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CURRICULUM-TEXTBOOK ALIGNMENT ANALYSIS BETWEEN THE NATIONAL CURRICULUM OF PAKISTAN 2022-23 MATHEMATICS AND THE GRADE 8 MATHEMATICS TEXTBOOK: A DIRECTED QUALITATIVE CONTENT ANALYSIS IN THE BALOCHISTAN CONTEXT

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ABSTRACT

In this research, the alignment between the NCP 2022-23 Mathematics curriculum and the Grade 8 Mathematics textbook published by the Balochistan Textbook Board has been measured qualitatively using the directed qualitative content analysis method. All 68 SLOs, which cover five domains (numbers and operations, algebra, Measurement, geometry, and statistics and probability), have been examined against a coded corpus comprising 977 textual records, of which 873 are substantive learning episodes from the textbook. The seven-dimensional alignment model (formal mapping, content and scope, cognitive demand, representation, context and modeling, mathematical practices, and opportunity to learn) was used for each SLO to make an overall within-case alignment judgment. While all 68 SLOs were formally mapped in the textbook, only 40 of them (58.8%) were strongly aligned, 25 (36.8%) were partially aligned, and 3 (4.4%) were weakly aligned, with no wholly unaligned SLOs. High representational and procedural fidelity can be seen in numerous multimodal and worked-example/practice episodes. However, low cognitive and contextual fidelity is evident: while the curriculum requires higher-order demand (analysis, justification, or creation) for 26 out of 68 SLOs (38.2%), only 6.2% of learner-response episodes involve such cognitive demand, and 77.1% of episodes lack real-world context. Thus, the textbook is highly aligned with the curriculum on structural and topical dimensions but less aligned on the epistemic dimension.

I. INTRODUCTION

The document that describes the aims of a national education system is called the curriculum, but the textbook has generally emerged as the key medium for achieving curriculum objectives, especially in poor-resource and far-flung provinces like Balochistan (Pakistan Today, 2024). The curriculum could be well planned, and textbooks could be comprehensive topically, but both could differ in the degree of reasoning, the level of contextual authenticity, or the variety of methods used in learning for learners. This discrepancy in curriculum implementation has consistently been identified as a major issue in curriculum evaluation and materials analysis (Polikoff et al., 2021).

National Curriculum of Pakistan 2022-23 (NCP 2022-23) has restructured the Mathematics curriculum of Grade 8 to have 68 officially defined Student Learning Outcomes (SLOs) in five domains and was designed to align with internationally acknowledged frameworks like TIMSS while designing this curriculum (Ministry of Federal Education and Professional Training, 2022). Provinces like Balochistan later adopted model textbooks based on this curriculum, including the Balochistan Textbook Board's Mathematics 8 (First Edition, 2025). Given that education in Balochistan has a very different setting from other provinces in terms of resource availability, teacher monitoring, and rural reach, the level of alignment between the textbook in use and the curriculum is very significant indeed (Pakistan Today, 2024). In this study, a qualitative content analysis was conducted to assess the degree of alignment between the NCP 2022-23 Grade 8 Mathematics Curriculum and the Grade 8 Mathematics textbook in use in Balochistan. In this analysis, in addition to checking for the presence of each curriculum topic in the textbook, the degree to which the textbook preserves the intended scope of content, cognitive demands, student performance, representations, contextual applications, mathematical practices, and learning opportunities for each official outcome is assessed. This analysis is conducted on the entire, exhaustively coded corpus of evidence rather than a selected sample and hence enables conclusions to be drawn from a chain of evidence for each outcome, each domain, and each case.

Statement of the Problem

Despite frequent emphasis in Pakistan's curriculum reform initiatives on standards and benchmarks, as well as on internationally referenced content (Ministry of Federal Education and Professional Training, 2022), the translation of reformed curricula into textbooks used by provincial education boards has seldom undergone systematic qualitative analysis. The alignment indices that are quantitative measures of the degree of topic and cognitive level correspondence, such as Porter's index utilized in TIMSS-referenced studies (Dhlamini, 2021), do not reflect how curriculum performance is actually transformed qualitatively, such as when a curriculum outcome requiring an analytical or justificatory response survives only as a computation. Prior alignment studies of the Single National Curriculum of Pakistan have also reported an unequal distribution of content strands and depth of knowledge levels in provincial assessments, without providing a parallel textbook alignment. This study bridges that gap by combining exhaustive coverage of outcomes with qualitative, evidence-based analysis in seven alignment dimensions.

