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Exploring Change and Alignment: An Academic Audit of Primary-Level Mathematics in Public Schools of Punjab Since 2000

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ABSTRACT

Primary-level Mathematics curriculum experienced five revisions since 2000 that could not break status qou in poorly performance of the students in basic algebraic operations on numbers. Alignment among curriculum, textbook, and assessment leads enhancing students' learning achievements. The instant study examines the change in the curriculum and determines the alignment among curricula, textbooks, and assessments proposed therein restricted to the basic algebraic operations on numbers since 2000. This investigation explores cosmetic quantitative changes in the focused curricula but no qualitative change because the ultimate scope remained unaltered. However, curricula, textbooks, and assessments proposed therein are found strictly aligned by employing Surveys of Enacted Curriculum (SEC) Modal devised by Porter. The cosmetic change transformed the curriculum into more structured form that facilitates the textbook developers, whereas; reduces the scope of multiple textbooks. Moreover, the curriculum is a document for the textbook developers and is revisable subject to the paradigm shift in the discipline.

Introduction

Every development anywhere is an offshoot of education that enables learners to solve real-life problems. All developments emerge from education (Bhatti et al., 2010, p. 1). Education surfaces and strengthens cognitive and non-cognitive abilities or skills to prepare the learner for solving problems. Education in the 21st century aims to develop skills so that students can solve their real-life problems (Saido, et el. 2018, p.17). Human beings need the development of both cognitive and non-cognitive skills that are caused and strengthened through education. Blooms' Taxonomy and Revised Blooms' Taxonomy explore six cognitive skills and bifurcated them into two core classifications i.e., Lower Order Think Skills (LOTS) and Higher Order Think Skills (HOTS).

Education is categorized into five levels i.e., (i) Pre-Primary School Education or Early Childhood Education (ECE); (ii) Primary School Education, i.e., grade I to grade V; (iii) Middle School or Elementary Education, i.e., grade VI to grade VIII; (iv) Matric or Secondary School Education, i.e., grade IX and grade X, and (v) Intermediate or Higher Secondary School Education, i.e., grade XI to XII, whereas; HE is categorized into general & professional education from grade XIII to Ph.D. (Memon, 2007, pp.49-50; Blood, 1996). The structure of the formal education system in Pakistan during the era focused on in the present study is shown in Table 1.

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Table 1. *Summary of the Formal Education System in Pakistan*

Formal Education System				
Level	**Grade**	**Duration (Years)**	**Age (Years)**	**Qualification**
Pre-Primary School Education	Kachi/ ECE	2	3 to 5	Pre-grade I (Early Childhood Education-ECE) was formally introduced in 1988 through the seventh five-year development plan.
Primary School Education	I–V	5	5 to 10	Primary School Certificate
Middle School Education	VI-VIII	3	10 to 13	Middle School Certificate
Secondary School Education	IX – X	2	13 to 15	Matric or Secondary School Certificate
Higher Secondary School Education	XI -XII	2	15 to 17	Intermediate or Higher Secondary School Certificate

Each level of education provides the base for the next level. Education drives Human Development Index (HDI) that triggers the Gross Domestic Product (GDP). HDI is an offshoot of education that has brought human beings from the stone age to the era of automation. GDP is the chief indicator of a country's economic status or strength; therefore, knowledge is among the crucial investments for development at any level. GDP and HDI are strongly co-related directly in developing countries with low per capita income. However, failure to cause quality education is the main threat to HDI and, thus, GDP. Baumann (2021, p. 36) observes that based on developmental growth, countries are categorized into four groups, i.e., (i) Most Developed Countries (MDCs); (ii) High Developed Countries (HDCs); (iii) Medium Developed Countries (MmDCs); and (iv) Low Developed Countries (LDCs). A country's rank also provides a take-off point for its future development. Highly developed countries have stronger HDI and GDP than developing and under-developing countries. Improvement in the education of a country improves its HDI and, thus, GDP. Deb (2015, pp. 16-17) observes a direct and substantial relation between HDI and GDP in low-income countries.

Pakistan is amongst the countries with low per capita income. All educational experiences revolve around the curricula whose content is interpreted through the textbooks. Poor quality education obstructs developmental growth in countries offering low per capita income, including Pakistan, where education quality is declining (Memon G. R., 2007, p. 54). A decline in quality education is a threat to HDI, and lower GDP amounts to a threat to the existence of a country. Survival of a country is embedded within adequate access to quality education. Optimal effective educational reform is subject to initiation right from the lower level. Therefore, quality education at the primary level is essential to cause quality at higher levels. School education develops the pupils' capacity for learning and the ability to cope with change promptly and flexibly in a knowledge society (Hargreaves, 2003, p. 10). There are scientific principles that work in social sciences as well. Trivially slightly differing initial states can evolve into considerably different states. The scope of this research does not permit entailing all aspects of shaping the holistic development of the students. Therefore, this study examines the curriculum, textbook, and assessment proposed therein.

Emphasis on the alignment of curriculum and instruction with the content coverage of the test improves students' learning (Madaus, 1983, p. 109). The world experiences constant change. Therefore, there is a need to keep the curriculum exposed to revision to prepare the students to meet new challenges. Continuous revision enhances the effectiveness of the curriculum implementation (Ramparsad, 2001, p. 289). Revision of the curriculum leads to meeting new challenges of changing world. Halai (2008, p. 124) emphasizes keeping the curriculum dynamic and updated to meet global challenges.

The development of textbooks with contents aligned with the curriculum ever remained challenging. Successful implementation of standards requires the support of aligned materials of high quality (Polikoff et al., 2020, p. 45). A book aligned with the curriculum is taken as the textbook. The educationists have considered curriculum alignment inevitable (Porter et al., 2007, p. 35). The alignment to the extent of agreement among the expectations of enacted curriculum, instructional content, and students learning achievements causes an effective education system (Webb, 2002, p. 2). The outcome of the curriculum is driven by its development mechanisms, including categorization of the developers, selection of the developers, training of the developers, involvement of the developers, timeframe, dissemination, implementation, and evaluation (Crato, 2020, p. 216; Ramparsad, 2001, pp. 289-290). The alignment of

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textbooks with the corresponding curricula is the primary cause of the commendable performance of Singapore's students in standardized tests (Fan, 2010, p. 7). Moreover, the usage of textbooks also positively affects SLAs. Gilbert and Wolf (2002 p. 6) referred strong relationship between the use of textbooks and students' learning achievements. Quality textbooks help teachers and learners shape their personalities (Dalim & Yusof, 2013, p.1043). The textbook of Biology for grade IX developed by the PCTB is misaligned with the curriculum (Bhatti et al., 2015, pp. 116-117). The textbook of Mathematics for grade VIII is misaligned with the curriculum 2006 (Hashmi, Hussain, Shoaib, 2018, p. 63). Therefore, the literature questions the alignment of entire curricula and textbooks adopted in public schools of Punjab.

