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Analysis of Alignment between Single National Curriculum Standards 2022 and Punjab Examination Commission Assessment 2023 in Pakistan

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Abstract

Standard-based curriculum enhances quality and coherence of educational outcomes to gauge the alignment between standards and assessment to meet the diverse needs of learners. The Single National Curriculum (SNC) 2022 was developed and implemented to provide quality education aimed at unifying and standardizing education across Pakistan in line with the fourth goal of Sustainable Development Goals (SDGs). The current study was descriptive to explore the alignment between curriculum standards and assessment of 8th-grade science. The sources of data were SNC 2022 science grade VI-VIII, a textbook of Punjab Curriculum and Textbook Board (PCTB) and Punjab Examination Commission (PEC) assessment test. The Webb Alignment Tool was used to measure the level of alignment on four criteria: categorical concurrence, range of knowledge, Depth of Knowledge (DOK) consistency, and balance of representation. The results of the study revealed that the assessment met the criteria of categorical concurrence whereas depth of knowledge consistency was at an acceptable level. The assessment slightly meets the criteria of balance of representation and range of knowledge even at a minimum acceptable level. Furthermore, there is a less good degree of alignment between SNC 2022 science SLOs and PEC assessment 2023. Furthermore, 84% of assessment items were of DOK level-l and level-2 and only 16% of items of DOK level-3 and level-4 were included.

Keywords: Alignment, Assessment, Single National Curriculum

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Introduction

Standard-based science education reforms gained momentum for accountability decisions of institutions and teachers, as well as alignment between the state content standards and assessment at the beginning of the 21st century globally. These waves also inspired educational leaders of Asian countries. Eleven educational policies, commissions and reports have been discussed for quantitative improvement but less focus on elevating curriculum content standards, instructions, and assessment in Pakistan (Liu & Fulmer, 2008; Siddiqui, 2016). As a signatory of Sustainable Development Goals (SDG) 2030 vision emphasizes the probing of reforms of Universal Primary Education (UPE), Education for All (EFA), and Universal Secondary Education (USE) results and focuses on quality education in Pakistan (Boeren, 2019; Eloff, 2024; Houff, 2012; UNICEF, 2000).

The SNC provides valuable insights into the effectiveness of educational reforms regarding unifying and standardizing the curriculum under the fourth goal of SDG to provide quality education and bridging disparities among public, private, and religious institutions in the country. A key objective of SNC 2022 science grade VI-VIII is to equip Higher-Order Thinking Skills such as problem-solving and inquiry based learning along with essential cognitive abilities among learners through a standard-based curriculum. The SNC 2022 science is divided into strands, standards, benchmarks and SLOs. The strands are further divided into twelve standards based on ninety-five SLOs. Owing the curriculum development process international education reforms, trends and alignment aspects were specially considered (Government of Pakistan, 2022; Government of Pakistan, 2014).

Alignment is defined as the extent to which curricula expectations and assessments are in agreement and work together to assist in teachers' efforts to facilitate students' learning progress toward a desired academic achievement (Roach et al., 2008). Alignment refers to the degree of agreement between content standards of the country for a specific subject area and the assessment criteria used to measure achievement score of the student in these standards (Bhola et al., 2003). The alignment between curriculum and assessment ensures what is taught in the classroom and what is assessed facilitating meaningful learning for learners. The alignment is critical for fostering higher-order thinking and critical thinking among learners, as it establishes that assessment accurately reflects the intended learning outcomes outlined in the curriculum. The alignment studies provide valuable insights into the effectiveness of educational reforms and standard assessments are crucial for effective science education implementation (Penuel et al., 2008; Sulaiman et al., 2017; Yeung, 2015). Practitioners claimed that alignment between assessment and curriculum standards is a prerequisite to increase students'

success in academic achievement and overall educational improvement (Baker, 2005; Bhola et al., 2003; Mainali, 2012; Porter, 2002; Webb, 2007).