Purpose of the Study

The purpose of this study was to determine, through directed qualitative content analysis, how faithfully the Grade 8 Mathematics textbook used in Balochistan represents the National Curriculum of Pakistan 2022–23 in terms of content scope, cognitive demand, student performance, mathematical representations, contextual application, mathematical practices, and opportunity to learn, across all 68 official Grade 8 Student Learning Outcomes.

Research Questions

1. To what extent does the Grade 8 Mathematics textbook formally and substantively cover the 68 official SLOs of the National Curriculum of Pakistan 2022–23?
2. How does the cognitive demand enacted in the textbook's learner-response episodes compare with the cognitive demand intended by the curriculum?
3. In what way is the textbook faithful to the contextual, representational, and practical demands of the curriculum?
4. What regularities exist in the process of converting the curriculum into the form of a textbook?

Significance of the Study

The study provides comprehensive coding and alignment at the outcomes level for a national subject curriculum and grade level in a particular provincial context, serving as an evidence base for curriculum developers, textbook boards, and teachers in Balochistan to make necessary changes to the curriculum rather than rewrite it altogether. Furthermore, the study serves as a model for conducting a curriculum-materials alignment study using directed qualitative content analysis (Hsieh & Shannon, 2005; Vears & Gillam, 2022).

II. LITERATURE REVIEW

Curriculum–Textbook Alignment as a Field of Inquiry

Alignment research asks whether the intended curriculum, the curriculum as represented in instructional materials, and the curriculum as enacted or assessed correspond with one another (Dhlamini, 2021). Much of this tradition has used the Surveys of Enacted Curriculum framework and Porter's alignment index to quantify correspondence between topic-by-cognitive-level matrices, as in TIMSS-referenced comparisons of national assessments (Dhlamini, 2021). While such indices are useful for summarizing large corpora, several recent qualitative and mixed-methods studies argue that a single alignment coefficient can mask the substantive character of the mismatch—whether a topic is entirely missing, present but under-practiced, or present with reduced cognitive demand (Zeynivandnezhad et al., 2024). The present study follows this qualitative tradition, treating each SLO as a case to be evaluated against multiple, explicitly defined dimensions rather than collapsing alignment into a single score.

In the domain of higher education and schooling, qualitative analyses of documents have compared learning outcomes and intended goals with instructional tasks and assessments, revealing broad topical alignment, with less consistent alignment at the cognitive and authentic levels (Aquino, 2024). Comparative research across national boundaries has expanded the use of this approach to cross-curricular, inquiry-oriented mathematics textbooks and similarly found that formal alignment with curriculum standards coexists with significant inconsistencies in the degree and level of intended pedagogical approach. These results align with the major distinction in the current study's findings: between nominal (formal) alignment and enacted (substantive) alignment.

Textbook Analysis and Opportunity to Learn

Textbooks continue to be the primary medium for conveying curricular intentions into practice in most educational settings and constitute an important influence on students' opportunities to learn (Polikoff et al., 2021). In analyzing the most popular Grade 8 mathematics textbooks in the United States through the Surveys of Enacted Curriculum framework, Polikoff et al. (2021) found poor alignment with content standards and low cognitive demand, despite broad topical coverage. This pattern of results parallels the current study's findings regarding the predominance of routine-procedure learner-response episodes in the textbook of interest. Moreover, studies based on content analysis of commercially available algebra textbook series have found considerable variation in task types, representations, and mathematical reasoning, even among textbooks formally aligned with the same standards (Huntley et al., 2024).