All subjects at the primary level are introduced as core ones in Pakistan. Whereas; Mathematics remained one of the core subjects up to the secondary school level. It is pretty popular among other disciplines as it provides support to solve the problems related to them. Mathematics is ever used in other disciplines to solve various problems (Pratama, G. S., & Retnawati, H., 2018, p. 2). Mathematics is a discipline with expanded deep roots and an effective means of communication. Mathematics has become a universal language (Pratama, & Retnawati, 2018, p. 2). Moreover, it grooms the capabilities and personality of the learner. Presentation of Mathematical problems in a real-world context enhances learning ability (Alajmi, 2012, pp. 258-259). Acceptable practice for solving real-world problems reduces the difficulty level of solving such problems (Wijaya et al., 2015, p. 45). Engaging in solving real-world problems induces a direct effect on the student's cognitive skills. Importance, attitude, and confidence in Mathematics are positively correlated to engagement. Cognitive engagement in Mathematics being used daily raises the students' confidence upon learning the discipline (Attard, 2012, p. 10). Despite its importance, Mathematics is considered complex to teach and learn. Mathematics is usually taken by students at all levels as a tedious and complex subject, challenging to teach, and hard to learn (Jameel & Ali, 2016, p. 124; Gafoor & Kurukkan, 2015, p. 4; Liu & Koirala, 2009, p. 4; Ma & Xu, 2004, p. 37). This alarming situation, particularly with a core subject, spread its roots in other disciplines. Therefore, there is a need to investigate the existing quality of the curricula and textbooks in Mathematics right from the primary level.

Revision of the curriculum provides an opportunity for improving the alignment between curriculum and textbook (Crato, 2020, p. 217). Positive change in students' attitudes toward Mathematics can be caused and enhanced by employing improved strategies emphasizing the need to learn new concepts (Akinsola & Olowojaiye, 2008, p. 69). Providing ample and safe opportunities enhances the mathematical ability of children (Zan & Martino, 2007, p. 166). In other words, practice is the key to mastering mathematical concepts. Number sense leads to learning Mathematics that begins right from early life before children join schools. In infancy, the primary number sense develops without little input or instruction. Learning the oral count list and comprehending the cardinal value of the number leads to expressing more significant numbers exactly with the observation of the unique successor of each number (Sarnecka et al., 2008, p. 288). As far as symbolic number sense is concerned, it depends on what a child receives and next to the primary preoral number sense transitional of conventional Mathematics taught in schools. Therefore, the children are blessed with the ability to learn Mathematics right from the sensorimotor stage. Mathematics requires relatively little cognitive ability to learn it quite logically. Interest in Mathematics causes an increase in career options (Gravemeijer et al., 2017, p. 119-120). School Mathematics serves two primary purposes, i.e., raising the literacy rate of the workforce for industry and technology and enabling the students to pursue careers with this subject (Altundağ et al., 2009, p. 467).

The students of public schools in Punjab consistently exhibited poorly in Mathematics at the primary level in the last two decades. Annual Status of Education Report (ASER) consistently informed alarming situations regarding SLAs even for performing the algebraic operations on numbers at primary level (ASER, 2008, p. 36; ASER, 2010, p. 37; ASER, 2011, p. 129; ASER, 2012. P. 110; ASER, 2013, p. 169; ASER, 2014, p. 175; ASER, 2015, p. 167; ASER, 2016, 182; ASER, 2018, p. 182; ASER, 2019, p. 170). These results get validated through various independent studies. Research results of two different studies conducted by the Punjab Curriculum and Textbook Board (PCTB) in collaboration with the School Education Department (SED) and Department for International Development (DFID) of the United Kingdom were found aligned with ASER (Minutes of 1st meeting of the Board of PCTB held on 04.12.2014). There is a need to examine primary-level Mathematics curricula and textbooks to explore obstructions leading to these poor results.

Keeping in view the scope of the study, place of curriculum and textbook, the importance of Mathematics as a subject, and the pivotal role of primary education being a foundation for higher levels of education, this study is restricted to primary-level Mathematics adopted in public schools of Punjab in the 21st century. Moreover, contents related to basic algebraic operations on numbers remain the focus of this research.

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The curriculum is an epicenter of all educational activities. The dynamic curriculum is the chief instrument of education (Venkataiah, 1993). Nine primary-level formal Mathematics curricula have been adopted in public schools in Punjab since 1947. First national Mathematics curriculum for the primary level 1975-1976. Revision of curriculum and textbook provides an opportunity to cause improvement therein. Prastowo (2011) observes that the life of a curriculum or textbook is subject to necessary revision. Therefore, periodic review and revision are a spirit of curriculum and textbook. Crato (2020, p. 216) observes that curriculum revision enhances SLAs. The primary-level Mathematics curricula experienced four revisions before the 18th amendment, i.e., in 1984-1985, 1994-1995, 2000, and 2006 (National Curricula for Mathematics, 2006, p. 1). Punjab Curriculum & Textbook Board disseminated the curricula in focus in 2014, 2017, and 2019 (Mathematics Curriculum Grades I-V, 2019, p. ii). Single National Curriculum Mathematics for Grades I-V was notified by the National Curriculum Council Ministry of Federal Education and Professional Training, Islamabad Government of Pakistan, in 2020, which was adopted by the Government of Punjab and PCTB.

Though the primary level Mathematics curriculum adopted in the public schools of Punjab experienced six revisions in the 21st century, i.e., in the years 2000, 2006, 2014, 2017, 2019, and 2020 and also implemented except ones in the years 2017 and 2019, the revisions did not cause a significant improvement in SLAs. Therefore, there is a need to determine and examine the changes after revisions.