Studies results reported that alignment researches provide valuable insights into the effectiveness of educational reforms and the implementation of educational standards (Houff, 2012; Rothman, et al., 2002). Assessing the alignment between the SNC 2022 science standards and PEC assessments is vital for ensuring that students develop higher-order thinking skills that contribute to improved educational outcomes and measuring existing alignment level in Punjab. The practitioners are using WAT for assessing alignment among curriculum content standards, instructions, and assessment worldwide.

The current study was designed to assess the alignment between the science curriculum standards developed by the Punjab Curriculum and Textbook Board (PCTB), Lahore and standardized assessment items developed by PEC for the academic year 2022-2023. This study explored whether the standardized assessment developed by PEC targeted all the SLOs listed in the SNC of science document.

Statement of Problem

It is essential to measure the level of alignment between curriculum standards and assessments for standards-based education. This is a central tenet of standards-based curriculum reforms (Barthakur et al., 2022; Webb, 1997). Curriculum designers intended curriculum content, instruction, and assessment to implement it in true spirit. Studies established vibrant results for alignment between curriculum standards and assessment in global and local perspectives. There is a dire need to measure the existing alignment between content standards and assessment in the national curriculum. The researchers are interested in determining the level of alignment between curriculum standards and assessment. Thus, the problem of the study is an analysis of alignment between single national curriculum standards and the Punjab Examination Commission (PEC) Assessment 2023 in Pakistan.

Significance of the Study

The government developed a national curriculum to meet international commitment and local needs to enhance the quality of education through standardized curriculum, instructional methods, and standards-based assessments. It is critical to evaluate the degree of alignment between curriculum standards and assessment by practitioners for fostering, problem-solving abilities, creativity and higher-order thinking, among learners. This study results established up to what extent alignment existed between curriculum standards and assessments. The findings of the study will reveal guidelines for policymakers, curriculum developers, assessment agencies and teachers for enriching

curriculum in the future. The findings of the study will be helpful for assessment agencies to bridge curriculum content and assessments. The findings of the study will be supportive for training institutions to develop standards-based curriculum training modules and standardized tests development training to enrich current assessment practices in Punjab, Pakistan.

Research Objectives

The major objective of the current study was:

To find out alignment among curriculum, textbook, and assessment.

Research Questions

The research questions of the study were:

i. What is the degree of alignment between SLOs and assessments in 8th grade science subject?

ii. Does SLOs and assessment address the same DOK levels?

iii. What is the level of agreement regarding the breadth of knowledge between standards and assessment items?

Literature Review

The literature review of the current study deals with curriculum alignment and it is linked to the previous alignment studies regarding alignment analysis of curriculum, textbook, and assessment.

There is an intensive trend towards standard-based curriculum implementation in educational settings globally. These trends concern the desire to ensure that educational institutions are meeting student standards, learning performance responsibilities, and alignment of content and assessment (Gilbert, 2004). Alignment refers to the level of agreement between elements of curriculum; content, instruction and assessments for specific subject. Alignment is defined as the level of consistency between standards and assessments (Case & Zucker, 2005). Curriculum alignment provides the opportunity to learn on student outcomes. It enables to understand various factors influencing on school achievement. Poorly aligned curriculum influences on instruction and learning, furthermore, alignment stems for educational accountability (Anderson, 2002; Ziebell & Clarke, 2018).

