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Challenges in Implementing the National Physics Curriculum in Government Secondary Schools: Evidence from Quetta, Balochistan, Pakistan

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ABSTRACT

The successful implementation of the National Curriculum 2023 for Physics requires teachers to move beyond content transmission toward conceptual understanding, scientific inquiry, mathematical reasoning, and practical learning. However, evidence on the practical conditions shaping its implementation in government secondary schools in Balochistan remains limited. This study examined the major challenges faced by Physics teachers in implementing the National Curriculum 2023 in Grades 9-10 government secondary schools in Quetta, Pakistan. A descriptive cross-sectional survey was conducted with 300 Physics teachers selected through proportionate stratified random sampling. Data were collected in October 2026 using a researcher-developed questionnaire comprising five challenge domains-teacher-related problems, laboratory resources, instructional issues, administrative factors, and assessment problems and a curriculum-implementation scale. Descriptive statistics, reliability analysis, correlation tests, group comparisons, and thematic analysis were employed. Assessment problems with mean maximum 3.78±0.59 and instructional issues 3.73±0.41 were the most prominent challenges, followed by administrative factors 3.48±0.18, laboratory resources 3.17±0.37, and teacher-related problems 3.16±0.14. Although overall curriculum implementation was relatively high (3.90±0.12), practical work remained comparatively weak, with 50.7% of teachers conducting practical activities once a month or less. Laboratory availability also masked substantial functional deficiencies: although laboratories were present in 80.7% of schools, only 38.3% reported apparatus in good working condition, 35.7% had laboratory assistants, and 43.3% reported reliable electricity. The findings indicate that curriculum implementation is constrained less by the formal presence of the curriculum than by inadequate instructional, assessment, administrative, and practical-learning conditions. Strengthening functional laboratory facilities, teacher preparation, practical-work opportunities, assessment practices, and school-level support is therefore essential for translating the National Curriculum 2023 into effective Physics learning.

Introduction

Physics is a core part of secondary school science teaching which builds the knowledge, understanding and conceptual reasoning of students about the physical world through the use of mathematical representations, observation, measurement and experimentation. It is therefore necessary to go beyond the mere acquisition of knowledge to encourage scientific inquiry, problem solving, and the use of science principles in everyday situations during effective Physics teaching. When Physics is taught in schools, however, students tend to see it as difficult due to its abstract concepts and mathematical requirements. Previous studies show that students respond positively to Physics when science concepts are linked to activities and explanations of physical phenomena that are meaningful (Angell et al., 2004; Zacharia, 2007).

In Pakistan, the conceptual understanding, mathematical reasoning, scientific investigation and practical learning are stressed in the National Curriculum 2023 for Physics in Grades 9-12 (National Curriculum Council, 2023). Achievement of these goals requires teachers to shift away from the traditional lecture approach to teaching and learning, and to adopt an approach of inquiry and student-centered learning. However, just adding the curriculum to schools doesn't mean that it will be implemented effectively in the classroom. The meaning and translation of curriculum expectations varies from teacher to teacher as it is shaped by their professional knowledge, resources, institutional support, and assessment contexts. Therefore, there can be a gap between what is taught and what is actually being implemented in the classroom (Fullan & Pomfret, 1977; Spillane et al., 2002).

The implementation of curriculum is more difficult especially if the teachers are not well prepared, the instructional materials are inadequate, the laboratory set-up is not ready, and institutional support is not available. Both Rogan and Grayson (2003) highlighted the role of teachers' capacities, learner characteristics, physical resources, school management and external educational support in successful implementation of science curriculum in developing countries. In physics education, they are particularly crucial because in order to teach well, one needs to be knowledgeable about what is being taught, have the right resources such as science materials, have enough class time and space for experimentation.

