DOI: https://doi.org/10.52131/pjhss.2022.1001.0172

Pakistan Journal of Humanities and Social Sciences

Volume 10, Number 1, 2022, Pages 43–49
Journal Homepage:
https://journals.internationalrasd.org/index.php/pjhss

Conceptual Difficulties of Elementary School Students in the Subject of General Science

Muzammila Akram[1], Shazia Aziz[2], Jam Muhammad Zafar[3], Muhammad Asghar[4]

[1] Assistant Professor, Department of Educational Training, The Islamia University of Bahawalpur, Pakistan. Email: muzammila.akram@iub.edu.pk
[2] Ph.D. Scholar, Department of Educational Training, The Islamia University of Bahawalpur, Pakistan. Email: shaziaazizchishtilhr@gmail.com
[3] Assistant Professor, Department of Humanities and Social Sciences Khwaja Fareed University of Engineering and Information Technology, Rahim Yar Khan, Pakistan. Email: dr.zafar@kfueit.edu.pk
[4] M.Phil. Scholar, Department of Educational Training, The Islamia University of Bahawalpur, Pakistan.

ARTICLE INFO

Article History:
Received: December 06, 2021
Revised: January 23, 2022
Accepted: January 25, 2022
Available Online: January 26, 2022

Keywords:
Conceptual Difficulties
Elementary School Students
Table of Specification
Bloom Taxonomy
Cognitive domain

ABSTRACT

Education is considered as the backbone to boost the development process of the country. From this perspective, the discipline of science is considered a competitive tool to develop a scientific outlook and to increase scientific literacy in students. The basic motivation behind this current study is to examine the conceptual difficulties of elementary school students in the subject of general science. The objectives of the study were to explore the conceptual difficulties of elementary students in the learning of general science and to find out the most difficult concepts of general science at the elementary level of education. The current research was descriptive in nature. Data was collected through concept based test to diagnose the conceptual difficulty of elementary school students in the subject of general science. A diagnostic test was made keeping in view the objectives of the study. For the development of the test, general science Text 1 Book for 8th class published 1by 1Punjab 1Text 1Book 1Board 1Lahore, edition 2020 was consulted. A table of the specification was prepared and delimited to only the first three levels of the cognitive domain of Bloom's taxonomy. The final results illuminated that 78% of items were difficult including chemistry-based concepts consisting of chemical reaction, properties of acids, and physics-based concepts including thermal contradiction, expansion properties of Liquids, working of Iris, Radiation, ozone depletion, air pollutants were considered most difficult concepts to understand by elementary students.

Corresponding Author's Email: muzammila.akram@iub.edu.pk

1. Introduction

In the 21st century, Science has been considered an important subject at all levels of education and understanding basic science concepts increases the content knowledge of the students. Science is the systematic study of the structure and behavior of the physical, social, and natural worlds through observation and experimentation. The study of science is considered as a key to innovation, global competitiveness, and human advancement. As highlighted by Shafer et al. (2015) that science should be much more than the rote memorization of theories, formulas, and vocabulary. It is the scientific study that assists in problem-solving and understanding the function and nature of phenomenon logically. Sometimes it is defined as the practical work and hands-on activities that allow individuals to obtain a clear understanding. Children have an innate curiosity about the natural world means that teaching science to secondary school students is both rewarding and critical for their futures (Kersting, Steier, & Venville, 2021). Science education aims at introducing main ideas and principles of science to all learners for the training of future scientists that calls for teachers with specific qualifications (Van Driel & Abell, 2010). The subject of general science is

eISSN: 2415-007X

taught as a compulsory subject at the elementary level in Pakistan. The basic purpose behind the teaching of general science is to make students familiar with the natural and physical world. Teaching and learning of general science engage learners in the practice of science and enable them to apply their knowledge in practical situations. It encourages critical thinking rather than cramming the information. The subject of general science is considered the most demanding subject at the elementary level. But unfortunately, education in general science is facing various challenges at the elementary level in Pakistan. These particular challenges cannot be overcome only by highlighting the importance of teaching general science however it also requires a broad action plan to evaluate the conceptual knowledge of learners that they acquire at elementary schools. For the past few years, students are facing difficulties to understand some basic science concepts.