Alignment studies structured globally have focused on measuring alignment between content, standards, and assessments. The standardized assessment is in a state of flux in developing countries (Pryor & Lubisi, 2002). Squires (2012) reported three curriculum; taught curriculum, tested curriculum, and written curriculum alignment. Each pair shows positive influence on aligning results. There was a strong link between taught and tested curriculum alignment (Schmidt et al., 2001). Baker (2005) claimed that in standard based education alignment among curriculum, instruction and assessment increase students' academic achievement. For an effective education system work curriculum standards, instruction and assessment be aligned. Alignment provides a sense of how actual teachers and students are doing their teaching and learning (Herman & Webb, 2007; Nasser et al., 2014). Alignment between curriculum standards and assessment is essential for educational achievement of students and overall educational development (Webb, 2007). Curriculum alignment results in better achievement score (Schmidt et al., 2001). Studies indicated that effective alignment significantly enhance educational outcomes by ensuring coherence among the intended, enacted, and assessed curricula (Dickinson et al., 2020). Well-aligned educational system harmonizes various elements essential for fostering student learning and achievement (Ziebell & Clarke, 2018). The alignment study of Zhao (2023) highlights the importance of alignment analysis clarifying how teachers implement curriculum standards effectively through aligned assessments. This is echoed by Lopez (2014) who declared that valid assessments align with classroom expectations to ensure that students were adequately prepared for evaluations.

Higher Order Thinking Skills (HOTS) are increasingly recognized as an essential component of science curricula to enhance active learning and critical engagement in scientific inquiry, which aligns with goals of developing students' cognitive skills for 21st century. The development and assessment of HOTS are critical for fostering critical thinking, problem-solving abilities, and creativity among learners. The HOTS assessments challenge students to analyze, evaluate, and create for measuring their metacognitive capabilities (Artika & Nurmaliah, 2023; Mat et al., 2023; Mat & Mustakim, 2021; Saido et al., 2018). In the same vein, Liu et al., (2021) focused on the need of assessments to align with HOTS competencies and suggested that traditional assessments are less adequate to capture students' critical thinking abilities. Standard-based curricula instill HOTS among students needed to navigate the world beyond simple memorization, developing critical analysis, problem-solving skills, and creative thinking that is not only essential for academic success but also in daily life. Teachers face challenges in integrating HOTS into school-based assessments and highlight the need for ongoing support and training (Wilson & Narasuman, 2020). The findings of Surya et al., (2019) analyze teachers' skills in developing HOTS-oriented

questions, indicating a gap that needs to be addressed through targeted professional development.

Literature reported Surveys of Enacted Curriculum (SEC), Competency-Based Education (CBE), and Webb alignment extensively implemented in curriculum, instruction, and assessment models globally (Cizek et al., 2018; McMaken, & Porter, 2012; Porter, 2002; Yu et al., 2022). One of the most widely used models is Webb's alignment model. Webb alignment is a more systematic approach to evaluate and improve alignment between curriculum standards, and assessment across educational settings. Webb's model was designed by Norman Webb that employs a blend of expert qualitative judgment, a coded quantitative system, and an examination of standards and assessments (Webb, 2007). The Webb alignment model differentiates between horizontal alignment; curricula, assessments, and vertical alignment; learning materials, instruction; and learner outcomes helps as a foundational framework for understanding their relationship (Qhibi et al., 2020).

Webb's alignment model provides a link between the content standards of a specific subject and the content covered by the assessment agency, intended to provide information to playmakers for an accountability mechanism. Webb's alignment results are used to revise content, modifying assessments, and verifying policy elements influencing students learning outcomes (Roach et al., 2008). The Webb's alignment method of curriculum alignment process includes two stages. Initially, a panel of five to eight curriculum subject content experts and practitioners were provided with training to use Webb analytic process as reviewers to rate the alignment content, assessment standards, and then participate in a coding process. During this phase, reviewers are assigned DOK levels to SLOs, evaluating the complexity of each learning outcome of specific curriculum (Webb, 2007).

This involves categorizing learning outcomes into four knowledge levels: recall, skill/concept, strategic thinking, and extended thinking. The SLOs were coded against four levels of knowledge; (DOK1), recall, (DOK2), skill/concept. (DOK3) strategic thinking, and (DOK4) extended thinking. Reviewers attribute DOK levels to assessment items and corresponding curriculum SLOs according to instructions.

