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Analysis of Multiple Intelligence in the Activities of Eighth-grade Science Textbooks

Abstract

NCERT publishes textbooks for classes I to XII in three different languages (Hindi, English and Urdu) based on the national curriculum framework. It addresses the diversity of the country and the needs of rural children. NCERT textbooks are widely followed in the country which makes it even more necessary to analyze the activities. In the year 1983, Howard Gardner published a book 'Frames of Mind' which challenged the traditional concept of intelligence as unitary and stated the diverse nature of intelligence. MI has an important role in education and textbooks are the representatives of the curriculum to be taught. This study intends to examine how much the rationalised content of the eighth-grade NCERT science textbook for the year 2023-24 incorporates the eight forms of intelligence proposed by Howard Gardner in his theory of Multiple Intelligence. Content analysis was adopted as the methodology for the study. A checklist was prepared by the researcher. An uneven distribution of multiple intelligences was found in the activities given in the rationalised content of the textbook. Most of the activities were experiential. The findings of the study revealed that most of the activities were based on logical intelligence (24.8%), followed by bodily kinesthetic intelligence (22.6%), verbal intelligence (15.6%), naturalist intelligence (6.3%), intrapersonal intelligence (2.4%) and musical intelligence (1.9%).

Keywords: *Content analysis, NCERT science textbook, Individual difference, Learning strategies, Multiple intelligence*

Introduction

Textbooks are an important part of teaching-learning process and it dominates the classroom practices in almost every school (NCERT, 2006). Teachers rely on textbooks and have a tendency of following the content from beginning to end (Sheldon, 1988) which further enhances the vitality of textbooks in the educational process. It is through textbooks that curriculum objectives are conveyed to students by teachers (Estaji & Nafisi, 2014). The textbook collects all the information that a learner at a particular stage is supposed to acquire. It also offers a systematic foundation for research, as well as exciting lines of inquiry that may be explored and extended across subjects (Issitt, 2004). The curriculum is largely reflected in the textbooks to address different learning needs of students (Botelho, 2003). It gives a formal outline of contents to be studied in the course and is used as a resource for both the student and the teacher giving an imperative reference (Sharma, 2017). The educational aims can be achieved only when a good quality textbook is used (Majeed & Wani, 2018).

NCERT publishes textbooks for classes 1 to 12 in Hindi, English and Urdu languages according to the national curriculum framework. It addresses the diversity among the students and the needs of rural children. The topics are organized and presented focusing more on the processes of learning with activities to enable learners to do and discover (Why NCERT textbooks matter, 2021). NCERT textbooks are widely followed in the country which makes it even more necessary to analyze the activities. The NCERT textbook is made in an effort to lighten the load of the curriculum by placing more emphasis on and providing space for opportunities for introspection, small-group discussion, and practical experience (NCERT, 2007). The NCERT textbook contains an ample number of activities designed after meticulous planning by curriculum developers. The activities in NCERT eighth grade Science textbook are analysed in this paper to understand the extent of representation of the eight types of intelligence propounded by Howard Gardner in his theory of Multiple Intelligence.

Multiple Intelligence Theory

In the year 1983, Gardner published a book 'Frames of Mind' which challenged the traditional concept of intelligence as unitary and stated the pluralistic nature of the concept of intelligence. According to Gardner, intelligence

is the biological mental capacity to process information that may be applied in a social context to address problems or create objects that are valued in a society (Gardner, 1999, p.33). This theory was developed after years of research on human cognition and contrasting views of intelligence as a single entity (Armstrong, 2017). Every individual is unique and has various ways of learning which can be catered to by the application of this theory. Gardner agreed to the way that the aptitudes of every individual are not comparable and the possibility of their mix is exceptional (Gardner, 2006). Many studies showed this theory's effectiveness in the learning process (Sreeraj, 2015; Vartak, 2012; Chaudhari, 2012; Kentab, 2016). Implementing MI theory as a teaching approach can reach and benefit many students (Bas, 2016). Classroom transactions using MI theory have a positive linkage in the development of human minds (Taase, 2012).

The multiple intelligence that was identified by Gardner includes verbal intelligence which is the capacity to use language and words. Logical or mathematical intelligence is the ability to use numbers, inductive and deductive reasoning and the ability to spot abstract patterns. Visual or spatial intelligence is the capacity to visualize and use images and pictures. Bodily or Kinesthetic intelligence is the ability to use body and direct physical motion. Musical or rhythmic intelligence is the capacity to distinguish between different tonal patterns, sounds, and rhythms. Interpersonal intelligence is the ability to interact and form relationships with other people. Intrapersonal intelligence is the ability to know the self, inward experiences, introspection, and awareness.