Practical work is vital to link theoretical knowledge to what can be seen and to the findings of experiments. Good laboratory activities can enhance conceptual understanding and cultivate scientific and investigative skills (Hofstein & Lunetta, 2004; Winter & Millar, 2023). But even if there are laboratories, it does not mean that there is meaningful practical learning. Abrahams and Millar (2008) discovered that students can learn to do activities but not acquire the relevant scientific understandings. In order to achieve the effect of laboratory teaching, it is essential to have the correct equipment, good preparation, teacher guidance and opportunities to interpret experimental results.

Implementation of the curriculum may also be further limited by the instructional and assessment conditions. Inquiry-based teaching can be challenging due to weak mathematical and scientific bases, high class numbers, short instruction time and language problems. Furthermore, task-oriented systems might promote rote learning and limit conceptual discussion and hands-on learning. Active learning and inquiry-based methods have shown to have a positive impact on student learning, however, proper implementation of these approaches requires instructional planning and support (Freeman et al., 2014; Minner et al., 2010; UNESCO, 2023). Limited teacher preparation was an important implementation concern identified by Nawaz and Akbar (2019) for the implementation of the Physics curriculum in public secondary schools of Punjab in Pakistan.

The issues are especially pertinent to government secondary schools in Balochistan where educational institutions are running with different infrastructures, some teachers are absent, and the staff do not receive proper training and development and the teaching facilities are also insufficient. While the previous studies conducted on science education and implementation of science curriculum in Pakistan are available, most of the studies are conducted in other provinces or general issues. There is a dearth of empirical studies that are specifically concerned with the problems confronting the Physics teachers in using the National Curriculum 2023 in the Government secondary schools in Quetta. More specifically, a more detailed study of the influence of teacher-related, laboratory, instructional, administrative and assessment conditions on curriculum delivery is needed.

By knowing these challenges one should be aware of the fact that the success of curriculum implementation also requires the quality of curriculum documents and the circumstances in which the teachers translate curriculum goals into practice. Hence, the present study was conducted on challenges faced by the Physics Teachers in Government Secondary Schools in Quetta city of Balochistan Pakistan in the context of teaching 9th and 10th grade Physics. More specifically, it focused on five aspects of the implementation of curriculum: teacher related problems, laboratory resources, instructional problems, administrative problems, and assessment problems. It also determined the laboratory readiness, the frequency of practical, teachers' reported curriculum-implementation practices, and the teachers' suggestions for improving the curriculum. The results offer district evidence that can be used to improve Physics teaching, provision of Physics labs, training of Physics teachers, and assessment of Physics learning.

Materials and Methods

Research Design and Study Setting

The study design was quantitative, descriptive and cross sectional which was designed to investigate the problems faced by the implementation of the National Curriculum 2023 for Physics in government secondary schools in Quetta District of Balochistan, Pakistan. The study was limited to Physics teachers who are taught Grades 9 and/or 10. The approach of this study was a cross-sectional design that records the reported experiences of teachers, the conditions of instruction, the equipment in the laboratory, the assessment methods used, and the percentage of the curriculum they implemented in a specific time. The study focused on descriptive approach without attempting to make causal inferences.

Population and Sampling

The targeted population was Physics teachers of grade 9 and/or 10 in government secondary schools of Quetta district. Eligible teachers were those from boys schools, girls schools and co-educational schools in urban and peri-urban areas. The teachers who were not teaching Physics at the above mentioned grade levels were not included while the teachers in private schools, colleges, middle schools and primary schools were excluded. The sampling was done using proportionate stratified random sampling method to get the sample of 300 Physics teachers. The school type and location were also taken into account to ensure representation of the different school settings, in consideration of stratification. The schools were randomly selected within the identified strata and physics teachers who met the eligibility criteria were invited. A total of 128 teachers (42.7%) from boys' schools, 164 teachers (54.7%) from girls' schools and eight teachers (2.7%) from co-educational schools were included in the final sample. As far as location was concerned, 86.3% (259) of the respondents taught in the urban schools while 13.7% (41) taught in the peri-urban schools.