Cognitive Demand in Textbooks and Classrooms

The literature consistently distinguishes cognitive demand between tasks that require memorization and the application of a procedure without any connection to meaning, and those that involve procedures with a connection to meaning and involve doing mathematics (Parrish & Bryd, 2022). In several classroom and textbook studies, the latter category has consistently proved rare, and there is evidence that cognitive demand is reduced when transitioning from a written task into classroom or textbook enactment (Parrish & Bryd, 2022). In the context of the present study, the finding that the higher-order cognitive demand category accounted for just 6.2% of learner-response episodes, compared with 38.2% of intended curriculum outcomes, is not inconsistent with the existing pattern of demand reduction in the literature on cognitive demand.

Context, Modeling and Mathematical Practice in Textbooks

It is quite a common finding in the field of mathematics education research that the context of word problems in textbooks rarely serves as a modeling tool, and that the scenario changes but the underlying mathematical demand remains at the routine calculation level. This distinction between decorative and consequential context is essential for research on mathematical modeling, where the process is described as requiring students to extract relevant information, make assumptions, choose a model, and interpret/evaluate its outcome, rather than the common word problem that provides all the necessary information. The current study implemented a four-point context-integration scheme (without context, surface context, consequential context, and empirical/observational context) to measure the frequency of actual mathematical modeling in the textbook in question.

The Pakistani and Balochistan Policy Context

The development of the National Curriculum of Pakistan 2022-23 has been motivated by the need to strengthen standards and benchmarks that were missing from the 2006 curriculum, and to bring the mathematics and science content closer to international TIMSS standards (Ministry of Federal Education and Professional Training, 2022). However, implementation of this curriculum has not been consistent across provinces. Commentaries on the implementation of the Single National Curriculum in Balochistan have noted that the province's cultural, linguistic, and economic diversity, combined with limited resources, has led to delays in implementation compared to other provinces (Pakistan Today, 2024). Quantitative research on the correspondence between assessment and curriculum in Grade 8 mathematics under the Pakistani Single National Curriculum has found incomplete SLO coverage and an imbalance in attention across different content areas in the assessment tests of this province. This suggests that curriculum-to-practice consistency remains a relevant issue across the Pakistani system. To the best of the researcher's knowledge, no published study has yet conducted an exhaustive SLO-by-SLO qualitative alignment analysis of the Balochistan Grade 8 Mathematics textbook against the NCP 2022-23; the current study aims to fill this gap.

Directed Qualitative Content Analysis as a Methodological Approach

Directed qualitative content analysis begins with a theoretically or empirically derived coding frame, applies that frame systematically to a text corpus, and remains open to emergent codes and refinements during piloting (Hsieh & Shannon, 2005). This approach is well suited to curriculum-alignment research because the curriculum document itself supplies a principled, predetermined structure—the SLOs and their associated performance, representation, and context descriptors—against which textbook evidence can be directly and traceably matched. Contemporary methodological guidance on qualitative content analysis emphasizes piloting the coding frame, decomposing compound units of analysis into independently verifiable sub-indicators, and using negative or disconfirming cases to refine rather than merely illustrate an emerging explanation (Vears & Gillam, 2022)—all practices that were incorporated into the design of the present study, as described in the Method section below.

III. METHOD

Research Design

This study used a qualitative, document-based, directed content analysis design (Hsieh & Shannon, 2005). The unit of intended curriculum was the official SLO as published in the National Curriculum of Pakistan 2022–23 (Mathematics, Grades 1–12); the unit of represented curriculum was the substantive instructional episode as it appeared in the Grade 8 Mathematics textbook. The reason that the directed approach was selected is that there already existed a clear structure in the form of the curriculum document, which provided a strong a priori framework to compare textbook evidence to in terms of content, cognitive demand, performance, representation, context, and practice descriptions for each SLO (Vears & Gillam, 2022).

Document Corpus

Two major sources were considered for this case study: (a) Mathematics Part of the National Curriculum of Pakistan 2022-23, Grades 1-12, published by the National Curriculum Council Secretariat, Ministry of Federal Education and Professional Training, and (b) A Textbook of Mathematics 8 (First Edition 2025), published by the Balochistan Textbook Board, Quetta. First of all, the authenticity and completeness of both sources were checked, and they were decomposed into components that could be coded. The national curriculum included a 68-row Grade 8 SLO matrix consisting of five domains, in which all elements, such as content, cognitive demands, performance, representations, contexts, practices, scope, and complexity of each SLO, were specified. The textbook provided 977 coded records across 13 units and 213 pages, including 873 instructional episodes, 71 opening outcome statements per unit, and 33 answer records; unit opening outcome statements and answers were coded separately from instructional episodes to prevent false counting due to topic mentions and repeated answers.

