

Content Analysis of Textbooks for Measuring Alignment with Standards: A Case of Secondary School Physics Textbook

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Publication of textbooks for Primary to Intermediate Education in Punjab, Pakistan is the key function of Punjab Curriculum and Textbook Board. The philosophy and agenda of Pakistan National Curriculum heavily translates in the content of published textbooks. This study aims at determining the degree of coherence among curriculum objectives with the contents of published textbooks. The study uses a mixed-method approach to analyze the degree of alignment among the variables and contents of Physics (IX) textbook. Porter's (2002) Alignment Index is used to determine the quantitative measure of alignment. The instrument was validated through experts' opinion and utilized for the content analysis of Physics (IX) textbook. The qualitative data was extracted by coding students learning outcomes stated in the curriculum objectives in a range of six cognitive categories and validating them with the contents of the selected textbook. The qualitative results indicate under-presentation of high-level cognitive skills in the contents of the textbook and quantitative data analysis establish low alignment index (A.I.: 0.79), which asserts misalignment of content with curricular objectives. The results of this study are significant for future revisions in contents of Physics (IX) textbook and offer a pedestal for future researchers in this domain. The study recommends systematic collaboration between curriculum developers and textbook writers to strengthen the alignment between two.

Keywords: curriculum alignment, textbook, student learning outcomes, curriculum evaluation

INTRODUCTION

Textbooks are the key instrument in achieving national curriculum goals through stating learning objectives, framing suitable learning content, providing detail of learning experiences, and sometimes assessment criteria as well. The learning content in textbooks standardizes learning outcomes for students of a specific grade level, and instructors draw upon textbook content to develop effective lesson plans. Research asserts that textbooks have the most important influence over the quality of teachers' instruction and organization of learning experiences (Polikoff, Koedel, & Hardaway, 2017). Textbooks enable teachers to steer their instruction within desired curricular objectives and provide a point of reference to students.

In addition to curriculum interpretation and implementation, textbooks make an integral part of teaching and learning resources in Pakistan (Mahmood, 2009). Textbooks are printed by provincial textbook boards and sole representative of cognitive, affective and psychomotor objectives idealized by the national curriculum documents (Bhatti, Khurshid, & Ahmad, 2017). In this case, textbook design and content also determines the depth and breadth of National Curriculum, content that is not presented in textbooks is most likely to be omitted from classroom instruction too (Bhatti, Jumani, & Bilal, 2015). Textbooks are tangible and pertinent visible tools to practically impart the inner thoughts and hidden tones of an overt curriculum (Mahmood, 2009) and the degree of a coalition between national curricular objectives and contents of a textbook, also referred as *curriculum alignment*, is crucial to determine the quality of classroom instruction and assessment (Polikoff, 2015). Alignment of textbooks with curricular objectives reduces gaps between classroom

implementation of curriculum and utilization of essential curricular components (Fan, 2010).

Punjab Curriculum and Textbook Board (hereafter PCTB) develops textbooks based on standards and benchmarks framed by the National Curriculum Council of Pakistan. PCTB identifies the needs projected by the national curriculum and recruits a panel of authors for developing textbook content. However, the National Curriculum Council of Pakistan does not oversee the functions of PCTB which increases the possibility of weak alignment of textbook content with the curricular objectives. Hume and Coll (2010) assert that a lack of coordination between curriculum developers and its implementers increases the risk of mismatch between the intended and delivered curriculum (Hume & Coll, 2010). Prior studies also indicate that students' standardized assessment depends on textbook contents in Pakistan therefore, it demands that the textbook content is congruent with the overarching objectives of the national curriculum to ensure a valid assessment of what is suggested in the curriculum (Bhatti, Jumani, & Bilal, 2015). The National Education Policy (2017) advises improved coordination at all levels to elevate the quality of textbooks in Pakistan to overcome the increasing gap between written and assessed curriculum (MoE, 2017). Research in Pakistan on quality of textbooks and alignment with national curricular objectives is an underexplored area of study and prior research in this domain reports misalignment, for instance, Bhatti, Jumani and Bilal (2015) reported misalignment between Biology-IX textbook and National Secondary School Curriculum for Biology (Bhatti, Jumani, & Bilal, 2015) through employing Survey of Enacted Curriculum (SEC) method.

The present study evaluates contents of Physics - IX textbook to investigate the extent of alignment of textbook content with the

National Secondary School Curriculum for Physics by using Porter (2002) Alignment Index. The Porter (2002) alignment index analyzes the extent of alignment between two variables by coding. In this case, the two variables are the cognitive complexity of students' learning outcomes and textbook content.

Objectives of the Study

The study was designed on the following research objectives:

- To analyze the contents of Physics – IX textbook present cognitive, affective and psychomotor domains of learning as stated by the National Curriculum for Physics (2006).
- To investigate the alignment between the national curriculum (2006) and the textbooks of Physics for grade IX published by Punjab Curriculum and Textbook Board.
- To recommend practical measures for achieving a higher degree of alignment between textbook content and curriculum objectives.