Constant failure makes a student believe in being disabled in the subject and thus accept his permanent defeat. Lack of confidence in doing Mathematics leads to failure, termed as negative feelings (Zan & Martino, 2007, p. 166). Moreover, switching over curriculum–based assessment targeted to be achieved by 2023 at the secondary level has not been achieved so far. It has been observed that curriculum, textbook, and assessment alignment drive the students' performance. Therefore, the existing situation requires exploration of the changes in the Mathematics curriculum due to revisions and the degree of alignment among curriculum, textbook, and assessment proposed therein. The enactment of "National Textbook and Learning Materials Policy and Plan of Action, 2007" was promulgated with the claim that the transformation of single textbook to multiple textbooks shall enhance the quality of the textbooks subsequent of choice on the part of the buyer and the competition among the developers (Textbook Policy, 2007, p. 1). This policy was practically proved to be a transformation of monopoly on textbooks from Government organizations to private publishers, i.e., the revival of the system, which was abolished based on independent investigations. These investigations include the First National Conference, 1947 (Government of Pakistan, 2007); Sharif Commission Report, 1959 (Sharif, 1959); and the investigation headed by General Ali Nasir Khan in 1962.

Students' achievement directly depends upon the alignment between the taught and the tested curriculum (Valverde & Schmidt, 1997, p. 62). Misalignment between prescribed and tested curriculum is the primary cause of the poor performance of American students (Cohen, 1987). The alignment between the textbook and the prescribed curriculum is the primary cause of the high performance of Singapore's students in standardized tests (Fan, 2010, p. 7). There is a strong relationship between curriculum, textbook, and assessment. Therefore, the alignment improves students' learning achievement (Squires, 2012, p. 132). The alignment status among curriculum, instructional material, and assessment guides developers, teachers, test developers, and policymakers in taking measures to increase quality on their part (Webb, 2002, p. 13).

The primary level Mathematics curriculum adopted in the primary schools of Punjab experienced six revisions during the last two decades, but SLAs experienced the status quo even at the LOTS level in the era of the 21st century that demands transformation to HOTS. Moreover, alignment among curriculum, textbook, and assessment is the primary cause of the admirable performance of Singapore's students in standardized tests (Fan, 2010, p. 7). Therefore, consistency in poor SLAs at the primary level of Mathematics and poorly ranking of Pakistan in SLAs based international assessment question the alignment among curriculum, textbook, and assessment proposed therein.

This research study determines the change experienced by the primary level Mathematics curriculum adopted in the public schools of Punjab during the last two decades. It determines the degree of alignment or/ and misalignment among curriculum, textbook, and assessment proposed therein since 2000.

The pursuit of all educational tasks is to ensure the effectiveness of the corresponding curriculum. This study aims to enhance SLAs in the core subject of Mathematics at the primary level in Punjab. Every task is like a journey that begins at the current position to reach its target point; therefore, this study provides the current position as feedback for policymakers and executives to assist them with measures to enhance SLAs right from the primary level.

Rationale of the Study

Pakistan is a developing country and remains facing financial crises. The only solution to uplift

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Pakistan is to keep improving its GDP, driven by HDI that depends upon education that revolves around curriculum being its epicenter. However, the pursuit of every research study is to identify knowledge gaps in the existing block of literature and fill a few of the identified gaps leaving the rest for future research. The existing literature block is devoid of changes caused by revisions, degree of alignment, or/ and misalignment among curriculum, textbook, and assessment proposed therein at primary level Mathematics curriculum adopted in the public schools of Punjab in the 21st century.

A positive break from the alarming status quo of poor SLAs is crucial to divert huge investments of resources i.e., time, human resources, energy, and finances for enhancing SLAs rather than maintaining otherwise through poor quality of education and thus exposing HDI and GDP to decline. The research objectives (ROs) of this investigation on the primary-level Mathematics curriculum adopted in the public schools of Punjab in the 21st century are:

RO 1. To determine the change experienced in the basic algebraic operations, i.e., addition, subtraction, multiplication, and division of rational numbers;

RO 2. To determine alignment among the primary level Mathematics curriculum, textbook, and assessment proposed therein related to the basic algebraic operations on numbers.

Literature has established that revision of curriculum or/ and alignment among curriculum, textbook, and assessment proposed therein lead to improve SLAs. Whereas, enforcement of four revised primary-level Mathematics curricula adopted in public schools of Punjab since 2000 failed to raise SLAs even in basic algebraic operations on numbers up to desirable levels. This situation questions above mentioned revisions and alignment. Therefore, the research questions (RQs) of this investigation on the primary level-Mathematics curriculum adopted in the public schools of Punjab in the 21st century are:

RQ 1. What changes did revisions cause in basic algebraic operations on numbers in the primary-level Mathematics curriculum enforced in the public schools of Punjab in the 21st century?

RQ. 2 What is the degree of alignment among the contents of basic algebraic operations on numbers in the curriculum, textbook, and assessment proposed in the primary-level Mathematics adopted in public schools of Punjab in the 21st century?

Significance of the Study

This investigation explores a few research gaps, fills some identified gaps, and leaves the rest as a guide for future research. This research study surfaces the quality of the primary-level Mathematics curriculum enforced in the public schools of Punjab in the 21st century. It explores the change in the primary-level Mathematics curriculum and determines the alignment among curriculum, textbook, and assessment proposed therein since 2000. This exploration would facilitate the stakeholders to take essential measures to ensure desirable SLAs, improving HDI and, thus, GDP. This research is extendable to other disciplines and grades as essential measures for enhancing SLAs across the levels of education. Moreover, this addition to the literature would attract researchers toward primary-level education.

Limitations of the Study

The primary-level Mathematics curriculum has been revised six times since 2000, i.e., in 2000, 2006, 2014, 2017, 2019, and 2020 but the ones notified in 2017 and 2019 were not enforced. Therefore, the scope of this research study regarding the alignment among the primary level Mathematics curriculum, textbook, and assessment proposed therein remains curtailed to ones notified in the years 2000, 2006, 2014, and 2020.

In furtherance to it, there are numerous variables upon which SLAs depend, but the same can be addressed in a funded project but cannot be addressed at individual-level research with limited financial resources and restricted and short timelines.

Delimitations of the Study

Various factors drive the quality of the curriculum and SLAs. Therefore, the scope of this investigation cannot be extended to explore and analyze all of the factors associated with the contents of the primary-level Mathematics curriculum, textbook, and assessment proposed. This investigation is delimited to the basic algebraic operations, i.e., addition, subtraction, multiplication, and division of numbers, for exploring the change in the contents and determining alignment among the curriculum, textbook, and assessment proposed therein since 2000.