Conceptual difficulty can be defined as a problem or difficulty to relate and forming of concepts. According to Duit (2007) learners hesitate to respond to those questions that they found difficult. Conceptual difficulties of general science students have become the major concern of science instructors (Özmen, 2004). Several researches have been done in the field of science education. Most of these studies highlighted that most of the students at the elementary level are facing conceptual difficulties in the subject of general science. The results of these studies showed that students come to class with their own experience or with their preconceived notions. These preconceived notions create conceptual difficulties of general concepts of science in students (Brown & Clement, 1989). On the other hand, it is observed that at the elementary level, students have a non-scientific attitude as they learned from mythical resources rather than scientific methods and they faced learning difficulties in science (Fetherstonhaugh & Treagust, 1992).

Generally, it is assumed that conceptual difficulties arise when the scientific instructions are taught to students in a dry manner or also when teachers faced difficulties to understand some basic concepts of science and it does not encourage them to challenge paradoxes and conflicts based on their own perceived notions and non-scientific opinions. To cope with their confusion sometimes, students made faulty assumptions, and these assumptions are so pathetic that made students insecure about the concepts. It is also observed that sometimes students become confused about the words that have different meanings in different contexts and also factual misconceptions often learned at early stages of education and retained unchanged till the higher level of education (National Research Council, 1997).

Therefore, conceptual difficulties have harmful nature that creates hurdles in students' learning. It also prevents students to observe scientific truths and over time conceptual difficulties turn into a permanent part of students' thinking or become a part of their knowledge. These conceptual difficulties stop students to learn new concepts taught by the instructor and it increases confusion in students. As indicated by Nussbaum and Novick (1982) students' conceptual difficulties could interfere with the learning process, making it very difficult for students to learn new information because conceptual difficulties gave incorrect interpretations for new concepts.

Because of the rapid development and enhancement, Science, technology, engineering, and math (STEM) have become the major concern of societies. Every nation is putting efforts to train its young generation to be more skilled and creative. This puts more pressure on teachers to focus more and work harder towards the enhancement of "S" in Stem (Morrison, Bartlett, & Raymond, 2009). Science Education is a term that refers to the teaching and learning process of science subjects at all levels in the educational institution. At the elementary level, science education in various countries has several difficulties. These problems can't be solved only by teaching science techniques. However, assessing conceptual knowledge of science that science students learn in elementary school demands a complete effort (Lamanauskas, 2007). Science education suffers from several weaknesses in Pakistan. One of the important problems is students' conceptual difficulties. Students' conceptual difficulties in the subject of general science have become a major area of interest of educational administration and teachers (Kashif, Shehzadi, & Arshad, 2020). From this frame of reference, the researcher conducted a research study on the conceptual difficulties of students in general science. The objectives of the Study are to explore the conceptual

difficulties of elementary students in learning the general science, to find out the most difficult concepts of general science at the elementary level of education.

2. Research Methodology

The current study was descriptive in nature. A concept based test to diagnose the conceptual difficulty of elementary school students in the subject of general science was used as a research instrument. For the development of the test general science text book for 8th class published by Punjab Text Book Board Lahore, edition 2020 was consulted. It was decided to include all chapters of the textbook in the universe of the test (see table no 1). For developing a diagnostic test, table of the specification was made and delimited to only the first three levels of the cognitive domain of Bloom's taxonomy. The test consisted of 30 items with four options. To assess the validity of the test a pilot study was conducted on 100 students of elementary schools. After the results of pilot testing, some items were rejected and a few were revised. In the final try-out testing 25 items out of 30 were used as they were up to the criteria. In final testing, the 300 elementary school students in Khanqah Sharif Bahawalpur district, Punjab were approached through simple random sampling. The face and content validity was assessed by five (5) experts who were teaching general science. Necessary amendments were done under the light of their suggestions. Internal consistency was assured by applying Cronbach alpha via SPSS version 20 and its value was 0.8. Criteria of item analysis were determined and every item was analyzed based on data (see table 2). Rejected items in pilot testing were not included in the final try-out test. The percentage of correct and incorrect answers was calculated. Below 40% corrected answers were considered very difficult (Akram, Surif, & Ali, 2014; Obomanu & Onuoha, 2012).