Utilizing a web-based tool, WAT v2, the alignment between standards and assessments was scrutinized (Webb, 2007). A brief description each alignment criterion has been discussed below;

***Categorical Concurrence**:* This standardization criterion assesses the level of consistency between the categories of content present in the academic standards and those evaluated in the assessments. The criterion was considered met when the numbers of assessment items that focus on a particular standard exceed five.

***DOK Consistency**:* This particular criterion aims to assess the degree of alignment between the Depth of Knowledge (DOK) level of assessments and the level of standards. The criterion is considered fulfilled when at least half of the targeted objectives are accurately targeted by items of the same complexity level. In other words, this criterion evaluates the extent to which the assessment items effectively measure the intended learning objectives and appropriately align with the level of rigor expected by the standards.

***Range of Knowledge**:* This criterion aims to evaluate whether the scope of knowledge required successfully answer assessment items matches the scope of knowledge covered in the standard. To meet this criterion, more than 50% of the objectives outlined in a standard should be assessed through the corresponding assessment items. This helps to ensure that students are being tested on the knowledge that is critical to mastering the standard, and that the assessment items are accurate reflections of what students need to know.

***Balance of Representation**:* The criterion of balance was an important factor that determines the extent to which the objectives outlined in a particular standard are given equal weightage during the assessment process. It is usually measured by an index value, with a score of 1 indicating a perfect balance in the assessment, while a score of 0 suggests that only a few learning outcomes have been addressed under the standard. This criterion is crucial in ensuring that assessments are fair, comprehensive, and accurate in measuring the effectiveness of educational practices (Webb, 2007).

The DOK assessed the task's complexity rather than its difficulty. The Webb model is based on four levels of complexity (Webb, 2007). Four DOK levels of complexity along with their common examples in the perspective of science subject are discussed below.

> *DOK Level-1 (Recall)* pertains to recall information such as a fact. Recalling refers to a straightforward procedure that needs to be followed. When a student is presented with a Level-1 question, they either possess the knowledge to answer it or they do not. Generally, a Level-1 question tests the students' familiarity with the topic at hand and is used to assess their foundational knowledge.

DOK Level-2 (Skill/Concept) requires students to select a strategy to solve a problem, analyze information, and construct a response based on their understanding of the given topic or concept. Level-2 activities are complex and challenging compared to Level-1, as they require students to apply their knowledge and skills to solve problems.

DOK Level-3 (Strategic Thinking) requires students to engage in a more advanced level of thinking that involves careful planning, analysis, and reasoning. This level of thinking is considered to be more complex and sophisticated compared to the more basic levels of thinking, Levels 1 and 2.

DOK Level-4 (Extended Thinking) demands students to exhibit an advanced level of cognitive skills. They must be able to connect ideas and evaluate multiple approaches to identify the most appropriate solution. Tasks at this level require intricate reasoning and the ability to create experimental designs, which often span over an extended period. To succeed at this level, students must be able to think critically and analyze complex information.

Studies were framed regarding alignment between curriculum and assessments globally and locally. A study was framed by Gulzar and Mahmood (2019) to determine the alignment between mathematics curriculum standards of secondary school and assessments of BISE Lahore in Punjab, Pakistan. The alignment between mathematics curriculum and four alignment criteria; categorical concurrence, DOK consistency, balance of representation, and range of knowledge was assessed through WAT. The results of the study claimed the assessment only met the criteria of categorical concurrence, and other levels met thin acceptable criteria without quality assessment items. Furthermore, 73% of assessment items are of the lowest DOK level-l and no items of DOK level-4 were included.

A study was structured by Liu and Fulmer (2008) to reveal alignment between science curriculum and assessment in physics and chemistry at school level in New York State. Porter alignment model was used to gauge alignment between curricula and assessment. The result of the study reported that there was a high alignment between core curricula and assessment. However, there are discrepancies in cognitive levels and topics. A study was designed by Ziebell and Clarke (2018) to examine the curriculum alignment between intended, enacted and assessed curriculum in primary mathematics and science in Melbourne, Australia. The sources of data were curricula document, teachers, and assessment classroom practices. The data were collected through video-recorded lessons, interviews, and work samples. The results of the study revealed that alignment is reflected between intended and assessed curricula in primary mathematics and science.