Theoretical Background

The change in the primary-level Mathematics curriculum is determined through document analysis. Students' Learning Outcomes (SLOs) of the primary-level Mathematics curriculum under revision and revision are bifurcated into common and uncommon SLOs. A few SLOs of the previous curriculum are not carried, whereas; a few are carried to the revised curriculum. A few SLOs have been added to the revised

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curriculum. Therefore, both curricula have standard and uncommon SLOs, i.e., two consecutive curricula. SLOs of the under-revision and revised curriculum are jointly shown in Figure 1.

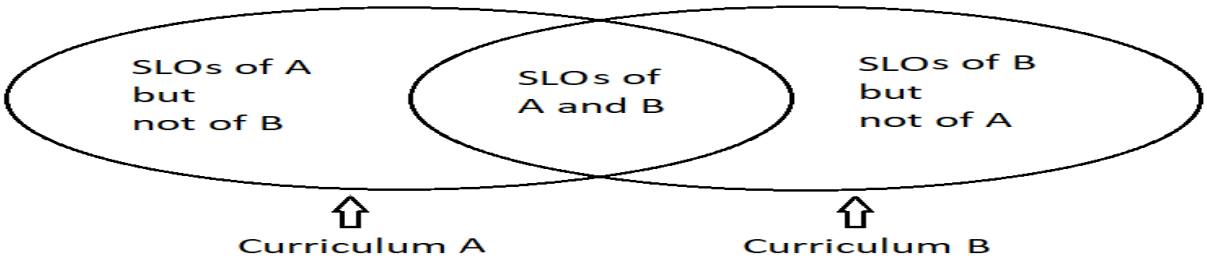

Figure 1: **Developed by the Researcher in 2023**

The revised or later curriculum change is determined through document analysis and demonstrated through a bar graph. For this purpose, SLOs related to an operation and class are compared with the entire SLOs adopted since 2000. Whereas; the alignment among respective contents of the curriculum, textbook, and assessment proposed therein is determined through the Surveys of Enacted Curriculum (SEC) model. SEC model is more convenient for determining curriculum alignment to textbooks and assessments. Porter developed and introduced it in 2001 (Polikoff et al., 2020, p. 38). SEC model is commonly used to determine the degree of alignment between curriculum and textbook (Bhatti et al., 2017, pp. 35-36). That is why the SEC model has been adapted to investigate the degree of alignment among primary-level Mathematics curriculum, textbook, and assessment proposed therein. SEC model requires converting the material into parts that may be standards, content learning objectives, or topics, and then the parts are sorted according to the cognitive level. Two subject specialists are selected to make up a panel of experts for the decision-making process. The panelists are trained to sort SLOs to be mapped to the cell relevant to the most appropriate cognitive level in the matrix. One SLO may relate to more cells in the matrix. The alignment is reported through index values ranging from 0 to 1. The produced matrix may then be topographically represented. The emphasis is noted relatively for each cell. It means that once the items are categorized, the weighted average of each cell is calculated. The most excessively, efficiently, and frequently used formula for Alignment Index (AI), proposed by Porter (Polikoff et al., 2020, p. 39), is as follows:

$$\text{AI} = \sum_i 1 - \frac{|x_i - y_i|}{2}$$

Here, x_i represents the weighted average in document X (intended curriculum) that is located in cell i, and y_i is a respective proportion in document Y (assessment curriculum) and A_i falls within the range of 0 to 1. One can say that the larger the value of the index, the better the alignment (Polikoff et al., 2020, p. 44).

This is because, according to the index formula, the value of the alignment index depends on two factors, i.e., the size of cognitive demands or dependence factors and the number of standards. AI decreases with an increase in the size of dependence factors and increases if the intersection of standards or "points" are increased. Fulmer has developed tables for obtaining acceptable minimum alignment index based on standard points and the number of cells of a matrix (Fulmer, 2011, pp. 25-32).

Research Methodology and Design

The MMR design opted for exploratory sequential design, i.e., qual → Quan. The movement of change in the primary-level Mathematics curriculum adopted in the public schools of Punjab since 2000 is explored through document analysis. The quality of the focused curricula in terms of cognitive skills and the alignment among curriculum, textbook, and assessment proposed therein is determined through an adapted SEC model. The data obtained through document analysis related to determining the alignment is quantitative and is analyzed respectively through adapting the SEC model, which is also quantitative. Qualitative research is taken as a complementary preliminary, whereas; quantitative research is taken as a principal follow-up. Therefore, the present research follows an exploratory Mixed Methods Research design.

Data Analysis

This investigation explains and explores the qualitative and quantitative changes after the revisions of the primary-level Mathematics curriculum adopted in public schools of Punjab since 2000. Analysis of the curriculum document explains that SLOs of a relevant part of each curriculum are a subset of 215 SLOs, whereas; 67 SLOs are common to all curricula. However, the number of SLOs of curricula 2000, 2006, 2014, 2017, 2019, and 2020 are 111,158, 149, 183, 183, and 162, respectively. Moreover, the curricula of 2017 and 2019 are quantitatively identical. Grade-wise quantitative position or change in the curriculum has been displayed through Bar Graph 1, whereas; overall position or change in the curriculum is through Line