Research Questions

The following research questions directed the present study:

- 1-To what extent the contents of Physics – IX textbook present cognitive, affective and psychomotor domains of learning as stated by the National Curriculum for Physics (2006)?
- 2-To what extent does the content of Physics textbook for grade IX align with the objectives presented by National Curriculum for Physics (2006)?

Significance of the Study

As discussed in the previous section, textbook alignment with the curriculum is a critical factor that impacts student achievement. The textbook alignment studies in Pakistan have reported misalignment with the national curriculum of Biology and Chemistry (Bhatti, Jumani, & Bilal, 2015; Bhatti, Khurshid, & Ahmad, 2017) and there exists no evidence of research that evaluates the alignment of Physics textbook with the National Curriculum for Physics (2006). The subject of physics education is often perceived as a challenging and cumulative subject (Angell, Guttersurd, Henriksen, & Isnes, 2004). Research suggests that most learning challenges for students stem from the way concepts are presented in the physics curriculum (Ornek, Robinson, & Haugan, 2007). Therefore, the curriculum outline and its alignment with the contents of a physics textbook plays a vital role in instilling motivation and interest among students and positively impact their experiences of physics instruction.

In the context of Pakistan, this study is the first to evaluate the content alignment of Physics textbook with National Curriculum for Physics (2006). It will set a platform for future researchers, curriculum evaluators and writers to review prescribed students' learning outcomes with regards to the pedagogic content presented in the textbook of Physics – IX.

Overview of National Curriculum (2006) for Physics

The National Curriculum (2006) for Physics is a thorough document that enlists vision statement, textbook development process, the breakup of five sub-domains of Physics, standards, benchmarks, students' learning outcomes, and assessment objectives. It also suggests the instructional strategies and teaching/learning resources necessary for the implementation of the curriculum. The document also lists standard experiments and required apparatus for practical work. The National Curriculum

(2006) for Physics comprehensively explains the cognitive and psychomotor students' learning objectives (GoP, 2018).

METHODOLOGY

The study was conducted through a mixed-method approach. The qualitative data was collected through document analysis which is a systematic approach for reviewing the content of written material (Bowen, 2009). For this study, the following documents were analyzed:

- 1- National Curriculum for Physics Grade IX/X (2006) which is compiled by the Government of Pakistan, under the supervision of the Ministry of Education, Pakistan.
- 2- Physics Textbook for Class IX published by Punjab Textbook Board, Lahore. The textbook comprises of 9 chapters written on 281 pages and each chapter ends with assessment exercises for students.

Each chapter opens with the presentation of students' learning outcomes (hereafter SLO) which defines content in terms of levels of cognitive demand (cognitive, affective, psychomotor). This study employs a thematic coding technique as a mean to develop a content taxonomy based on the SLO presented in the Physics – IX textbook.

The second tool employed in this study is Porter (2002) Alignment Index, extant research projects this method as practical and reliable for collection of consistent data on current instructional practices and content being taught in classrooms (Blank, 2009; Kurz A. , Elliott, Wehby, & Smithson, 2010; Ndlovu & Mji, 2012). Research from China (Liu, et al., 2009), Singapore, America (Polikoff, 2015), South Africa (Ndlovu & Mji, 2012) and Pakistan report the success of this method for measuring the level of agreement between instruction and instructional materials with the curriculum. The Porter's (2002) Index analyzes congruence between mathematical frequency listed in two tables (9x8), each listing SLO (cognitive, affective and psychomotor) in nine rows each representing individual chapter from the textbook (matrix X) and three levels of cognitive demand (matrix Y) respectively. As a result, a matrix of 9x8= 72 was obtained, the value in each cell was divided by the sum of values for every column and listed in new tables (X_i , Y_i), while the sum of values in every column equaled to 1. Then the ratio difference was found by subtracting the values of every cell of X from the corresponding cell of the other matrix. The alignment index is calculated with the following formula, and the value ranges from 0 – 1 (Polikoff & Fulmer, 2013).

$$\text{Porter Alignment Index } P = 1 - \frac{\sum_{i=1}^n |X_i - Y_i|}{2}$$

Where n is the total number of cells in the table and i refers to a specific cell ranging from 1 to n . For example, for a 9 x 8 table, $n = 72$ and X_i refers to the i^{th} cell of the test grid, and Y_i refers to the corresponding cell (i^{th} cell) in matrix Y. The discrepancy between two tables can be calculated by adding the absolute values of these differences (Liu & Fulmer, 2008; Porter, 2002).

Results

The results for the alignment among the SLO presented in the textbook compared to the National Curriculum for Physics (2006) are depicted in Table 1.