Research Methodology

The current study was descriptive research to explore the phenomenon. Cheng (2014) described that the methodology for assessing alignment involves both qualitative and quantitative approaches. An online Webb Alignment Tool Second Version (WAT v2) was used to measure the alignment level in curriculum standards and assessments. The WAT allows for a detailed examination of how well assessments reflect the intended curriculum to evaluate the alignment of curriculum standards with assessment practices in science education (Tian, 2024). An assessment of 47 items was entered into the Webb tool according to the type of items, and their distribution in various assessment sections of 100 marks. The PEC test items for general science grade-VIII developed for final term assessment generated from the Item Bank System (IBS) for the academic session 2022-2023 were also selected.

The WAT training manual recommended that for reliable results of study 5-8 reviewers must engaged in successful completion of the review. At least, one of those reviewers must be a practicing teacher of that curriculum with reasonable experience (Webb, 2005). A two-day training workshop was arranged to the reviewers. This training aimed to orient the reviewers on how to register themselves on the online tool and to enable them to effectively review and add their responses in the tool. The training was divided in two phases. In phase-1, all reviewers were provided with training about understanding of DOK levels, alignment criteria and registration on the WAT v2. Each reviewer then entered the DOK levels against each SLO in the tool. The researchers who were fulfilling the dual roles of a reviewer as well as the leader organized a consensus session. The purpose of this session was to highlight the issues as different reviewers may assign different DOK levels to a specific SLO. So, a positive discussion was carried out to bring them all on the convergence and agreed on the DOK value for each SLO. In phase-II training, reviewers were provide with training regarding how to code the assessment items against one, two or a maximum of three SLOs to align them with the curriculum standards (Webb, 2005). They were also provided with training to code an item against strands, standard, if there is no corresponding SLOs present in the curriculum. Still, if an item does not match or target any strands or standards then that may be coded as un-code-able (Webb, 2005). All instructions were provided following the guidelines listed in the training manual. After the training, while reviewers were coding the assessment items, the leader entered the consensus DOK values of each SLO in the tool. At the end, the group leader arranged a debriefing session. The purpose of this session was to get reviewers' feedback related to the overall alignment process. A study was created through matching the curriculum standards with the assessments.

Reliability of the Study

The WAT v2 gauges the reliability of the study by calculating the Intra-class correlation by the method of Shrout and Fleiss in 1979 (Webb, 2005). Intra-class correlation reliability must be greater than .7. The pair-wise benchmark for a specific assessment is calculated by pairing the reviewers who have given the same DOK level to a particular assessment item. Their same responses are then added and divided by the total number of all possible pairs of reviewers. The resultant value of .7 or higher represents a good agreement whereas a value less than .5 is considered as bad agreement among reviewers (Webb, 2005).

Table 1
Intra-class Coefficient and Pairwise Comparison

Assessment Test	Grade	Intra-class Correlation	Pair-wise Benchmark	Pair-wise Comparison
PEC	8	.981	.71	.94

Table 1 demonstrated the intra-class reliability of 8th grade PEC assessment was .981. The pair-wise benchmark was declared .71and pair-wise agreement in this study was .94.

Sample and Sampling Techniques

The five reviewers were selected through purposive sampling technique experts in standards-based science curriculum and assessment recommended in training manual to gain reliable results of study (Webb, 2005). Two reviewers were PhD in education and working in the curriculum wing as a curriculum expert, two reviewers were an M.Phil in science education and working in PEC as an assessment expert and one reviewer was an M.Phil in physics and working as an elementary school teacher in the public sector. The researchers played a dual role of a reviewer as well as group leaders for this study. The composition of the reviewer's group was heterogeneous, as they comprised of practicing teachers, curriculum and assessment experts.