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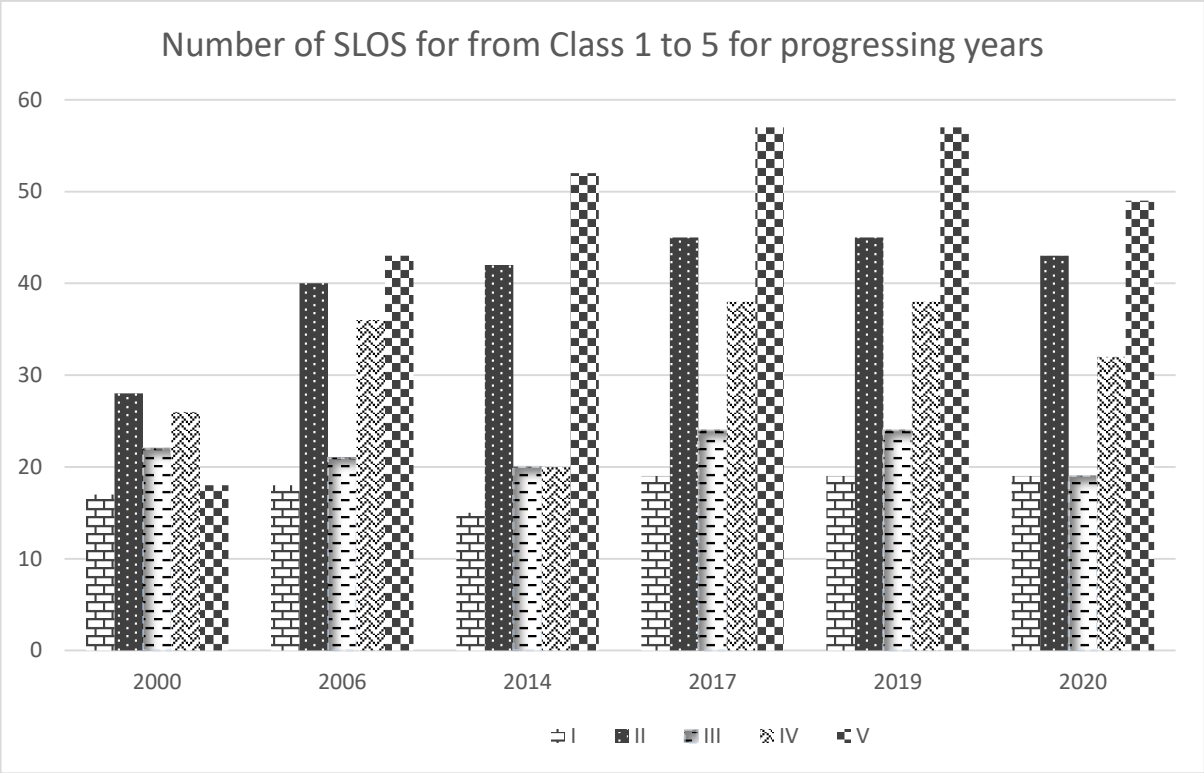
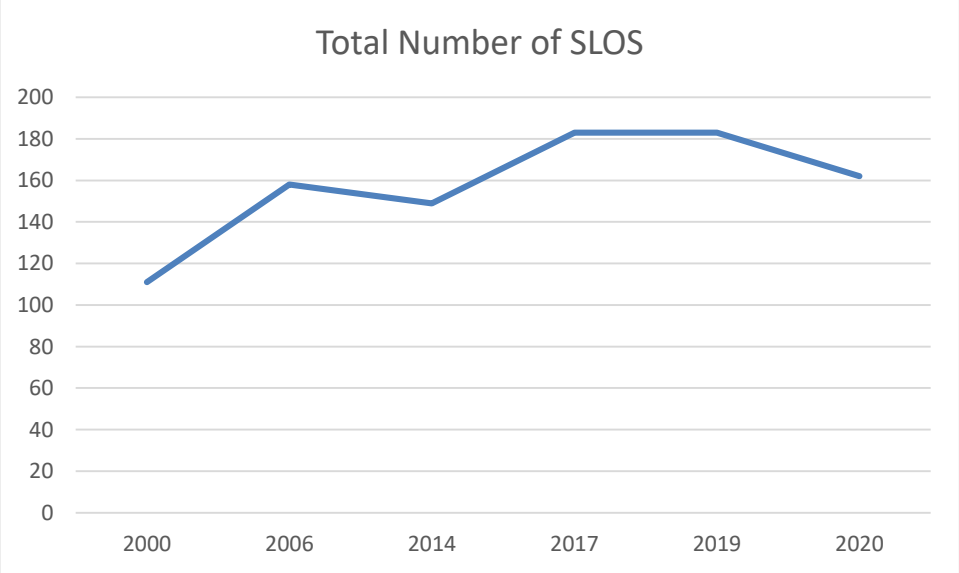
Graph 2. Curriculum 2000 is the base and not compared with the previous curriculum. Thus, five revisions have been examined for the purpose.

Graph No. 1: *Bar Graph Grade-Wise SLOs of Primary-Level Mathematics adopted in the Public Schools of Punjab during the 21st Century*



Graph No. 2: *Line Graph for SLOs of Primary-Level Mathematics adopted in the Public Schools of Punjab during the 21st Century*



The qualitative analysis of the relevant contents of the curriculum explores the four basic algebraic operations, i.e., addition, subtraction, multiplication, and division, applied to rational numbers in the form of whole numbers, fractions, and decimal fractions. Moreover, the curriculum prescribes whole numbers up to 6 digits, fractions with the same and different denominators, and decimal fractions up to four decimal places at primary-level Mathematics.

Basic algebraic operations on whole numbers have been introduced right from grade I of entire curricula since 2000. Addition and subtraction up to 6-digit whole numbers without or/ and with carrying and borrowing, respectively, are prescribed at the primary level of education. These are concluded within the contents for grades I and III in Curriculum 2000; grades I to IV in Curricula 2006, 2014, 2017, and 2019; and

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grades I to V in Curriculum 2020. However, addition and subtraction of whole numbers of complexities and arbitrary size are also introduced beyond the curriculum 2000. Multiplication and division up to 3-digit by 2-digit whole numbers are concluded within grades II and III in curriculum 2000; whereas; 6-digit by 3-digit whole numbers are concluded within grades II to V in curricula 2006, 2014, 2017, and 2019; and 5-digit by 3-digit and 5-digit by 2-digit whole numbers are respectively concluded within grades II to V in the curriculum 2020.

Basic algebraic operations on fractions are prescribed from grade III in all of the six curricula. Addition and subtraction of fractions with the same and different denominators are concluded within grades III and IV in the curriculum 2000; grades III to V in the curricula 2006, 2014, 2017, 2019, and 2020. Multiplication and division of a fraction by a whole number or/ and by another fraction with the same and different denominators are concluded within grade IV in the curriculum 2000; and grades IV and V in the curricula 2006, 2014, 2017, 2019, and 2020.