Table I: Distribution of the 68 Grade 8 Mathematics SLOs Across Curriculum Domains

Domain	Domain Title	Number of SLOs

Domain	Domain Title	Number of SLOs
A	Numbers and Operations	24
B	Algebra	25
C	Measurement	5
D	Geometry	7
E	Statistics and Probability	7
Total		68

Development of Coding Frames and Alignment Dimensions

The coding frame was built deductively from the curriculum's descriptive categories, piloted on a sample of SLOs and textbook episodes, and then fully coded for the entire corpus. For each SLO and each of the corresponding textbook episodes, the coding frame specified: the cognitive and/or task demand (six ordered levels: recall/procedural routine to strategic thinking, justification and evaluation and creation/generalization); the expected student performance; the required and/or actual form of representation (numerical, symbolic, tabular, graphical, constructional/geometrical, and experimental); the level of context-integration (no context, superficial context, mathematically important context, empirical/observational context); the mathematical practice and/or tool; and an opportunity to learn (OTL) category describing the instructional role of the episode (modelled example, independent practice, relational explanation, guided prompt, recap/review, or experiment/ activity). In the case of the appearance of a language, mathematics, or time-unstable element (such as an outdated conversion rate between currency units) in any textbook episode, the corresponding quality flag was noted.

After completing coding of both documents, outcome-level alignment assessments were made with the help of a seven-dimension framework: (1) formal mapping; (2) content and scope; (3) cognitive demand and performance; (4) representation; (5) context and modeling; (6) mathematical practice and tools; and (7) opportunity to learn. All SLOs were qualitatively assessed as either strong, partial, weak, or non-aligned based on their least consequential dimension, rather than on an average score, as recommended in the qualitative content analysis literature (Hsieh & Shannon, 2005; Zeynivandnezhad et al., 2024).

Table II: Overall Alignment Rating Categories and Operational Definitions

Rating	Operational Meaning
Strong	The textbook substantively addresses the complete or nearly complete SLO and preserves its central performance, representation, and opportunity-to-learn requirements.
Partial	The topic and major content are present, but one or more consequential requirements are reduced, uneven, inaccurate, surface-level, or insufficiently practiced.
Weak	Only part of the intended outcome is enacted, or a central method, performance, or context is largely missing despite nominal claim mapping.
Not aligned	No substantive textbook evidence addresses the outcome.

Procedure

Analysis proceeded in six stages: (1) document verification and profiling of both sources; (2) structural decomposition and data preparation, including division of the curriculum into 68 discrete SLOs and the textbook into unit, page, and episode-level segments; (3) coding-frame development and pilot coding on a subset of outcomes to test and refine category definitions, including decomposition of compound SLOs (those naming multiple methods, cases, or representations) into independently matchable sub-indicators while retaining the 68 official outcomes as the reporting denominator; (4) full directed qualitative content coding of both documents in their entirety; (5) SLO-by-SLO qualitative alignment analysis comparing curriculum requirements with the frozen textbook evidence corpus across the seven dimensions described above; and (6) within-case analysis, in which the

outcome-level findings were synthesized into recurrent themes, a case-level transformation model, and domain-level comparisons, with negative and disconfirming cases deliberately examined to test and refine the emerging explanation (Vears & Gillam, 2022). Ethical guidelines have been followed during document collection, coding, and analysis. In view of the fact that this research was based entirely on official public documents such as the curricula and textbooks, there was no need for any form of informed consent or confidentiality due to the absence of any human subjects. All source materials have been used for legitimate academic purposes only.