Table 1: Distribution of Students' Learning Outcomes (SLO)

Physics - IX Textbook	Cognitive		Affective		Psychomotor	
	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
	193	82%	51	10%	28	8%

The percentage of different levels of cognitive SLO as presented in the Physics – IX textbook are listed in Table 2

Table 2: Percentage of Cognitive SLO

Physics - IX Textbook	Knowledge	Comprehension	Application	Analysis	Synthesis	Evaluation
	82%	84%	42%	46%	35%	22%

Table 3: Alignment of textbook contents with the national curriculum

Chapter No.	Cognitive SLO ¹						Affective SLO	Psychomotor SLO
	K	C	App.	A	S	E		
1	0.02	0.04	0.05	0.02	0.04	0	0.02	0.01
2	0.03	0.01	0	0.02	0.08	0.05	0.08	0.11
3	0.04	0.06	0.04	0.04	0.11	0.14	0.14	0.30
4	0.01	0.08	0.14	0.28	0.24	0.25	0.03	0.27
5	0.01	0.06	0.23	0.17	0.21	0.12	0.15	0.18
6	0.02	0.10	0.09	0.09	0.11	0	0.21	0
7	0.01	0.01	0	0.22	0.08	0.25	0.04	0.01
8	0.01	0.05	0.21	0.16	0	0.05	0.19	0.08
9	0.01	0.03	0.17	0	0.13	0.08	0	0.02
Total	0.16	0.44	0.93	1.00	1.00	0.94	0.86	0.98
Alignment Index (A.I.)	0.93	0.82	0.65	0.68	0.65	0.58	0.62	0.61
Avg. A.I.	0.79							

Discussion

The results indicate that the contents of Physics - IX textbook over the present cognitive domain (82%) of learning objectives compared to the affective (10%) and psychomotor (8%) domain. Within the cognitive domain, higher ability strands are under presented ($K = 82\%$, $E = 22\%$). Results listed in Table 2 assert that textbook content, framed within nine chapters, is misaligned individually with respect to the categories of cognitive demand. The degree of misalignment also varies categorically in different levels of the cognitive domain. The alignment index value for the content belonging to the Knowledge category is more aligned (A.I.=0.93) with the curriculum compared to content belonging to the highest level of the cognitive domain; Evaluate (A.I.=0.58).

Table 3 presents the alignment of contents of Physics – IX textbook with National Curriculum (2006). The critical value of the mean alignment index for 72 cells matrix is 0.9483. It is clear from the results that the contents do not align with the curriculum (A.I = 0.79). A closer view of data also indicates inconsistencies for different categories of cognitive learning domain within the nine chapters of Physics – IX textbook, with the highest difference marked by Chapter 4 and 5 (refer to Table 3).

Based on the results, this study concludes that the Physics – IX textbook:

- 1- under presents students' learning outcomes under the category of affective and psychomotor learning domains;
- 2- fails to present content suitable for students' learning outcomes in the different categories of cognitive learning domain especially the highest categories (comprehend, analysis, synthesis, evaluation); and
- 3- within the textbook, the content does not get from lower to higher cognitive levels in a consistent and steady manner.

Conclusion

The current study indicates low curriculum alignment and progression in cognitive complexity of students' learning outcomes. It validates previous studies (Bhatti, Khurshid, & Ahmad, 2017; Bhatti, Jumani, & Bilal, 2015; Saeed & Rashid, 2014) that have reported a weak alignment between curriculums of various subjects (e.g. Biology, Chemistry) with their respective textbooks. In addition to the weak alignment index (A.I.=0.79), the current study also reports under-representation of higher cognitive learning outcomes which is not age-appropriate for class IX students. The current research sets a platform for future studies in the domain of curriculum alignment investigation. A profound analysis of research in Pakistan in this field opens a need to extend the alignment studies to determine the relationship between textbook content and standardized assessments for class IX.

Recommendations

The current study endorses that curriculum alignment offers a framework for evaluating the degree of agreement between learners' achievement, pedagogical perspectives, and learners' assessments. The findings indicate towards weak alignment dynamics and pose a need to improve the degree of congruence among attributes relating to domains of learning (cognitive, affective, psychomotor), curriculum, and textbook contents. In the light of the above results and discussion, the researchers recommend the following to achieve higher alignment between the textbooks and curriculum:

- The contents of Physics – IX textbook should emphasize equally on all domains of learning.
- To ensure horizontal alignment between contents of Physics – IX textbook with broader curriculum outline, it is essential to project all levels of cognitive complexity while focusing more on the higher levels suitable for the age of Class IX students.
- The contents also require rearrangement to ensure vertical alignment and a perpetual extension in the level of difficulty starting from lower to complex levels of cognitive engagement.
- Lastly, there is a need to establish systematic collaboration between the process of curriculum development and the selection of contents for textbooks. A collaborated process will ensure a greater degree of alignment between the selected pedagogic material, recommended classroom teaching, resources and the overall curriculum outline (Polikoff, 2015).

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¹ Cognitive levels of learning according to Bloom's Taxonomy.

K = Knowledge, C = Comprehension, App. = Application, A = Analysis, S = Synthesis, E = Evaluations

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