Basic algebraic operations on decimal fractions are introduced from grade III in the curriculum 2000, whereas; grade IV in curricula 2006, 2014, 2017, 2019, and 2020. Addition and subtraction of decimal fractions up to 4 decimal places are concluded within grades III to V in the curriculum 2000; grades IV and V in the curriculum 2006, 2014, 2017, and 2019; and within grades III to V in curriculum 2020. Multiplication and division of decimal fractions by whole numbers or/ and by another decimal fraction up to 4 decimal places are also concluded respectively within grades IV and V in the curriculum 2000; by whole numbers or/ and by fraction or/ and by another decimal fraction up to 4 decimal places are also concluded within grades IV and V in the curriculum 2006, 2014, 2017, and 2019, whereas; multiplication of 3-digit numbers up to 2 decimal places and division of 3-digit numbers up to 2-decimal places by 2-digit numbers of 1 decimal place are concluded within grades IV and V in the curriculum 2020.

It has been observed that the primary-level Mathematics curriculum gets more structured than the previous one. Curriculum 2006 elaborates or structures Subsequently, the curricula exhibited more quantitative variations concerning the number of SLOs but with the same ultimate scope. However, the cause of the reduction of the number of SLOs in the second revision in 2014 is to eliminate overlapping SLOs in the curriculum 2006 for the curriculum 2014. The third revision in 2017 proved a revival of the curriculum in 2006 with cosmetic changes that enhanced the number of SLOs. However, the fourth revision provides nothing new except eliminating evidence for inactions or disinterest to extend intellectual contribution towards the subject. The fifth revision in 2020 provides presentation differences coupled with suggested activities maintaining the scope of the primary-level Mathematics adopted in the public schools of Punjab since 2000. It has also been observed that the curricula for 2017 and 2019 remain expired without implementation.

The first primary-level Mathematics curriculum adopted in the public schools of Punjab in the 21st century was introduced in 2000; five revisions have been carried out so far. The revisions occurred in 2006, 2014, 2017, 2019, and 2020. Only four curricula disseminated in 2000, 2006, 2014, and 2020 have been implemented. Therefore, this study encounters limitations in determining alignment among SLOs of the curriculum related to the basic algebraic operations on rational numbers, their interpretation in the textbook, and the assessment proposed therein. SEC model devised by Porter has been adapted to gage the alignment using the following formula and comparing the results with the values of the alignment index in Fulmers' table:

$$\text{AI} = \sum_i 1 - \frac{|x_i - y_i|}{2}$$

The alignment index among four curricula, textbooks, and assessments proposed therein is shown in the Table No. 2 coupled with its line graph:

Table No. 2: *Values of Alignment Index*

Year	AI			
	TA	CA	TC	Required
2000	0.617453	0.837616	0.726659	0.5502
2006	0.674163	0.893207	0.744725	0.585
2014	0.661152	0.896984	0.734628	0.582
2020	0.556469	0.877141	0.679327	0.5506

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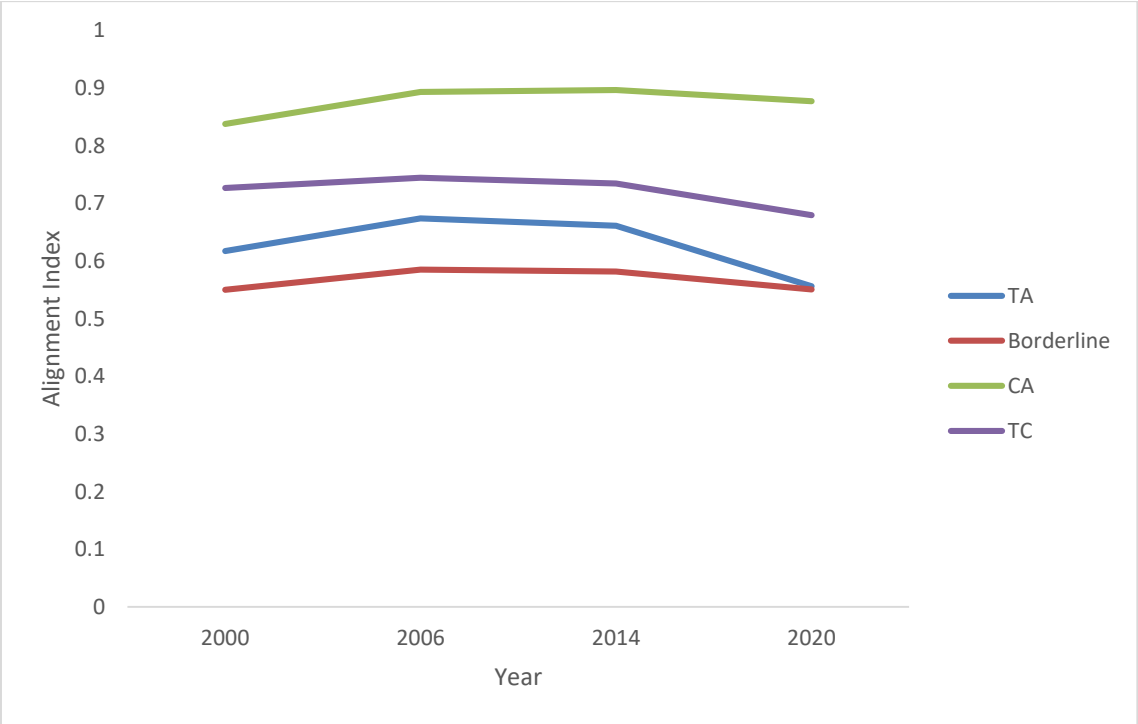

Graph No. : *Alignment of CT, TA, and AC*

SLOs of the curricula 2000, 2006, 2014, and 2020 related to basic algebraic operations on rational numbers are found aligned with the textbooks, contents interpreting SLOs through textbooks are also found aligned with the assessment proposed therein, and these assessments are also found aligned with the relevant SLOs of the curricula.

Though curriculum versus textbook, textbook versus assessment proposed therein, assessment proposed in a textbook versus curriculum are found aligned with different degrees of alignment, alignment between assessments proposed in the textbooks and prescribed relevant SLOs of the curriculum is found with highest degree, alignment between textbook and assessment proposed therein is found with the medium degree, whereas; the alignments between textbook and assessment are found with the lowest but above the borderline distinguishing regions of alignment and otherwise. The transitivity property is embedded within the alignment. The alignment among curriculum, textbook, and assessment proposed therein is necessary but insufficient for enhancing students' learning achievements.

Discussion

Literature is deficient regarding alignment between curriculum and textbook, textbook and assessment, and assessment and curriculum at the primary or foundation level of education. Moreover, the principal author of this research paper is not only Subject Specialist in Mathematics but has served in the curriculum and textbook field for more than 27 years.