Trustworthiness

Several aspects of the design facilitated the validity of the analysis. First, the boundaries of the case, the curriculum corpus, the textbook corpus, and the official 68-SLO denominator were set prior to synthesis, avoiding post hoc reconceptualization of the unit of analysis. Second, the alignment judgments of each official SLO were based on a fully coded matrix rather than a selectively sampled or illustrative sample of the data, so the percentages presented reflect the full case rather than selected subsets. Third, compound outcomes were explicitly deconstructed into component sub-indicators to ensure that partial coverage of a multi-component indicator could not be mistaken for complete alignment. Fourth, claims were triangulated based on multiple independent lines of evidence for each claim—in this case, outcome-claim mapping, substantive episode content, cognitive demand coding, OTL coding, context coding, representation coding, and source quality flags. Fifth, negative and contrasting cases, or outcomes at which higher-order or contextual demands were actually maintained, were intentionally included rather than excluded to avoid the overgeneralization of an oversimplified deficit story.

Limitations

This research has focused on analyzing the textbook and the curriculum as texts; it does not cover how teachers teach through the textbook in the classroom, students' responses to certain tasks, or the actual learning process. A textbook can enable performance without requiring it to be taught as is, and teachers in the classroom can complement what the textbook lacks. The alignment judgments reported here are qualitative and evidence-based rather than psychometric measures of curriculum fidelity or student achievement. The analysis is bounded to one national curriculum document and one textbook edition for one grade and subject; generalization to other grades, subjects, provinces, or textbook editions requires additional cases. Finally, the source-quality flags identify evident language, mathematical, or temporal issues within the analyzed corpus; they do not constitute an independent, exhaustive mathematical error audit of every page of the textbook.

IV.RESULTS

Overall Alignment Distribution

All 68 official curriculum SLOs were formally signaled in the textbook's unit-opening outcome claims. The textbook contained 71 such claims rather than exactly 68 because three outcomes (M-08-B-21, M-08-D-04, and M-08-D-07) were split into multiple textbook claims, while two outcomes (M-08-B-19 and M-08-B-20) were merged into a single claim. No official SLO was found entirely without corresponding textbook evidence. At the substantive level, however, the outcome-by-outcome comparison of curriculum requirements with the corpus of coded textbook evidence produced a more differentiated picture.

Table III: Outcome-Level Distribution of Overall Alignment Ratings (N = 68 SLOs)

Overall Rating	Number of SLOs	Percentage
Strong	40	58.8%
Partial	25	36.8%
Weak	3	4.4%
Not aligned	0	0.0%
Total	68	100.0%

Of 40 SLOs (58.8%), high alignment was observed, indicating that the textbook retained the key elements of the outcome in terms of content, performance, representation, and learning opportunities. Of 25 SLOs (36.8%), partial alignment was established, indicating that the core concept was retained, although the cognitive demand, context, breadth of approach, precision, or practice was reduced. Low alignment among three SLOs was observed for the topics related to solving simultaneous equations, the application of the Pythagorean theorem in the real world, and theoretical/ experimental probabilities.

Domain-Level Findings

Table IV: Domain-Level Alignment Distribution

Domain	Strong	Partial	Weak	Not Aligned	Total SLOs	Strong %
A – Numbers and Operations	13	11	0	0	24	54.2%
B – Algebra	14	10	1	0	25	56.0%
C – Measurement	3	1	1	0	5	60.0%
D – Geometry	6	1	0	0	7	85.7%
E – Statistics and Probability	4	2	1	0	7	57.1%

There were excellent matches between Geometry and six out of seven SLOs (85.7%). The topics on rotation and enlargement (terms used to describe circles), triangle and quadrilateral constructions, bisectors, congruence, and similarity were all addressed with step-by-step construction illustrations, example and exercise problems, and review activities. Numbers and Operations had the most episodes (383 for 24 SLOs), and while there was excellent topical and procedural coverage, the alignment rate was relatively low (54.2%) because, in some instances, the curriculum expected students to analyze or apply knowledge rather than compute. Algebra (56.0% strong alignment) had the same trend, whereas the sole weak outcome for this domain – simultaneous equation solution methods – exemplified the clearest scope-of-content problem in the entire case. Measurement (60.0% strong, yet with the lowest number of SLOs) and Statistics and Probability (57.1% strong) both included authentic strengths (formula and illustration accuracy in Measurement and robust graph selection and justification in Statistics) with one specific weakness (real-life application of Measurement in Measurement and theoretical and experimental probability comparison in Statistics and Probability).