Research Instrument, Measurement

The data were gathered with a structured questionnaire developed by the researcher, called Questionnaire for Physics Teachers. The conceptual framework of the study and related literature on Science curriculum implementation, teachers' working conditions and Physics education guided its development. The questionnaire consisted of background data, six measurement scales (Likert-type), one multiple response item on teachers' major problems, and one open-ended item asking for suggestions on how to make the curriculum more effective.

All 56 scale items were answered on a five-point Likert scale which ranged from 1 (strongly disagree) to 5 (strongly agree). Each scale was composed of a number of items and scores were computed by taking the mean of the items within each scale (not reversed). A crucial difference was preserved in the scores: Higher scores in the teacher, instructional, administration, and assessment scales were related to more serious problems, while higher scores in the laboratory-resources scale were related to better resources provided. Likewise, the higher the curriculum-implementation scores, the higher the level of implementation was reported. For descriptive interpretation, mean scores were classified into five equal intervals: 1.00–1.80 (very low), 1.81–2.60 (low), 2.61–3.40 (moderate), 3.41–4.20 (high), and 4.21–5.00 (very high). The four negatively worded problem scales were read as no problem to very serious problem, and the positively worded laboratory-resources and curriculum-implementation scales were read as more inadequate, to more implemented. Teachers were also asked how often students did practical Physics work, the responses were coded 0 (never) to 5 (every week). Teachers then made a selection from a pre-defined list of challenges in a separate multiple-response question. The last open-ended question invited suggestions on ways to enhance curriculum implementation.

Validity and Reliability

All indicators identified in the literature and the conceptual framework of the study were used in developing the questionnaire. The draft was checked for content relevance, clarity and representativeness. The item wording and addition of locally relevant examples were also reviewed face-to-face by the research supervisor and practising Physics teachers. Corrected item–total correlations were used to analyze further evidence from the main survey. The degree of internal consistency was tested using Cronbach's α for responses from the 300 participants. These coefficients were .855 for teacher-related problems, .874 for laboratory resources, .853 for instructional issues, .854 for administrative factors and .814 for assessment problems. An alpha coefficient of .715 was attained for the five item scale of the curriculum-implementation scale, and an overall coefficient of .810 was obtained for the 56 item scale. These findings showed that there was acceptable to good internal consistency among the scales.

Data collection and Ethical Considerations

The data was collected from 10th October 2026 to 31st October 2026. The questionnaire was completed using Google Forms and the survey link was sent to the eligible Physics teachers via head teachers of the targeted schools and teacher networks. When Internet access was scarce, the researcher visited the schools and helped teachers access the online questionnaire with their own devices. Participants were given information before starting the questionnaire, about the purpose of the study, the voluntary nature of the questionnaire, the confidentiality and the time estimated to complete the questionnaire. Prior to respondents, eligibility and informed consent were confirmed. Teachers were allowed to opt out of any participation and participation was voluntary. The respondents were not requested to give any names or the name of their school and the results were reported on an aggregate basis. Overall, 300 full responses were kept for analysis.

Data Analysis

The data was coded and analyzed in IBM SPSS Statistics. Teachers' characteristics and answers to the questionnaire items and composite scales were summarized using descriptive statistics such as frequencies, percentages, means, and standard deviations. The five challenge domains were descriptively compared to the curriculum-implementation scale to determine the most salient challenges reported. Laboratory-resource responses were explored to identify the existence of facilities as well as their reported levels of adequacy and functionality. Response frequencies and percentages were used to summarize the frequency of practical-work. The multiple response

question was analyses by calculating the percentage of teachers that chose each challenge. The responses to the open-ended question were condensed into themes that occurred repeatedly and the number of times each theme occurred was computed.