The primary-level Mathematics curriculum adopted in the public schools of Punjab since 2000 has experienced five revisions, i.e., six versions of the curriculum have been introduced in the 21st century. However, only four curricula disseminated in 2000, 2006, 2014, and 2020 have been implemented, whereas; two curricula disseminated in 2017 & 2019 are not only expired without their implementation but are also found identical. The ultimate objective of a topic is sufficient to be taken as SLO enhance the scope of diversed multiple textbooks, whereas; revision of primary-level Mathematics curriculum should be subject to the paradigm shift in the discipline. The curriculum is a document for the textbook developers.

A more structured curriculum curtails the need and scope for the multiple textbooks. However, the single textbook policy has been transformed into a multiple textbook policy since 2007, whereas; revisions of the curriculum caused a more structured curriculum after the cosmetic change therein. This change becomes beneficial for wanting textbook developers.

This study explores curriculum and textbook; textbook and assessment proposed therein; and assessment proposed in textbook and curriculum aligned ; in the textbook in the textbook and curriculum of Mathematics adopted in the public schools of Punjab being well aligned since 2000. Therefore, consistency in poorly performance leads to hold that alignment among curriculum, textbook, and assessment is necessary but not sufficient condition for attaining the prescribed student's learning objectives. Alignment is also found

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enjoying transitivity onver curriculum, textbook, and assessment.

There is a need to explore sufficient conditions for attaining the prescribed students' learning objectives. Moreover, there is a need to explore the distribution of lower bounds for the quantum of the change justifying curriculum revision across the disciplines, levels, and grades. It is also worth exploring to surface sufficient conditions that ensure students' learning achievement across disciplines, levels of education, and grades.

Quality of textbooks at the primary level is crucial as the foremost step to meaningfully enhancing HDI or/ and GDP. Therefore, there is a need to work on the capacity building of textbook developers.

Findings

The ultimate scope of the primary-level Mathematics curriculum adopted in the public schools of Punjab remains the same in the 21st century. The primary-level Mathematics curriculum document is practically for the textbook developers, like the medical Doctor's prescription is for the pharmacist.

Each revision of the primary-level Mathematics curriculum caused the quantitative cosmetic change that transformed the existing curriculum into a more structured form that facilitates the textbook developers. Therefore, none of the five primary-level Mathematics curriculum revisions have enjoyed qualitative change since 2000.

The focus of the curriculum developers upon structuring the curricula without altering the scope of the discipline provides evidence that they considered textbook developers lacking the capacity for curriculum interpretation. However, a structured curriculum reduces the scope of multiple textbooks and vice versa. Moreover, the ultimate objective of a topic is sufficient SLO of primary-level Mathematics curriculum for genuine textbook developers and to promote multiple textbooks.

Primary-level Mathematics curriculum needs revision subject to a paradigm shift in the discipline. Moreover, the curriculum is a document for textbook developers, as a medical Doctor's prescription is for pharmacists. Therefore, there is a need to invest more input particularly intellectual input in developing learning materials including textbooks, at the primary level. HDI or/ and GDP cannot be enhanced meaningfully without this investment.

Conclusion

Revisions of the primary level Mathematics curriculum caused no qualitative change as the ultimate scopes of the basic operations over the domain of rational numbers remained with the unaltered scope, whereas; break up of SLOs, repeating SLOs, eliminating overlapping, and varying presentation styles coupled with proposed activities only caused quantitative cosmetic change therein. this cosmetic change facilitates textbook developers.

Alignment among curriculum, textbook, and assessment proposed therein is trivially necessary but insufficient to enhance students' learning achievements.

Usually, textbooks and curricula are not distinguished; therefore, the curriculum is practically a document for the textbook developers and not for the teachers and the students.

Recommendations

There is a need to explore why the fourth revision of the primary-level Mathematics curriculum caused no change, i.e., why was curriculum 2019 accepted as a revised version whereas; the same was identical to the earlier curriculum 2017.

This study may be extended across disciplines, levels, and grades.

References

Alajmi, A. H. (2012). How do elementary textbooks address fractions? A review of mathematics textbooks in the USA, Japan, and Kuwait. *Educational Studies in Mathematics*, *79*(2), 239–261.

Altundağ, R., Yıldız, C., Köğce, D., & Aydın, M. (2009). Teacher views about the 8th-grade mathematics textbook prepared according to the new primary education mathematics curricula. *Procedia - Social and Behavioral Sciences*, *1*(1), 464–468. Retrieved from http://doi.org/10.1016/j.sbspro.2009.01.084

Akinsola, M. K., & Olowojaiye, F. B. (2008). Teacher instructional methods and student attitudes towards Mathematics. *International Electronic Journal of Mathematics*

Attard, C. (2012). Engagement with Mathematics: What does it mean and what does it look like? *Australian Primary Mathematics Classroom*, *17*(1), 9–12.

Barrett II, A. J., & Ahmed, A. K. (2000). MIDWEST ADULT EDUCATION RESEARCH METHODOLOGIES: A SEVENTEEN YEAR SURVEY. *Asia; Botswana; Haiti; Nicaragua; Wisconsin (Milwaukee)*, 38.

Bhatti, A. J., Jumani, N. B., & Bilal, M. (2015). Analysis of Alignment between Curriculum and Biology

Correspondence concerning this article should be addressed to Mazhar Hayat, pdf1900016@ue.edu.pk