Cognitive Demand and Student Performance

The curriculum includes a dominant cognitive demand at the strategic analysis, justification/evaluation, or creation/generalization level in 26 of the 68 SLOs (38.2%). In the fully coded textbook corpus of 630 learner-response episodes (those requiring a student response as opposed to only expository episodes), only 39 episodes (6.2%) were coded at a similar higher-level cognitive demand, while 429 episodes (68.1%) were coded as routine procedure tasks. This constituted the single largest source of alignment loss in the case: verbs such as analyze, deduce, justify, interpret, and compare included in the curriculum were often turned into definition-example-routine-exercise sequences in the textbooks, asking students to perform a demonstrated calculation rather than reason about it.

Table V: Distribution of Cognitive/Task Demand in Textbook Learner-Response Episodes

Indicator	Count	% of Substantive/Response Episodes
Substantive textbook episodes	873	100.0% (base)
Learner-response episodes	630	72.2% of substantive episodes
Routine-procedure episodes (TD3)	429	68.1% of learner-response episodes
Higher-order episodes (TD4–TD6)	39	6.2% of learner-response episodes

Opportunity to Learn

The textbook provided a dense procedural instructional infrastructure: 237 modeled examples (27.1% of substantive episodes), 231 independent-practice episodes (26.5%), and 151 review or recap episodes, together dominating the opportunity-to-learn (OTL) profile. By contrast, episodes coded as relational explanation (19 episodes, 2.2%), guided prompts (18 episodes, 2.1%), and practical or experimental activities (6 episodes, 0.7%) were comparatively rare. The textbook is therefore best characterized instructionally as a worked-example-and-practice resource rather than a resource built primarily around guided reasoning, investigation, or activity-based learning, notwithstanding its substantial procedural volume.

Context, Application, and Modeling

Table VI: Distribution of Context Integration Across Substantive Textbook Episodes

Context-Integration Level	Count	Percentage
No context (CI0)	673	77.1%
Surface context (CI1)	162	18.6%
Mathematically consequential context (CI2)	3	0.3%
Empirical/observational (CI3)	35	4.0%
Total substantive episodes	873	100.0%

Of the 873 episodes of textbooks classified as substantive, 673 episodes (77.1%) had no context whatsoever. Another 162 episodes (18.6%) employed shallow context, in which named individuals, currencies, or objects embellished a procedural problem without changing the mathematical model, the assumptions, or the approach necessary. Three episodes (0.3%) employed context that was mathematically significant in the sense that it involved making modeling choices. There were 35 (4.0%) episodes, predominantly involving probability experiments, classified as empirical/observational. This distribution accounts for a considerable proportion of the partial scores in all domains, given that curricular expectations requiring real-world problems were often formally there but substantively reduced to mere substitution problems.

Multimodality and Representation

Alignments with the representational elements of mathematics were strongly evident in the textbook. Number line representations, Venn diagrams, tables, equations, graphs, geometrical diagrams, construction diagrams, histograms, frequency polygons, and empirical data were all used in relevant parts of the curriculum. There were 345 out of 873 (39.5%) substantive episodes that included multimodal representations, which were integral to the mathematical activity performed in these examples, rather than being supplementary material that was used only for illustration purposes.

Accuracy and Quality of Sources

The majority of substantive episodes (804 out of 873 or 92.1%) had no apparent problems with their source quality. However, 69 instances (7.9%) contained at least one flag related to the issue. In particular, there were 29 language/typography flags, 19 mathematics/formulas/solutions flags, and 21 temporal inconsistency/contextual obsolescence flags (primarily related to currency conversion rates and symbols). They were concentrated in absolute values, currency conversion, an example in insurance, selected sequence and identity of algebraic expression, mensuration label sets, statistical range definition, and probability wordings. However, even when present, the topic itself could not guarantee faithful alignment.