Table 1: List of Contents in General Science of Class 8th

Chapter No.	Chapter Name	Page Number
Chapter 1	Human Organic System	1
Chapter 2	Cell Division	19
Chapter 3	Biotechnology	32
Chapter 4	Pollutants and Their Effects on Environment	45
Chapter 5	Chemical Reactions	61
Chapter 6	Acid Alkalis/Bases and Salts	78
Chapter 7	Force and Pressure	99
Chapter 8	Measurement of Physical Quantities	113
Chapter 9	Sources and Effects of Heat Energy	123
Chapter 10	Lenses	137
Chapter 11	Electricity	149
Chapter 12	Exploring Space	160

Source: Punjab Curriculum Authority, Punjab Text Book, Lahore (2020)

Table 1 presents chapter-wise detail of the universe of the test. The above list of content from the textbook of general science was taught in all public schools of Punjab province in the 8th class. In the above list chapters, 1 to 4 were from biology while chapters 5-6 were from chemistry, and chapters 7 to 12 were from physics. These chapters are further divided into sub-topics according to the related content of the text.

Table 2: Table of specifications of Items

Level	Item No	Total
Knowledge	1,3,8,12,14,15,18,22	8
Comprehension	4,7,9,20,21,23,24,25	8
Application	2,5,6,10,11,13,16,17,19	9
Total		25

Table 2 displayed the table of specifications. It displayed that 8 items were at knowledge level and 8 items were comprised of comprehension objectives while 9 items were based on the application level under the cognitive domain of Bloom Taxonomy.

Table 3: Criteria of Item Analysis of the Test

	Item Analysis Criteria		
	Difficulty Power	**Discrimination Power**	**Distractor Effect**
Selected item	0.20-0.80	0.30 and above	At least 2% response on each option
Needs Revision	0.20 – 0.80	0.20 – 0.29	Any distractor had less than 2% response
Rejected item	Below 0.20	Below than 0.20	Below than 2% response on option

Source: (Akhter, Akhtar, & Iqbal, 2019)

Table 3 showed the criteria of item analysis of the diagnostic test. After item analysis, 5 items were rejected, as they showed discrimination power below 0.20. While certain items were revised as they showed discrimination power between 0.20-0.29. However, all other items were selected because they showed discrimination power up to the criteria.

Table 4: Item Analysis of Pilot try-out and Final try-out Results

	Pilot try-out Results								Final try-out results						
Items	**DS**	**D**	**Distractor effect**				**RM**	**Items**	**DS**	**D**	**Distractor effect**				**RM**
	N=100	**N=100**	**A**	**B**	**C**	**D**		**Items**	**N=300**	**N=300**	**A**	**B**	**C**	**D**	
1	0.33	0.75	75*	12	12	02	S	1	0.37	0.57	67*	15	14	4	S
2	0.43	0.66	23	65*	07	05	S	2	0.43	0.75	15	63*	16	6	S
3	0.18	0.55	15	05	72	08*	R	3							
4	0.32	0.57	43*	14	18	25	S	4	0.32	0.56	63*	19	12	6	S
5	0.19	0.61	03	07	10*	80	R	5							
6	0.27	0.73	39*	21	22	18	S	6	0.44	0.47	60*	16	14	10	S
7	0.10	0.28	04	05	88	03*	R	7							
8	0.27	0.59	10	48*	40	02	Nr	8	0.31	0.71	26	17	15	42*	S
9	-0.10	0.72	08	17	03*	72	R	9							
10	0.34	0.52	25	03	20	52*	S	10	0.47	0.52	11	28	42*	19	S
11	0.29	0.82	11	48	39*	02	Nr	11	0.39	0.59	42*	33	16	09	S
12	0.33	0.70	70*	13	12	05	S	12	0.34	0.75	09	16	16	59*	S
13	0.04	0.82	07	05*	07	82	R	13							
14	0.32	0.62	20	62*	03	15	S	14	0.40	0.79	10	57*	18	15	S
15	0.28	0.55	23	18	39*	20	Nr	15	0.31	0.69	40*	27	18	15	S
16	0.31	0.70	32	12	08	48*	S	16	0.43	0.59	12	52*	20	16	S
17	0.41	0.69	43*	22	13	22	S	17	0.35	0.71	7	5	83	5	S
18	0.39	0.72	20	60*	10	10	S	18	0.41	0.79	09	15	62*	14	S
19	0.33	0.51	13	40*	28	19	S	19	0.79	0.53	11	53*	20	16	S
20	0.39	0.76	20	50*	20	10	S	20	0.87	0.58	58*	18	15	09	S
21	0.48	0.60	60*	17	12	11	S	21	0.61	0.41	10	41*	27	22	S
22	0.30	0.68	12	12	08	68*	S	22	0.81	0.54	08	18	20	54*	S
23	0.22	0.65	10	40*	30	20	Nr	23	0.66	0.44	15	22	19	44*	S
24	0.26	0.62	11	50	09	30*	Nr	24	0.37	0.70	26	20	41*	13	S
25	0.53	0.37	20	40*	20	20	S	25	0.79	0.53	13	21	53*	13	S
26	0.48	0.64	19	50*	22	09	S	26	0.49	0.74	19	64*	08	09	S
27	0.43	0.59	12	18	11	59*	S	27	0.39	0.70	50*	20	10	20	S
28	0.44	0.65	09	16	65*	10	S	28	0.44	0.69	26	17	42*	15	S
29	0.48	0.64	64*	11	13	12	S	29	0.39	0.76	19	13	7	61*	S
30	0.29	0.63	29	20	12	39	Nr	30	0.49	0.79	17	60*	16	7	S