Textbook at Secondary Level in Punjab. *Pakistan Journal of Social Sciences (PJSS)*, *35*(1).
Bhatti, A. J., Khurshid, K., & Ahmad, G. (2017). Curriculum alignment: An analysis of the textbook content. *Pakistan Journal of social Sciences*, *37*(1), 30-43
Bhatti, M. A., Bano, S., Khanam, F., & Hussain, A. (2010). Problems in the Implementation of National Education Policies at Elementary level.
Blood, P. R. (1996). *Pakistan: a country study*. DIANE Publishing.
Cohen, A. M., & Brawer, F. B. (1987). *The Collegiate Function of Community Colleges: Fostering Higher Learning through Curriculum and Student Transfer*. Jossey-Bass Inc., Publishers, 350 Sansome Street, San Francisco CA 94104.
Crato, N. (2020). Curriculum and educational reforms in Portugal: An analysis on why and how students' knowledge and skills improved. *Audacious Education Purposes: How Governments Transform the Goals of Education Systems*, 209-231.
Dalim, S. F., & Yusof, M. M. M. (2013). Quantitative method of textbook evaluation for chemistry (KBSM) Form 4 textbook. In *Proceeding of the International Conference on Social Science Research, ICSSR* (Vol. 2013, pp. 1038-1046).
Deb, S. (2015). Gap between GDP and HDI: Are the rich country experiences different from the poor. *IARIW-OECD Special Conference*.
Fan, L. (2010, March). Principles and processes for publishing textbooks and alignment with standards: A case in Singapore. In *APEC Conference on Replicating Exemplary Practices in Mathematics Education, Koh Samui, Thailand* (pp. 7-12).
Fulmer, G. W. (2011). Estimating critical values for strength of alignment among curriculum, assessments, and instruction. *Journal of Educational and Behavioral*
Gafoor, K. A., & Kurukkan, A. (2015). Why High School Students Feel Mathematics Difficult? An Exploration of Affective Beliefs. *Online Submission*.
Gilbert B and Wolf 2002 *According to The Book* (New York: Springer Science and Business Media New York
Government of Pakistan. (2007). National textbook and learning materials policy and plan of action.
Gravemeijer, K., Stephan, M., Julie, C., Lin, F. L., & Ohtani, M. (2017). What Mathematics Education May Prepare Students for the Society of the Future?. *International Journal of Science and Mathematics Education*, *15*(1), 105-123.
Halai, N. (2008). Curriculum reform in science education in Pakistan. *Science education in context: An international examination of the influence of context on science curricula development and implementation*, 115-129.
Hargreaves, A. (2003). *Teaching in the knowledge society: Education in the age of insecurity*. Teachers College Press.
Hashmi, A., Hussain, T., & Shoaib, A. (2018). Alignment between Mathematics Curriculum and Textbook of Grade VIII in Punjab. *Bulletin of Education and Research*, *40*(1), 57-76.
Jameel, T., & Ali, H. H. (2016). Causes of poor performance in mathematics from the perspective of students, teachers and parents. *American Scientific Research Journal for Engineering, Technology, and Sciences (ASRJETS) 15*(1),122-136.
Lee, T. W., Mitchell, T. R., & Sablynski, C. J. (1999). Qualitative research in organizational and vocational psychology, 1979–1999. *Journal of vocational behavior*, *55*(2), 161-187.
Liu, X., & Koirala, H. (2009). The effect of mathematics self-efficacy on mathematics achievement of high school students.
Ma, X. and Xu, J. (2004). Assessing the relationship between attitude towards mathematics and achievement in mathematics: A meta-analysis. *Journalfor Research in Mathematics Education*, *28*(1),26-47.
Madaus, G. F. (1983). Establishing Instructional Validity for Minimum Competency Programs: Robert Calfee with the assistance of Edmund Lau and Lynne Sutter. *The Courts, Validity, and Minimum Competency Testing*, 95-113.
Memon, G. R. (2007). Education in Pakistan: The key issues, problems and the new challenges. *Journal of Management and Social Sciences*, *3*(1), 47-55.
Morgan, D. L. (2014). Pragmatism as a paradigm for social research. *Qualitative inquiry*, *20*(8), 1045-1053.
Polikoff, M. S., Gasparian, H., Korn, S., Gamboa, M., Porter, A. C., Smith, T., & Garet, M. S. (2020). Flexibly Using the Surveys of Enacted Curriculum to Study Alignment. *Educational Measurement: Issues and Practice*, *39*(2), 38–47. https://doi.org/10.1111/emip.12292
Prastowo, A. (2011). Panduan Kreatif Membuat Bahan ajar inovatif (Jogjakarta: Diva Press).

Correspondence concerning this article should be addressed to Mazhar Hayat, pdf1900016@ue.edu.pk

Pratama, G. S., & Retnawati, H. (2018, September). Urgency of higher order thinking skills (HOTS) content analysis in mathematics textbook. In *Journal of Physics: Conference Series* (Vol. 1097, No. 1, p. 012147). IOP Publishing.

Ramparsad, R. (2001). A strategy for teacher involvement in curriculum development. *South African Journal of Education, 21*(4), 287-291.

Retnawati, H., Arlinwibowo, J., Wulandari, N. F., & Pradani, R. G. (2018). Teachers' difficulties and strategies in physics teaching and learning that applying mathematics. *Journal of Baltic Science Education*, *17*(1), 120-135.

Saido, G. M., Siraj, S., Nordin, A. B. B., & Al_Amedy, O. S. (2018). Higher order thinking skills among secondary school students in science learning. *MOJES: Malaysian Online Journal of Educational Sciences*, *3*(3), 13-20.

Sarnecka, B. W., & Carey, S. (2008). How counting represents number: What children must learn and when they learn it. *Cognition*, *108*(3), 662–674.

Scott, D., & Morrison, M. (2006). *Key ideas in educational research*. A&C Black.

Sharif, S. M. (1959). Report of the commission on national education.

Squires, D. (2012). Curriculum alignment research suggests that alignment can improve student achievement. *The Clearing House: A Journal of Educational Strategies, Issues and Ideas*, *85*(4), 129-135.

Tashakkori, A., & Creswell, J. W. (2007). Exploring the nature of research questions in mixed methods research. *Journal of mixed methods research*, *1*(3), 207-211.

Tashakkori, A., Teddlie, C., & Teddlie, C. B. (1998). *Mixed methodology: Combining qualitative and quantitative approaches* (Vol. 46). Sage.

Valverde, G. A., & Schmidt, W. H. (1997). Refocusing US math and science education. *Issues in Science and Technology*, *14*(2), 60-66.

Venkataiah, N. (Ed.). (1993). Curriculum Innovations for 2000 AD. New Delhi: Ashish Publishing House.

Webb, N. L. (2002). An analysis of the alignment between mathematics standards and assessments for three states. Paper presented at the annual meeting of the American Educational Research Association; April 1–5, 2002; New Orleans, LA.

Wijaya, A., van den Heuvel-Panhuizen, M., & Doorman, M. (2015). Opportunity-to-learn context-based tasks provided by mathematics textbooks. Educational Studies in Mathematics 89(1), 41–65.

Zan, R., & Di Martino, P. (2007). Attitude toward mathematics: Overcoming the positive/negative dichotomy. *The Montana Mathematics Enthusiast*, *3*(1), 157-168.

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