Instrument

The international and local practitioners used WAT for curriculum, instruction, and assessment alignment studies (Cizek et al., 2018; Gulzar & Mahmood, 2019; Porter, 2002; Roach et al., 2008; Webb, 2007; Yu et al., 2022). In the same vein, the researchers used an online WAT v2 to measure curriculum standards and assessments alignment on DOK levels.

Data Collection

The researchers obtained prior permission to use the tool by emailing its developer, Norman Webb to measure alignment between curriculum standards and assessments. After completing the review process, the reviewers entered the data in WAT v2.

Analysis and Interpretation of Data

The current study was framed using Webb alignment tool second version (WAT v2) tool. Curriculum and assessment practitioners are using WAT tool to measure alignment between curriculum standards, and assessments in Science, Mathematics, English and Social studies (Webb, 2007; Yu et al., 2022). The reports generated through WAT v2 were analyzed further to address the study objectives.

Table 2
DOK level of SLOs for Science

Grade	Level-1 Recall	%	Level-2 Skill/Concept	%	Level-3 Strategic Thinking	%	Level-4 Extended Thinking	%	Total
8	20	21	60	63	14	15	1	1	95

Table 2 depicted consensus data of DOK level values for Level-1, 20 SLOs, Level-2, 60 SLOs, Level-3, 14 SLOs, and Level-4, 1 SLO. These values suggested that out of 95 SLOs, only 15 SLOs have DOK levels higher than 2. This makes up only 16 % of the total SLOs aimed towards Higher-order thinking skills.

Table 3
Summary of Acceptable Alignment Levels on Four Criteria with PEC assessment

Domains	Alignment Criteria			
	Categorical Concurrence	DOK Consistency	Range of Knowledge	Balance of Representation
Life Sciences	Yes	Weak	Weak	No
Physical Sciences	Yes	Yes	No	Weak
Earth & Space Sciences	Yes	Yes	No	Yes

Note: Total Assessment Items – 47

Table 3 demonstrated results regarding criteria of alignment. Alignment criteria was reported in yes, no and weak. Yes, means criteria fulfilled, no, not fulfilled, and weak thin fulfilled. There are three domains in the General Science curriculum of 8th grade 2022. The Table showed that based on the four alignment criteria there is a moderate alignment between curriculum and assessment 2023.

Table 4

Knowledge Range and Representation Balance between Science SLOs and PEC Assessment

Reporting Category		No. of SLOs Hits		Range of Standards: Num of SLOs Hit		Range of Standards: Total %		ROK	Total Hits %		Balance Index		BOR
Domains	SLOs	*M*	*S.D*	*M*	*S.D*	*M*	*S.D*		*M*	*S.D*	*M*	*S.D*	
Life Sciences	33.2	52.8	6.8	16	1.58	48.22	5.03	Weak	50	2	0.59	0.05	No
Physical Sciences	56	48.1	1.34	16	0	28.57	0	No	41	2	0.67	0.02	Weak
Earth and Space Science	6	13	0	1.8	0.84	30	13.94	No	9	1	0.83	0.17	Yes
Total	95.2	113.9	7.57	11.3	8.2	35.6	11		33	21	0.7	0.12	

Total Assessment Items - 47

*Not*e *M* = Mean; *S D* = Standard Deviation; ROK = Range of Knowledge; BOR = Balance of Representation

The first column of Table 4 reported the names of three domains provided in curriculum 2022, while the second and third columns represent the number of benchmarks, and SLOs respectively. The fourth and fifth columns showed mean and standard deviation for SLOs, columns sixth and seventh described the average and total % for SLOs coded by reviewers, and the eighth column stats range of the knowledge domain. The last column represents the Balance of representation for each domain. It can be interpreted from the Table 4 that the alignment criterion of range of knowledge was not met while there is moderate alignment for criterion of balance of representation.