Note: DS= Discrimination power, D= Difficulty level, S= Selected, R=Rejected, Nr= Need revision, RM= Remarks

3.1 Pilot Testing Results

Table 4 showed that a total of 30 items for pilot testing the test was given to 100 students. 5 items were rejected. Item no 3, 5, 7, 9, and 13 items were showing discrimination power less than 0.20, so they were rejected. While items no 8, 11, 15, 23, 24, and 30 were revised as they showed discrimination power between 0.20-0.29. However, all other items were selected.

3.2 Final Try-out Results

Items in the final try out including 3, 5, 7, 9, and 13 were rejected so these items were left blank in the final try-out table. However, before the final try-out test item no 8, 11, 15, 23, 24, and 30 were revised. Item no 1, 2, 4, 6, 10, 12, 14, 16, 17, 19, 20, 21, 25, 26, 27, 28 and 29 were selected because they showed discrimination power up to the criteria. The group

statistics of table 4 illuminated that out of 30 items 25 items were selected, 5 items were rejected and 6 items were revised.

3.3 Findings and Results

After analyzing elementary school students' conceptual difficulties in general science, the above table 5 illuminated that 78% of the items were difficult for elementary school students. Table 5 showed that only 15%, 16%, 18%, 19 %, and 33 % of elementary school students answered correctly items no 4, 5, 7, 8, and 9. This concluded that the concept of ozone depletion, types of Air pollutants, properties of air pollutants, greenhouse gases, and properties of greenhouse gases were considered difficult to understand by elementary school students. Other difficult concepts as concluded by provided data were Decomposition reactions (item no 11), the number of Oxygen atoms in a molecule of Mg (HCO3) (item no 12), Reaction of acidic acid with sodium hydrogen (item no 17), the concept of Thermal contradiction (item no 18), expansion properties of Liquids (item no 19), Function of Thermometer (item no 21), Concept of Radiation (item no 22), properties of objects (item no 23) and working of Iris (item no 24).

Table 5: Analysis of elementary school students' conceptual difficulties in General Science

Item no	Focus of Items	% of correct answers	% of incorrect answers	Remarks
1	Concept of Sensory neuron	67	33	Not difficult
2	Function of Nephron	63	37	Not difficult
3	Definition of hydropower plant	42	58	Not difficult
4	Types of Air pollutants	19	81	Difficult
5	Ozone depletion	15	85	Difficult
6	Ultraviolet radiation	59	41	Not difficult
7	Properties of air pollutants	33	67	Difficult
8	Types of greenhouse gases	18	82	Difficult
9	properties of greenhouse gases	16	84	Difficult
10	A chemical reaction between zinc and dilute sulphuric	63	37	Not difficult
11	Decomposition reactions	28	72	Difficult
12	Oxygen atoms in molecule of Mg (HCO3)	14	86	Difficult
13	Thermal decomposition of calcium	53	47	Not difficult
14	Definition of airbus	41	59	Not difficult
15	Concept of Electric current	53	47	Not difficult
16	The hydrostatic pressure of the liquids	42	58	Not difficult
17	Reaction of acidic acid with sodium hydrogen	17	83	Difficult
18	Concept of Thermal contradiction	27	73	Difficult
19	Expansion properties of Liquids	32	68	Difficult
20	Examples of Thermal expansion of solids	53	47	Not difficult
21	Function of Thermometer	18	82	Difficult
22	Concept of Radiation	19	81	Difficult
23	Examples of inheritable characters	62	38	Not difficult
24	Working of Iris	20	80	Difficult
25	Properties of Objects	20	80	Difficult

4. Conclusion and Discussion

The basic purpose behind the study is to explore the elementary school students' conceptual difficulties in general science. After analyzing the results it was observed that the majority of the elementary schools students faced conceptual difficulties in the subject of general science. This study is linked with the study conducted by Brown and Clement (1989), conceptual difficulties can be found at all ages of students but the ratio of conceptual difficulties at the elementary level is higher than other levels of education and it became the major concern of the instructors. The second objective of the study was to find out the difficult concepts of science at the elementary level. The present data revealed that chemistry-based concepts including chemical reaction, properties of acids, and physics-based concepts including thermal contradiction, expansion properties of Liquids, working of Iris, Radiation, ozone depletion, air pollutants were considered the most difficult concepts to understand by elementary school students. As concluded by Bahar and Polat (2007) majority of the students at the elementary level faced conceptual difficulties in the concepts of chemistry and physics.