Results

Characteristics of the respondents

In this study, 300 Physics teachers from the government secondary schools Quetta District have participated. The sample consisted of 55.7% (n = 167) female and 44.3% (n = 133) male teachers. The majority of the respondents were age group 30 to 49 years (72.0%) and those with 5–15 years of teaching experience accounted for 56.6% of the respondents. With regard to qualifications, 60.7% had a master's degree and 27.6% had a master's or an MS, MPhil or PhD. Of those, however, only 48.0 had majored in Physics, 47.0 had majored in another science discipline and 5.0 had majored in a non-science discipline (Table 1). The majority of teachers were employed in girls' schools (54.7%) or boys' schools (42.7%) with the remaining 2.7% from co-educational schools. 86.3% of these schools were urban schools and 13.7% peri-urban schools. A fairly large percentage of the respondents indicated difficult classroom environments, with 36.7% reporting classes with 46-60 students and 27.7% teaching more than 60 students. Therefore, 64.4% were in charge of classes that had more than 45 students. In addition, 32 (10.7%) said that they had trained in relation to the National Curriculum 2023 in Physics (Table 1).

Table 1. Demographic and Professional Characteristics of Participating Physics Teachers

Characteristic	Category	n (%)
Gender	Male	133 (44.3)
	Female	167 (55.7)
Age	Below 30 years	37 (12.3)
	30–39 years	117 (39.0)
	40–49 years	99 (33.0)
	50 years and above	47 (15.7)
Academic major	Physics	144 (48.0)
	Other science	141 (47.0)
	Non-science	15 (5.0)
School location	Urban	259 (86.3)
	Peri-urban	41 (13.7)
Average class size	Fewer than 30	41 (13.7)
	30–45	66 (22.0)
	46–60	110 (36.7)
	More than 60	83 (27.7)
National Curriculum 2023 training	Yes	32 (10.7)
	No/not sure	268 (89.3)

Note: N = 300. Percentages may not total exactly 100 because of rounding. Five respondents did not report their professional qualification.

Reliability of the measurement scales

All six measurement scales had acceptable to good internal consistency (Table 2). Cronbach's alpha coefficients were between .715 and .874. The items in the laboratory-resources scale had the highest reliability (α = .874), followed by the items in the teacher-related problems scale (α = .855), the items in the administrative factors scale (α = .854), the items in the instructional issues scale (α = .853), and the items in the assessment problems scale (α = .814). The reliability for the scale of implementing the curriculum was also at an acceptable level (α = .715). The full 56 item instrument had an alpha coefficient of .810. Corrected item–total correlations ranged from .42 to .68, which were above the recommended .30. Furthermore, deleting any individual item did not improve the reliability coefficient of its respective scale. Therefore, all items were retained for subsequent analyses.

Table 2. Internal Consistency and Reliability of the Measurement Scales

Measurement scale	Items	Cronbach's α	Reliability
Teacher-related problems	10	.855	Good
Laboratory resources	12	.874	Good
Instructional issues	11	.853	Good
Administrative factors	10	.854	Good
Assessment problems	8	.814	Good

Curriculum implementation	5	.715	Acceptable
Complete instrument	56	.810	Good

Note: N = 300. Corrected item–total correlations ranged from .42 to .68. No item deletion increased the alpha coefficient of its respective scale.

Overall levels of curriculum implementation and reported challenges

There was significant inter-challenge domain variation in the composite scores (Table 3). Assessment problems recorded the highest mean (3.78±0.59), followed by instructional issues (3.73±0.60) and administrative factors (3.48±0.64). For all three domains, the responses were in the serious problem range of the response scale. The problems related to teachers were rated moderate (3.16±0.78).

The mean score for the laboratory resources scale was (3.17±0.65), which represents moderate resources adequacy. These items were positive phrased and should not be taken as a level of laboratory provision; rather, it is a sign of continued low levels of resources available and sufficient. The overall score for the curriculum-implementation was relatively high, however (3.90±0.51). This indicates that teachers overall have said that they teach a few aspects of the curriculum, but there was a clear weakness in practical activities.

Table 3. Descriptive Statistics for the Five Implementation-Related Challenge Domains and Overall Curriculum Implementation

Variable	Mean	Descriptive interpretation
Teacher-related problems	3.16±0.78	Moderate problem
Laboratory resources	3.17±0.65	Moderate resource adequacy
Instructional issues	3.73±0.60	Serious problem
Administrative factors	3.48±0.64	Serious problem
Assessment problems	3.78±0.59	Serious problem
Curriculum implementation	3.90±0.51	High implementation

Note: N = 300. Higher scores indicate more serious problems for teacher-related, instructional, administrative and assessment domains. Higher laboratory-resource scores indicate better resource provision, while higher curriculum-implementation scores indicate greater reported implementation.

