills: Questioning and predicting, Planning and conducting, Processing and analysing data and information, Evaluating, Communicating
CBSE/NCERT	3 to 5	Curricular Expectations as per of EVS curriculum includes Suggested Pedagogical Processes and Learning Outcomes

Table-6 Summary of strand-Matter and Material Properties organisation in the curriculum documents

Table 7 Summary of strand-Matter and Material Properties organization in curriculum standards in this study

Country/Board	Year	G1	G2	G3	G4	G5
USA(NGSS)	2017	✓	✓	✓	✓	✓
CP	2013	✓	✓	✓	✓	✓
ACARA	2016	✓	✓	✓	✓	✓
CBSE/NCERT*	2017			✓	✓	✓

*NCERT specifies Learning outcomes under the subject EVS and are available for grade 3-5 only while all other documents in the study mentions LEs from grade 1-5 in the strand-Matter and Material Properties.

ISSN: P-2455-0515
E- 2394-8450

Educreator Research Journal

VOLUME–IX, ISSUE– III

OPEN ACCESS

MAY – JUNE 2022

Original Research Article

Summary of emphasis on the strand Matter and Material Properties is as follows:

G5	5	14	10	3
G4	7	13	9	2
G3	4	14	7	2
G2	9	7	8	0
G1	4	9	5	0
	USA(NGSS)	CP	ACARA	CBSE/NCERT

Table-8 Number and grade placement of learning expectations related to the Matter and Material Properties strand within science Note: The number indicates the number of learning expectations.

NCERT gives 2-3 LEs from Grade 3-5 while all other curriculum have a fair number of LEs for each grade i.e. 1-5.

Weight of topic within the Matter and Material Properties strand

LEs	USA(NGSS)	CP	ACARA	CBSE/NCERT
Number of LEs	29	57	39	7
Percent of toatal Science LEs	45%	55%	30%	16%

Table-9 Weight of topic within the Matter and Material Properties strand

Cambridge Primary gives maximum emphasis (55%) to Matter and material Properties strand compared to the other curriculums while NCERT only (16%).

Cognitive level of learning expectations related to the Matter and Material Properties strand

Table 10 Number and distribution of level in cognitive domain for LEs related to the Matter and Material Properties

Curriculum	No. of LEs	Level-1 (Knowledge)	Level-2 (Comprehension)	Level-3 (Application)	Level-4 (Analysis)	Level-5 (Synthesis)	Level-6 (Evaluation)
USA (NGSS)	29	0%	0%	7%	31%	45%	17%
CP	57	19%	21%	4%	46%	5%	5%
ACARA	39	10%	23%	8%	54%	3%	3%
CBSE/ NCERT	7	0%	0%	14%	29%	0%	57%

Cambridge Primary and Australian curriculum (ACARA) documents mentions LEs emphasising all six levels of cognitive domains as per the Bloom's Taxonomy but USA(NGSS) and NCERT curriculum documents does not mention LEs related to Knowledge and comprehension and their focus is Level 3 to 6 as evident from the above table.

Conclusion

Statements that outline the subject content for specific grades are typical in science curriculum frameworks. These statements can be used to explain the characteristics of a science programme and to assess its quality. That

ISSN: P-2455-0515
E- 2394-8450

Educreator Research Journal

VOLUME–IX, ISSUE– III

MAY – JUNE 2022

Original Research Article

is, these assertions are meant to serve as a set of guidelines for the construction and assessment of Science curricula. They reflect the content's scope and highlight specific themes for students to understand at all levels. Based on the analysis of the set of LEs associated with this topic, some content similarities and differences are evident across the different documents. More specifically, this examination reveals that the Cambridge Primary document has exceptional high weights in the selected topic than ACARA, USA (NGSS) and NCERT. Meanwhile, most LEs related to the topic are categorized into the Level 4 i.e. analysis. It is also clear from Table 10 that the Cambridge Primary curriculum framework emphasizes the Matter and Material Properties strand (LEs-57) within science subject from grade 1-5. In general, depending on the topic chosen, curriculum documents vary with respect to the strengths and weaknesses. T he findings of this study will shed light on the learning expectations outlined in the analysed official curriculum papers. Understanding how much attention is paid to a certain topic in the intended curriculum may help to establish the context for variances in students' learning opportunities. The impact of curriculum papers on instructors' practise could be the subject of future research.

References:

Chen, J.-C., & Hsieh, C.-J. (2008). *Comparison of the learning expectations for school mathematics across several Asian countries and U.S. states*. Paper presented at the The 3th IEA International Research Conference (IRC 2008).

Houang, R. T., Schmidt, W. H., & Cogan, L. (2004). *Curriculum and learning gains in mathematics: A cross-country analysis using TIMSS*. Paper presented at the The First IEA International Research Conference (IRC 2004).

Martin, M. O., Mullis, I. V. S., Foy, P., & Olson, J. F. (2008). *TIMSS 2007: International science report: findings from IEA's trends in international mathematics and science study at the fourth and eighth Grades*. Lynch School of Education,

http://www.mayarschools.com/userfiles/2017/12/pages/Science%20Primary%20Framework_940181559_335_1000564366.pdf

https://ncert.nic.in/pdf/syllabus/Preliams.pdf

https://www.utica.edu/academic/Assessment/new/Blooms%20Taxonomy%20-%20Best.pdf

https://files.eric.ed.gov/fulltext/ED504951.pdf

http://dfreelon.org/utils/recalfront/recal3/

https://www.researchgate.net/profile/Tiia_Ruutmann/publication/308815971

Cite This Article:

**** Rajendra B. Deshmukh & ** Dr. Mary George Varghese, (2022).*** *Cross-national comparison of the learning outcomes in primary scienc,* ***Educreator Research Journal****, Volume–IX, Issue– III, May – June 2022, 227-233.*