5. Recommendation

After the analysis of data based on findings following recommendations were made.

- Teachers should encourage their students to actively participate in the teaching-learning environment for concept formation by a cooperative learning environment.
- This diagnostic test for science was administered to only 8th standard students. Further researches should investigate the conceptual difficulties of other courses at the elementary level.
- Researchers might be used this test for a large population in other districts of Punjab.
- Difficult concepts might be taught at micro level, macro level, and symbolic level. Therefore, multiple representation of knowledge might be recommended for science instructions.
- The Federal Government might give financial aid to every school for the improvement of the quality of science instruction.
- School administration might spend financial resources to upgrade its science laboratories.
- Science teachers might explore the best possible reasons behind the conceptual difficulties of their students.

References

Akhter, N., Akhtar, A., & Iqbal, S. (2019). Development and Validation of Multiple-Choice Test of the Geometry Part of Mathematics for Secondary Class. *Global Social Sciences Review, 4*(2), 283-292.

Akram, M., Surif, J. B., & Ali, M. (2014). Conceptual difficulties of secondary school students in electrochemistry. *Asian Social Science, 10*(19), 276.

Bahar, M., & Polat, M. (2007). The Science Topics Perceived Difficult by Pupils at Primary 6-8 Classes: Diagnosing the Problems and Remedy Suggestions. *Educational Sciences: Theory & Practice, 7*(3), 1113-1129.

Brown, D. E., & Clement, J. (1989). *Overcoming Misconceptions via Analogical Reasoning: Factors Influencing Understanding in a Teaching Experiment*. Retrieved from Washington, DC.:

Duit, R. (2007). Students' and teachers' conceptions in science: A bibliography. In.

Fetherstonhaugh, T., & Treagust, D. F. (1992). Students' understanding of light and its properties: Teaching to engender conceptual change. *Science education, 76*(6), 653-672.

Kashif, N. U., Shehzadi, K., & Arshad, Z. (2020). An Analysis of Teaching Learning Process in Higher Education Institutions of Bahawalpur. *iRASD Journal of Educational Research, 1*(1), 09-14.

Kersting, M., Steier, R., & Venville, G. (2021). Exploring participant engagement during an astrophysics virtual reality experience at a science festival. *International Journal of Science Education, Part B, 11*(1), 17-34. doi:https://doi.org/10.1080/21548455.2020.1857458

Lamanauskas, V. (2007). Science education as a core component of educatedness. *Problems of Education in the 21st Century, 1*, 5-6.

Morrison, J., Bartlett, R., & Raymond, V. (2009). STEM as curriculum. *Education Week, 23*(03), 2.

National Research Council. (1997). *Science teaching reconsidered: A handbook*: National Academies Press.

Nussbaum, J., & Novick, S. (1982). Alternative frameworks, conceptual conflict and accommodation: Toward a principled teaching strategy. *Instructional science, 11*(3), 183-200. doi:https://doi.org/10.1007/BF00414279

Obomanu, B., & Onuoha, C. (2012). Students conceptual difficulties in electrochemistry in senior secondary schools. *Journal of Emerging Trends in Educational Research and Policy Studies, 3*(1), 99-102.

Özmen, H. (2004). Some student misconceptions in chemistry: A literature review of chemical bonding. *Journal of Science Education and Technology, 13*(2), 147-159. doi:https://doi.org/10.1023/B:JOST.0000031255.92943.6d

Shafer, A. B., Wolf, J. B., Alves, P. C., Bergström, L., Bruford, M. W., Brännström, I., . . . Ekblom, R. (2015). Genomics and the challenging translation into conservation practice.

Trends in ecology & evolution, 30(2), 78-87. doi:https://doi.org/10.1016/j.tree.2014.11.009

Van Driel, J., & Abell, S. (2010). Science teacher education. *International Encyclopedia of Education*, 712-718.