Major challenges reported by Physics teachers

Teacher-related problems

The general mean for the teacher-related problems was 3.16±0.78 suggesting moderate difficulty. The item-level results showed, however, that workload and concerns around lack of professional support were significant issues. Teachers' workload is the highest-rated item with regard to insufficient time for planning practical activities (3.73±0.18); 74.0 % of respondents agreed or strongly agreed with this statement. A lack of recognition or incentives for the use of innovative teaching strategies was another concern (3.43±0.11), supported by 59.7% of the teachers. Likewise, 60.0% stated that they have limited opportunities to share ideas or plan lessons with other Physics teachers on the (3.36±0.41) Figure 1.

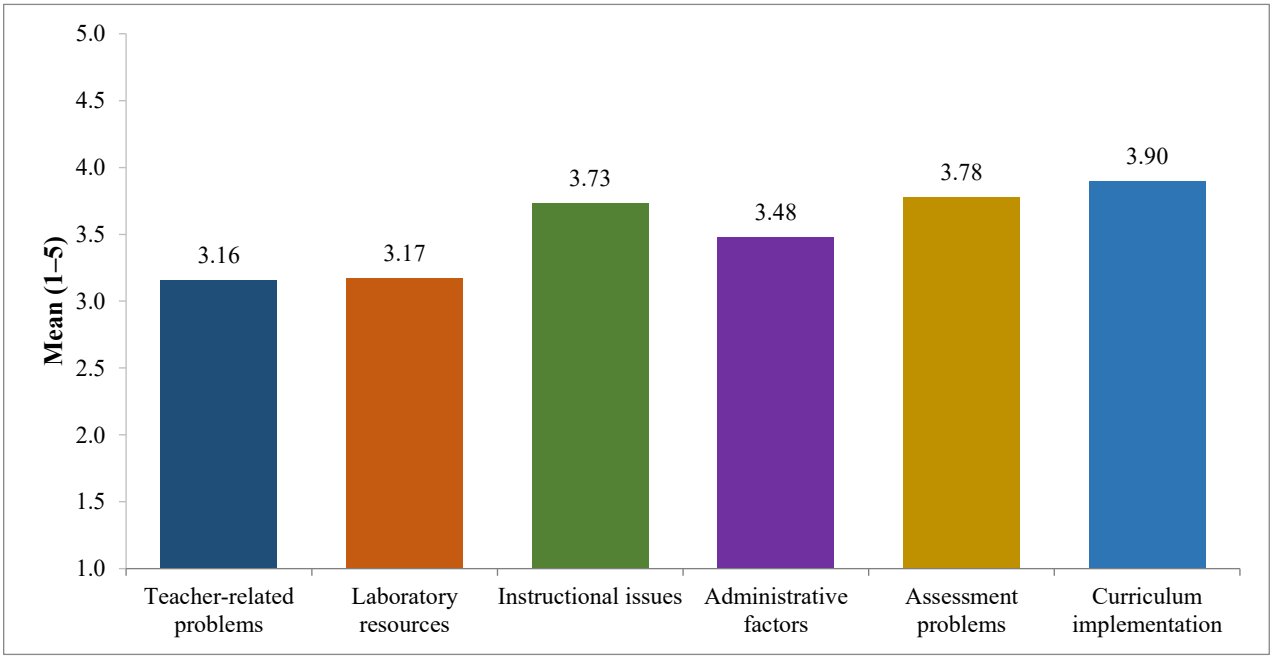


Figure 1. Mean scores of the five challenge domains and curriculum implementation

Other concerns were offered by 48.0% of respondents, inadequate preparation for inquiry-based Physics teaching, and being assigned subjects outside Physics. The lowest mean, on the other hand, was the teachers' lack of confidence in conducting prescribed laboratory experiments (2.81±0.15) with 53.7% of teachers disagreeing or strongly disagreeing that they lacked confidence in conducting prescribed laboratory experiments. In general, teachers' reported problems did not reflect a lack of confidence in their subject-related practical skills in general, but rather were strongly linked to workload and professional relationships, and to institutional recognition.