The Three Weakly Aligned Outcomes

Table VII: Summary of the Three Weakly Aligned Grade 8 Mathematics SLOs

SLO	Defining Curriculum Requirement	Why the Outcome Is Weak
M-08-B-15	Solve simultaneous linear equations in two variables using elimination, substitution, graphical, division, and factorization methods.	Only elimination, substitution, and graphical methods are substantively developed; the division method is absent, and factorization is named but not taught.
M-08-C-03	Solve real-life word problems using the Pythagorean theorem.	The outcome is formally claimed, but the substantive Pythagorean-theorem work is overwhelmingly abstract; meaningful real-life problem-solving is not adequately enacted.
M-08-E-07	Compare experimental and theoretical probability in simple events.	Experimental and theoretical probability are each defined and illustrated, but students are rarely required to perform the defining comparative judgment.

Negative and Contrasting Cases

Negative-case analysis was employed to examine whether the textbook inevitably reduced higher-order or contextual demand in the curriculum. Several results rejected a wholly deficient account and helped refine the core explanation of this study. Verification of set laws (M-08-A-22) involved demonstrating and verifying operations and the commutative, associative, and distributive properties through exercises for learners, thereby preserving evaluative demand. Stepwise construction techniques were applied in rotation, including the construction of a center of rotation (M-08-D-01) and enlargement with a center and scale factor (M-08-D-02); this way, the task required learners to develop a strategy rather than recognize. Graph selection, justification, and interpretation (M-08-E-01) involved the choice of a graph type, justifications, and conclusions drawn by the learner—this task proved to be one of the most prominent higher-order successes found in the corpus. Construction of statistical displays (M-08-E-04) involved extensive work with frequency tables, equal-width histograms, and frequency polygons. The textbook can preserve higher-order curriculum demands; thus, the previously discussed reduction seems to be a design/prioritization pattern rather than a textbook-format limitation.

V. DISCUSSION

The Central Case Pattern: Structural Fidelity with Selective Epistemic Reduction

Considered as a whole, the case cannot be adequately described by a simple aligned/misaligned binary. Formal coverage of the curriculum is complete, substantive content coverage is extensive, and nearly three-fifths of outcomes are strongly aligned by the seven-dimension framework applied here. At the same time, more than two-fifths of outcomes carry a consequential weakness, and the case's single largest transformation—reducing cognitive demand from 38.2% curriculum-intended higher-order outcomes to 6.2% higher-order textbook episodes—cuts across nearly every domain. The most defensible case-level description is therefore one of transformation rather than omission: the textbook typically includes the curriculum topic, but frequently changes the level, breadth, or contextual form of the mathematical performance the curriculum intends.

A Seven-Stage Transformation Model

The pattern observed across the case is consistent with a seven-stage model of curriculum-to-textbook transformation: (1) formal transfer of curriculum outcomes into unit-opening claims, which prevents complete omission but does not by itself guarantee enactment; (2) content selection and sequencing, in which every domain and topic cluster receives a corresponding unit or section; (3) procedural elaboration, in which curriculum content is expanded into demonstrated worked methods; (4) practice saturation, in which independent-practice and review episodes reinforce those methods; (5) representational scaffolding, in which visual and symbolic curriculum forms are preserved through diagrams, graphs, and constructions; (6) cognitive-contextual compression, in which

routine tasks dominate and consequential context and higher-order performance become comparatively rare; and (7) local quality perturbation, in which a minority of otherwise well-covered outcomes are further weakened by language, mathematical, or temporal inaccuracies. Stages 1 through 5 explain why the case achieves broad and largely accurate topical alignment; stage 6 explains the great majority of partial and weak ratings; and stage 7 explains why a small number of outcomes are weakened despite adequate topical and procedural coverage.

Interpreting the Findings Against Prior Research

The magnitude of cognitive-demand reduction documented here—from more than a third of curriculum outcomes intending higher-order reasoning to roughly one in sixteen textbook learner-response episodes achieving comparable demand—closely parallels findings from cognitive-demand research showing that higher-demand task categories are consistently the rarest in both textbooks and enacted instruction. That demand tends to decline during the transition from written task to student task (Parrish & Bryd, 2022). It is also broadly consistent with United States-based Survey of Enacted Curriculum research reporting low overall cognitive-demand alignment in widely used Grade 8 mathematics textbooks despite adequate coverage of content standards (Polikoff et al., 2021), suggesting that procedural dominance in mathematics textbooks may be a cross-national tendency rather than specific to this case. On the other hand, the finding in the current study that both representational and constructional fidelity persisted despite decreased cognitive demand is one way in which the study contributes a qualitatively different perspective than mere alignment statistics: a textbook can be very faithful to the curriculum's desired forms (diagrams, graphs, constructions) without being particularly faithful to its desired epistemic demands (analysis, justification, interpretation).