Table 5

Categorical Concurrence between Science SLOs and PEC Assessment Items

Reporting Category		Level by SLOs			Hits		Categorical Concurrence
Domains	No. of SLOs	Levels of DOK	# of SLOs by DOK	% W/in Domain by Levels	*M*	*S.D*	
Life Sciences	33.2	1	6	18.18	52.8	6.8	YES
		2	19	57.58			
		3	7	21.21			
		4	1	3.03			
Physical Sciences	56	1	11	19.64	48.1	1.34	YES
		2	38	67.86			
		3	7	12.5			
Earth and Space Science	6	1	3	50	13	0	YES
		2	3	50			

Total	95.2	1 2 3 4	20 60 14 1	21 63 15 1	113.9	7.57

Total Assessment Items - 47

Note. DOK=Depth of Knowledge; *M*=Mean; *S.D*= Standard Deviation; W/in= within

Table 5 depicted that the alignment criterion of categorical concurrence was fully met for all three domains against the PEC assessment 2023.

Table 6

DOK Level of Consistency between Curriculum Standards and PEC Assessment

Reporting Category		Hits		DOK Level of Item						DOK Consistency
Domains	No. of SLOs	M	S.D	Below %	S.D	At %	SD	Above %	SD	
Life Sciences	33.2	52.8	6.8	51.65	2	40.67	3	7.68	1	WEAK
Physical Sciences	56	48.1	1.34	44.15	6	52.73	6	3.12	0	YES
Earth and Space Science	6	13	0	28.46	17	56.92	17	14.62	33	YES
Total	95.2	113.9	7.57	45.83	3.1	47.67	2.2	6.5	3.5	

Total Assessment Items - 47

Mean: M; Standard Deviation: SD

Table 6 shows DOK levels of consistency between SLOs and DOK levels of assessment items. The first five columns are the same as Table 4 and Table 5, whereas columns six to eleven reported the %age and SD of assessment items coded by reviewers and processed during WAT v2 alignment. The twelfth column represents DOK level consistency for each domain.

Table 7

PEC Assessment 2023 Items Representativeness

Grade	Total SLOs	SLOs Not Targeted	%	SLOs Targeted More Than once	%
8	95	54	56.84	22	23

Table 7 showed that the PEC assessment 2023 did not target almost 57% of SLOs. The %age of the items targeted was narrowed to less than 50 percent making it almost 43%. Most of the items did not match with any SLO even its standard. Understandably, any assessment with 47 items can not cover or target the 95 SLOs yet many items repeatedly target the same SLO. The SLOs targeted more than once were 23%.

Table 8
List of Un-coded Items (Minimum two Reviewers)

Class	Item No. as in Assessment	No of Items	Total Marks	Item % age w/in assessment	% Marks
8	20, 22, 23, 24, 27, 33, 34, 35	8	17.5	17	17.5

Table 8 revealed a number of assessment items that were not coded. Items 20, 22, 23, 24, 27, 33, 34, and 35 were marked un-coded by minimum two out of five reviewers. 17% of 47 items and 17.5% of 100 marks were not targeted by any SLO.

Table 9
Distribution of Marks in the PEC Assessment 2023

Item marks	1.5	2	3	4	5	Total
Items	32	4	3	5	3	47
Marks	48	8	9	20	15	100

Note.

PEC assessment consisted of 100 marks, and all 47 assessment items were compulsory to solve.

Table 9 revealed that out of 47 items, thirty-two were MCQs each carrying 1.5 marks, which amounted to 48 marks. There were four Restricted Response/Short Questions of two marks each. Similarly, three Restricted Response/short-question items were included with three marks each. Furthermore, there were five ERQs of four marks each and three ERQs of five marks each. All of them had a total of 100 marks. Assessment of science consisted of a total 100 marks that students were directed to attempt 47 questions in three hours. The assessment with 47 items cannot fully address a curriculum with 95 SLOs.