Multiple intelligence and textbooks

MI theory has been adopted in the educational process of schools (Botelho, 2003). If multiple intelligence is considered while planning an activity then the learner's comprehension and retention of the content will be long term. Alsalhi (2020) researched the integration of MI into the school science textbook contents. The researcher further revealed that all eight types of intelligence were represented in the textbooks with some types of intelligence dominating it. In the content analysis of four young learners textbooks by Estaji and Nafisi, (2014) in Iran, it was found that verbal/ linguistic intelligence predominates the activities and naturalist intelligence is least represented.

Content analysis of textbooks in several countries was conducted to study the representation of MI. Most of them were done in English textbooks and very

limited work was done in the science subject. MI has an important role in education and textbooks represent the curriculum to be taught. Thus, this research was conducted to investigate the representation of multiple intelligences in the activities depicted in the rationalised content of the eighth-grade NCERT science textbook for the year 2023-24. Only the first 13 chapters were selected for this study as it was the rationalised content for the year 2023-24, hence were used for content analysis in this study.

Research Methodology

The research was conducted to study the extent of representation of multiple intelligence propounded by Gardner in the activities of the rationalised content of eighth-grade NCERT science textbook for the year 2023-24. Content analysis was adopted as the methodology. The activities given were analyzed for illustration of any kind of multiple intelligence. Two kinds of activities were given in each chapter. One activity was within the lesson and another one was given as extended activities by the end of every chapter. Both types of activities were considered and evaluated for the representation of multiple intelligences. A checklist was prepared by the researcher after reviewing the previous works of Alsahi (2020), Armstrong (2017), Botelho (2003), Estaji and Nafisi, (2014). The eight types of intelligence were considered for the study, excluding existential intelligence. Possible activities were identified and categorized as per the different intelligences suggested by Gardner. The tool was given to experts for validation and the reliability was calculated by comparing the work of two raters using the Cohen Kappa's method, which was 0.91. The activities given in the textbook were first identified and categorized in a Microsoft Excel sheet. Altogether, there were 13 chapters in the revised content of the NCERT science textbook for the year 2023-24. About 144 activities were found in this chapters.

Data analysis

The investigator conducted a thorough analysis of the activities. In the present study, activities were analyzed based on the checklist prepared according to the eight multiple intelligence. Most of the activities were experiential in nature. There were activities showing only one type of intelligence for eg.

i). "Try to observe eggs of the following organisms...Make drawings of the eggs that you have observed".

This activity's primary goal was to study and sketch the egg, which represents spatial intelligence. Thus, it was determined that this specific task exemplified spatial intelligence.

ii). "*Visit a doctor. Find out why antibiotics should not be overused. Prepare a short report."*

In this activity, the student had to visit a doctor and prepare a report on it that depicts two types of intelligence: interpersonal and verbal. After identifying the intelligence, the frequency and percentage were calculated based on the number of times a particular intelligence was found in an activity. Similarly, all the 144 activities were analysed and the findings of the study are presented in the next section chapter-wise.

Result and Findings

The findings of the analysis are presented chapter-wise in the following section. Table 1 represents the chapters of the rationalised content in eighth grade science textbook published by NCERT for the year 2023-24.

Table 1 – List of the rationalised chapters from the NCERT class 8 Science textbook for the year 2023-2024.

Sr No.	Name of the chapters	No. of Activity
1.	Crop Production and Management	7
2.	Microorganisms: Friend And Foe	9
3.	Synthetic Fibres and Plastics	5
4.	Materials: Metals and Non-Metals	10
5.	Coal and Petroleum	14
6.	Combustion and Flame	7
7.	Conservation of Plants and Animals	16
8.	Cell — Structure and Functions	14
9.	Reproduction in Animals	8
10	Reaching the Age of Adolescence	17
11	Force and Pressure	13
12	Friction	10
13	Sound	14
	Total	144

In Chapter 1, a total number of 7 activities were given which were all hands-on activities. The activities which required only writing for eg: activity 1.3 *"Make the following Table in your note book and complete it"* was considered to represent only verbal intelligence. The activity involves only writing, specifically describing food and its source. Similarly, all the activities were analysed in the chapter based on the checklist prepared, and it was found that most of the activities were based on verbal intelligence, followed by bodily kinesthetic and naturalist intelligence. The activities in the chapter had the most miniature representation of spatial and intrapersonal intelligence, with no representation of musical and interpersonal intelligence.