Laboratory resources and functional readiness

The results for the laboratory-resources scale yielded a mean of 3.17±0.65, which suggests moderate adequacy. While 80.7% of respondents indicated that their schools' science or Physics laboratory was used for practical activities, schools with a science laboratory, did not necessarily mean that it was fully functional or equipped (Figure 2).

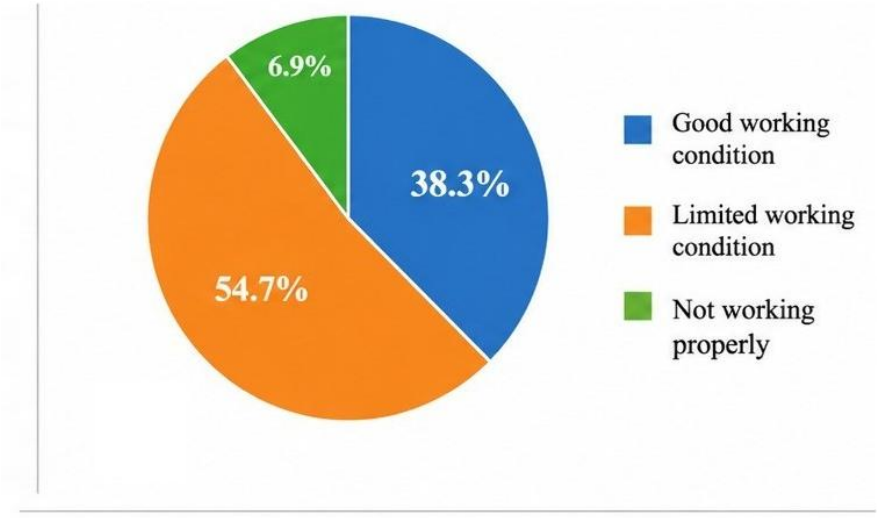


Figure 2. Functional readiness of school Physics laboratories

It is noted that only 54.7% agreed or strongly agreed that adequate apparatus was available to conduct the prescribed practical activities and 38.3% reported that the apparatus was in good order. When necessary, consumable materials were available 44.7% of the

respondents reported (Figure 2). Laboratory assistants were also scarce, with just 35.7% saying they had an assistant or technician to assist in experiments preparation. There were also various technical and infrastructure challenges. The provision of computers, projectors or Internet access for Physics lessons was provided by only 35.3% and 43.3% thought the electricity supply was adequate for practical work. In addition, 46.3% (Figure 2) agree that their overall laboratory facilities is adequate for implementing the Physics curriculum. The results showed that there is a significant gap between the actual existence and practical availability of laboratory facilities to meet the needs of the curriculum.

Instructional issues

One of the highest challenge domains was instructional issues (3.73±0.60). The poor mathematical preparation of students was the highest rated concern for instruction (4.13±0.56), with 89.0% of the teachers agreeing or strongly agreeing that many students in Grade 9 lack the mathematical skills necessary for Physics. Likewise, 84.3% answered that the students lacked a solid understanding of fundamental scientific concepts taught in previous grades (3.94±0.42).

Language problems were also mentioned with 64.7% of respondents citing language of textbooks or language of instruction as a problem in students' comprehension (3.84±0.31). Other common complaints were that students were absent from school regularly (3.82±0.29), students had varying abilities (3.82±0.11), and that students were not interested or motivated (3.82±0.31).

Restrictions in the curriculum were also apparent. Around 73.0% of teachers felt the Physics syllabus was too long to be covered in the academic year (3.78±0.025). Moreover, 60.0% indicated that teaching with large classes was a challenge for activity-based teaching, and 57.3% indicated that the prescribed textbook was not sufficient to support activity-based teaching. The findings in this study point to the significance of the students' prior learning, language, and class conditions and syllabus coverage in the instructional concerns.