Results of the Study

- The results of the study showed that there is need to align the assessment with the SLOs as 54 SLOs out of 95 have not been targeted by the assessment items. Overall there is very thin degree of alignment between SLOs and assessment 2023 based on the Webb's criteria. Various SLOs were not targeted in the assessment, and SLOs were repeated in objective and subjective parts. According to Webb alignment, the minimum range of knowledge acceptance level is 50%. The results reported 48.2%, 28.5%, and 30% for three domains for Ranges of knowledge. Despite fulfilling the criteria of categorical concurrence and DOK consistency, the reason why range of knowledge criterion was not met can further be understood that no assessment with only 47 items targeting 95 SLOs can even target each SLO even once.

- DOK consistency is at acceptable level for second and third domain but it is weak for first domain. DOK consistency is more as the majority of the SLOs were of DOK levels 1 and 2(85%).
- The results indicate that the alignment between curriculum SLOs and PEC assessment 2023 is weak in relation to Balance of Representation and the Range of Knowledge as some items did not target any specific SLO, benchmark/standard or even domain. Secondly, some of the items hit a specific SLO more than once which is not acceptable especially when there are only 47 assessment items to assess a total of 95 SLOs in the curriculum document.

Conclusion

The current study determined the alignment between SNC 2022 science and PEC assessment 2023 based on a set of criteria using WAT v2. The results of the study showed that only the criterion of categorical concurrence was met while other levels met thin acceptable criteria with less quality assessment items. This determines that there is a less good degree of alignment between SNC 2022 science SLOs and PEC Assessment 2023. Furthermore, 84% of assessment items are of the lowest DOK level-l and level-2 and no items of DOK level-4 were included.

Discussion

The alignment between curriculum and assessment ensures educational practices are coherent and effective for educational systems. The results of the study showed that only the criterion of categorical concurrence was met while the two criteria of balance of representation and DOK consistency were met at a thin acceptable level. The fourth criterion of range of knowledge was not met. Furthermore, 84% of assessment items are of the lowest DOK level-l and no items of DOK level-4 were included. These results are also consistent with the study framed by Gulzar and Muhammad (2019) in Punjab, Pakistan to determine the alignment between mathematics curriculum standards and assessment of BISE Lahore at the Secondary level. This study is also consistent with Martone & Sireci (2009) which highlighted that assessments often failed to cover the full depth of the curriculum, particularly at higher cognitive levels. Similarly, Liu et al., (2009), also revealed the element of misalignment in terms of distribution of cognitive levels between US curriculum and assessment tests despite fulfilling the criteria of categorical concurrence. The results of the current study were consistent with the findings of the study framed by Schmidt et al., (2001) in Thailand which showed that there was a significant relationship between curriculum standards and achievement gains of students. Furthermore, the study Designed by Ziebell and Clarke (2018) in Australia revealed that alignment is reflected between intended and assessed curricula in primary mathematics

and science. The current study is also consistent with the study of Liu and Fulmer (2008) in New York State which reported that there was alignment between core curricula and assessment at school level. However, there are discrepancies in cognitive levels and topics.

Recommendations

Based on results of the study, the following recommendations are suggested.

- Policymakers arrange regular subject based third party alignment studies to effectively improve alignment between national curriculum standards and assessments.
- The teachers training institutions provide training to the item developers regarding Bloom's taxonomy to develop assessment items related to four DOK levels, particularly of higher DOK levels.
- Assessment generated by expert may include MCQs (multiple-choice question), RCQs (restricted response questions) and ERQs (extended response questions) of four DOK levels.
- PEC may align the SNC 2022 science with assessment items and add more items that target missing SLOs as compared to the existing IBS.
- The results of the study provide a pathway to future researchers regarding analysis of alignment between national curriculum standards, instructions, and assessment in Science, English, Social studies and Mathematics.

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