Chapter 2 had a total of 9 activities. After the analysis, it was found that most of the activities were based on logical intelligence, followed by spatial intelligence, Verbal intelligence, and bodily kinesthetic intelligence. Furthermore, it was found that no activities in the chapter were based on musical and intrapersonal intelligence.

In chapter 3, a total of 5 activities were given. The activities were analysed based on the checklist prepared. For example, the activity 3.2 "*Take two cloth pieces of the same size, roughly half a metre square each. One of these should be from natural fibre. The other could be synthetic fibre. You can take help of your parents in selecting these pieces. Soak the pieces in different mugs each containing the same amount of water. Take the pieces out of the containers after five minutes and spread them in the sun for a few minutes. Compare the volume of the water remaining in each container"* represented logical, kinesthetic and interpersonal intelligences. Similarly, all the other activities were analysed and it was found that most of the activities were based on logical intelligence, followed by spatial and interpersonal intelligence, verbal and kinesthetic intelligence. No activities in the chapter were found to depict naturalist, musical and interpersonal intelligence.

10 activities were given in chapter 4. The analysis shows that majority of the activities depicted logical intelligence, followed by spatial, bodily kinesthetic and verbal intelligence. Interpersonal intelligence had the least representation, with no mention of musical, intrapersonal, and naturalist intelligence.

Chapter 5 had a total of 14 activities. All the other activities were analysed and it was found that most of the activities depicted naturalist and verbal

intelligence followed by intrapersonal intelligence. The activities in the chapter had the least representation of kinesthetic and logical intelligence, with no representation of musical intelligence.

7 activities were given in chapter 6. The activities were analysed and it was found that most of the activities were based on spatial intelligence, followed by verbal, bodily kinesthetic and naturalist intelligence. The activities had the least representations of logical and interpersonal intelligence. No representation of musical and intrapersonal intelligence was found.

Chapter 7 had a total of 16 activities. All the other activities were analysed and it was found that most of the activities had the maximum representations of logical and verbal intelligence followed by interpersonal intelligence. Furthermore, it was found that intrapersonal intelligence had the least representations and none of the activities were based on musical and naturalist intelligence.

In chapter 8, a total of 14 activities were given. All the other activities were analysed and it was found that most of the activities were based on logical and bodily kinesthetic intelligence, followed by spatial intelligence. The activities had the least representation of interpersonal and intrapersonal intelligence, with no representation of musical and naturalist intelligence.

8 activities were given in chapter 9. It was found that the activities were mainly based on bodily kinesthetic intelligence, followed by logical and verbal intelligence. The activities had the least representation of spatial intelligence. Additionally, it was found that none of the activities were based on musical, interpersonal and naturalist intelligence.

There were 17 activities in chapter 10. The analysis found that most of the activities were based on bodily kinesthetic intelligence, followed by logical and spatial intelligence. The activities had the least representation of verbal intelligence with no representation of spatial, naturalist and intrapersonal intelligence.

In chapter 11, a total of 13 activities were given. The analysis found that most of the activities were based on logical intelligence, followed by bodily kinesthetic. The activities had the least representation of interpersonal intelligence. Furthermore, it was found that none of the activities were based on spatial, musical, naturalist and intrapersonal intelligence.

Chapter 12 had a total of 10 activities. After analysing all the activities in the chapter, it was found that majority of the activities were based on logical and bodily kinesthetic intelligence, followed by verbal intelligence. Spatial intelligence had the least representations, while musical, naturalist and intrapersonal intelligence had no representation in the chapter.

14 activities were given in chapter 13. The activities were analysed and it was found that majority of the activities were based on bodily kinesthetic and logical intelligence followed by spatial intelligence and verbal intelligence. None of the activities were found to represent naturalist, musical and intrapersonal intelligence.

Table 2 – Chapter-wise representation of multiple intelligences in the science activities.