The results that 77.1% of episodes were fully decontextualized, and only 0.3% of episodes contained consequential mathematical modeling, are indicative of a much larger issue in the mathematical modeling literature regarding how textbook "real-world" problems may look like a word problem but lack the process of interpretation and decision-making that is an integral part of true mathematical modeling. Whenever the curriculum discusses the application of mathematics in the real world, including topics such as currency exchange, ratios, Pythagorean problems, and probability, textbooks provide the context for a word problem without any assumptions or model selection.

Domain-Level Interpretation

The alignment of geometry is rather high (85.7%). This is because geometry content involves more practical, visual learning, and the textbook's structure closely follows this pattern. By contrast, Algebra and Measurement each contain outcomes whose defining performance is methodological breadth (multiple solution methods) or authentic real-world application, and it is precisely these outcomes that produced the case's clearest weak ratings. This domain-level contrast supports the broader case-level explanation: the textbook's translation mechanism is well suited to visual, procedural, and constructional curriculum demands and comparatively less well suited to demands requiring analytic breadth, deduction, or authentic modeling, regardless of the domain in which those demands occur.

Implications for Textbook Revision and Curriculum Enactment

The findings indicate that textbook revision should not primarily add new topics or additional routine exercises, since content coverage is already extensive and no outcome was found absent. Instead, revision should focus on the quality of existing learning opportunities. Six directions follow directly from the evidence: (a) increasing cognitive fidelity by adding tasks that require explanation, comparison, error analysis, derivation, and defence of choices around already-covered content; (b) deepening contextual integration by replacing surface-context wrappers with situations that require assumption-making, model selection, and interpretation; (c) completing compound outcomes by auditing every multi-component SLO against its sub-indicators, using M-08-B-15 as the clearest illustrative case; (d) protecting the textbook's demonstrated representational strengths while layering reasoning prompts onto existing diagrams and graphs; (e) correcting identified source-quality issues, particularly around currency conversion, absolute value, sequence and identity examples, and statistical definitions, through independent mathematical review and a systematic, dated currency-rate convention; and (f) rebalancing opportunity to learn by supplementing the existing abundance of modelled examples and routine practice with relational explanation, guided reasoning prompts, and practical or experimental activities.

Directions for Future Research

Future research may consider conducting classroom-based analyses of how teachers in Balochistan teach the textbook and whether they try to compensate for the weaknesses in contextualization and cognitive demand revealed in this analysis. Comparing textbooks used in other provinces, as well as Grade 8 Mathematics and Grade 7 or 9 Mathematics in Balochistan, will allow us to determine whether the observed transformation is unique to this textbook or whether it reflects a similar tendency in translating the National Curriculum of Pakistan 2022–23 into textbooks. Lastly, replication of this study using the seven-dimension framework in other disciplines would also be useful.

VI.CONCLUSION

Based on the findings above, this directed qualitative content analysis shows substantial alignment between the Grade 8 Mathematics textbook being used in Balochistan province and the National Curriculum of Pakistan 2022–23 in terms of topic coverage, sequencing, use of mathematical representations, worked examples, and practice opportunities. All 68 SLOs outlined in the national curriculum were formally included in the textbook, with no SLO found unaligned. Nevertheless, the results show that more than two-fifths of the outcomes are partially or weakly aligned with the National Curriculum of Pakistan due to a decrease in cognitive demand, the presence of decontextualized or surface-context-based tasks, incomplete coverage of compound methodology, and some accuracy-related issues. Thus, it is safe to say that the textbook in question provides good coverage of the content, yet it is not fully faithful to the performances and epistemic practices outlined in the curriculum. This means that when creating a revised version of the textbook, it should not include any additional content; the main goal is to enhance the existing analysis, reasoning, deduction, authentic modeling, comparison, and accuracy of mathematics in the covered topics.

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