Administrative factors

Administrative factors had a mean score of 3.48±0.64, which was a challenging issue. Disruption of the academic calendar due to security conditions, weather or school closures (3.75±0.19) was the highest rated concern and was reported by 70.7% of respondents. The supervision of teachers as education officers was also seen as being more focused on inspection than support for teaching and learning (3.70±0.25) and 56.3% of teachers agreed.

Another widespread concern was inadequate timetabling provision for practical: 68.3% of teachers agreed that their school timetable did not allow sufficient time for practical activities (3.69±0.31). Other reported constraints were the late or unclear communication of curriculum changes (3.63±0.21), the greater teaching burden arising from the lack of Physics or science teachers (3.61±0.19), and the reduction of teacher participation in decision making on school resources/ planning (3.61±0.23). Compared to this, the weakest response for the administrative concerns was head teachers provide inadequate support for practical work (2.74±0.11), where 48.0% disagreed or strongly disagreed with this statement.

Assessment problems

The mean of the problems in the assessment domain was the highest of the five challenge domains (3.78±0.59). The most salient concern was the need for more teacher training for conceptual and application style questions for assessment (4.07±0.14), endorsed by 80.6% of the respondents. Preparing students for board and annual exams was another big question with 87.0% agree/strongly agree that there was insufficient time for practical work (4.06±0.14) Table 4.

In addition, 79.6% indicated that practical examinations were not sufficient in evaluating the students' real practical skills. Many 81.4% (Table 4) felt that the amount of marks allocated to practical work was too few to encourage practical teaching. In addition, 77.7% said that the examination results of students were the primary criterion according to which teachers were evaluated, and 69.0% said the main purpose of the examinations was to memorize and recall, not to understand. Only one assessment item in the moderate range was related to the match between the curriculum learning outcomes and examination papers (3.29±0.17).

Table 4. Most Prominent Item-Level Challenges Reported by Physics Teachers

Challenge indicator	Domain	Mean	Agreement (%)
Weak mathematical skills among students	Instructional	4.13±0.13	89.0
Examination pressure limiting practical work	Assessment	4.06±0.16	87.0
Weak student foundations in basic science	Instructional	3.94±0.19	84.3
Insufficient marks for practical work	Assessment	3.74±0.08	81.4
Need for training in conceptual and application-based assessment	Assessment	4.07±0.16	80.6
Workload limiting practical-work planning	Teacher-related	3.73±0.07	74.0
Lengthy Physics syllabus	Instructional	3.78±0.14	73.0
Disruption of the academic calendar	Administrative	3.75±0.14	70.7

Recall-oriented examinations	Assessment	3.71±0.13	69.0
Insufficient timetable time for practical work	Administrative	3.69±0.14	68.3

Note: Agreement represents the combined percentage of respondents selecting agree or strongly agree. N = 300. The table combines the highest-priority indicators from different measurement domains; the ranking is based on agreement percentages, not on a single common scale.

Reported Implementation Practices and Frequency of Practical Work

Although some problems were identified above, the overall curriculum-implementation score was fairly high (3.90±0.51). The highest mean score (4.21±0.13) indicated that teachers were most likely to agree or strongly agree with encouraging students to ask questions, make predictions, and investigate concepts, of the five implementation indicators. The same goes for the demonstrations when the practical activities could not be carried out (3.94±0.16; 88.4%). Further, 86.0% of them were able to complete the Physics syllabus as prescribed during the academic year (Figure 3).