Chapter	Verbal/ Word Smart	Logical/ Number Smart	Spatial/ Picture Smart	Kinesthetic/ Body Smart	Musical/ Music Smart	Interpersonal /People Smart	Intrapersonal / Self-Smart	Naturalist / Nature Smart
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1.	4	2	1	3	0	0	1	3
2	2	4	3	2	0	1	0	1
3	1	4	2	1	0	2	0	0
4	1	8	5	4	0	1	0	0
5	9	0	2	1	0	3	2	10
6	4	3	5	3	0	2	0	1
7	7	6	3	0	0	5	1	0
8	4	14	7	13	0	1	3	0
9	4	5	4	6	0	0	3	0
10	4	13	2	11	8	6	0	0
11	7	10	2	8	0	1	0	0
12	8	7	3	7	0	3	0	0
13	4	6	6	6	0	4	0	0
Total	59 15.6%	82 24.8%	45 14.9%	65 22.6%	8 1.9%	29 11.5%	10 2.4%	15 6.3%

Table 2 indicates the number of representations of the eight multiple intelligences given by Gardner in the analysis of the activities chapter-wise. Based on the number of times, it was depicted in an activity, the percentage was calculated and given in the table. The overall analysis shows that logical intelligence was found to appear the most in the activities (24.8%) followed by bodily kinesthetic intelligence (22.6%), verbal intelligence (15.6%), spatial intelligence (14.9%), interpersonal intelligence (11.5%), naturalist intelligence (6.3%), and

intrapersonal intelligence (2.4%). Furthermore, it was also found that the activities had the least representation of musical intelligence (1.9%).

Discussion

The study found that all types of intelligence were represented in the activities given in the rationalised content of the NCERT class eight Science textbook for the year 2023-24. However, they were not given equal representation in the content of the textbook activity. Analysis of science activities from textbooks found that the majority of the activities were experiential and each chapter provided an ample number of activities to enhance learning by doing and for students to connect to real-life situations. The total number of activities analyzed was 144 from 13 chapters.

The study found maximum representations of logical intelligence (24.8%) in the activities which may be due to the reason that science activities mostly comprise of applying logic and reasoning, enhancing the thinking skills of the learners. This finding however contradicted the result of Alsalhi (2020) where verbal intelligence (38.8 %) pre-dominated the textbook analysis of the VII grade science textbook of Jordan. This discrepancy could be due to the contextual differences in designing the curriculum. The NCERT textbooks are designed based on the NCF 2005, which envisage inquiry-based learning in science focusing more on reasoning and problem-solving skills. The Indian textbook developers might have considered the recommendations of NCF 2005 while framing the activities of the science textbook; hence, the representation of logical intelligence is found in the maximum number.

Bodily kinesthetic intelligence (22.6%) and verbal intelligence (15.6%) were the second and third most represented intelligence in the study. This may be because science activities encourage the learners to actively participate in the activities done whether at home or in the classroom. The representation of naturalist intelligence (6.3%), intrapersonal intelligence (2.4%) and musical intelligence (1.9%) were found to be very small. Taase (2012) revealed a very low ratio of interpersonal and intrapersonal intelligence while kinesthetic, musical and naturalist intelligence was not found in any percentage in his study on analysis of MI in textbooks of Iranian educational system. Alsahi(2020) also revealed a very small representation of interpersonal intelligence, intrapersonal intelligence, kinesthetic intelligence, naturalist intelligence, and musical intelligence in the science textbook analysis of Jordanian schools.

From the findings, an uneven distribution of MI in the rationalised content of NCERT eighth-grade science textbook for the year 2023-24 is evident. Most of the activities represented logical intelligence. This finding is quite relevant as science activities are mostly hands-on experiential based as recommended by the NCF 2005. Another reason could be the influence of sociocultural context on Indian education. For example, the ability to recall and reproduce knowledge accurately is often considered as being intelligent and an academic achievement in Indian society. This cultural preference may have shaped the emphasis on logical-mathematical intelligence in the textbooks, while other forms of intelligence received comparatively less representation in the activities.

Conclusion

The research was undertaken to evaluate MI in the eighth-grade science textbook. The findings revealed an uneven distribution of MI in the activities. Furthermore, most of the activities were found to be experiential. Logical intelligence (24.8%), bodily kinesthetic intelligence (22.6%) and verbal intelligence (15.6%) were the most represented intelligence while naturalist intelligence (6.3%), intrapersonal intelligence (2.4%) and musical intelligence (1.9%) were found in small numbers. Studies show the effectiveness of using multiple intelligence strategies in teaching learning process. It is suggested that activities based on MIT be considered while designing the activities for school children for quality learning and all-round development of learners. The concept of individual differences should be emphasized in designing activities. Education should shift from "one size fits all" notion and the learners should be taught the way they learn. Their strengths should be identified and learning strategies should be developed based on their strength.

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