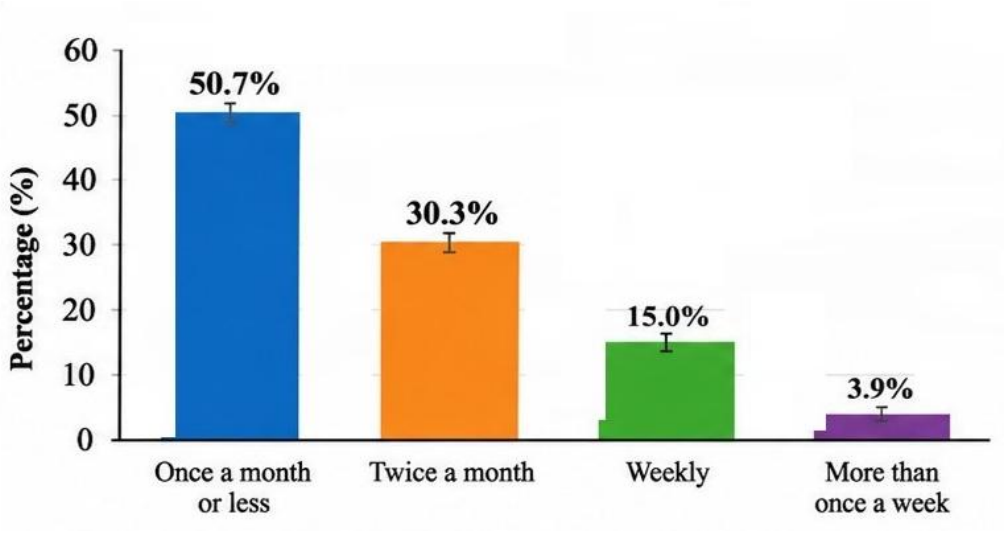


Figure 3: Frequency distribution of student practical work

But the lowest implementation mean (3.67±0.16) was recorded for regular performance of prescribed experiments with students. Fewer than three quarters (65.3%) said they undertook the recommended practical activities regularly, and 24.3% responded with the neutral option. This means that practical learning was not as well practiced as other reported teaching practices.

This was supported further by the frequency data (Table 5). About a third of teachers (34.3%) indicated that they had two or three practical activities every month, while 15.0% indicated that they had practical activities weekly. 33.0% of them did practical work about once per month, 7.7% once per term, 7.3% once or twice per year and 2.7% never did practical work. There was a general consensus that practical activities were carried out once per month or less, with 50.7 % reporting to this effect.

Table 5. Frequency of Student Practical Work in Physics

Frequency	n	%
Never	8	2.7
Once or twice a year	22	7.3
Once a term	23	7.7
About once a month	99	33.0
Two or three times a month	103	34.3
Every week	45	15.0
Total	300	100.0

Note: Practical-work frequency was coded from 0 (never) to 5 (every week); with a mean value 3.34±1.20.

The Challenges Teachers Identified For Implementation

In another multiple response question, teachers identified the challenges they viewed as being most serious for implementing the Physics Curriculum. The most common concern mentioned was overcrowded classrooms (44.3%). The problems were followed by students'

poor foundation in Mathematics and Science (42.3%), lack of teacher training (40.7±0.11) and a lengthy syllabus (39.3±0.18). Other common responses were heavy workload (28.0%) and insufficient laboratory equipment (27.0%).

Other priorities were lack of sufficient teaching time (22.7%), lack of technology/electricity (18.7%), recall-based examinations (16.7%), lack of adequate administrative support (11.3%), and lack of funds (10.7%). These answers offer a complementary picture of teachers' priorities and must be separated from agreement percentages on each of the statements on the Likert scale.

Teachers' Suggestions for Improving Curriculum Implementation

Of the 239 teachers that responded to the open-ended question, 79.7% responded with an answer. They were sorted into 12 themes, and individual responses allowed to be associated with more than one theme.

The most common recommendations were to help improve laboratories, provide adequate apparatus and incorporate regular practical work. Forty-seven point three percent (47.3%) of the respondents mentioned this theme (Figure 4. Allocate more teaching time (61 respondents, 25.5%) and introduce separate practical periods (61 respondents, 25.5%) were the suggestions that were made. 52 respondents (21.8%) identified strengthening mathematical and scientific foundations of students (Figure 4).

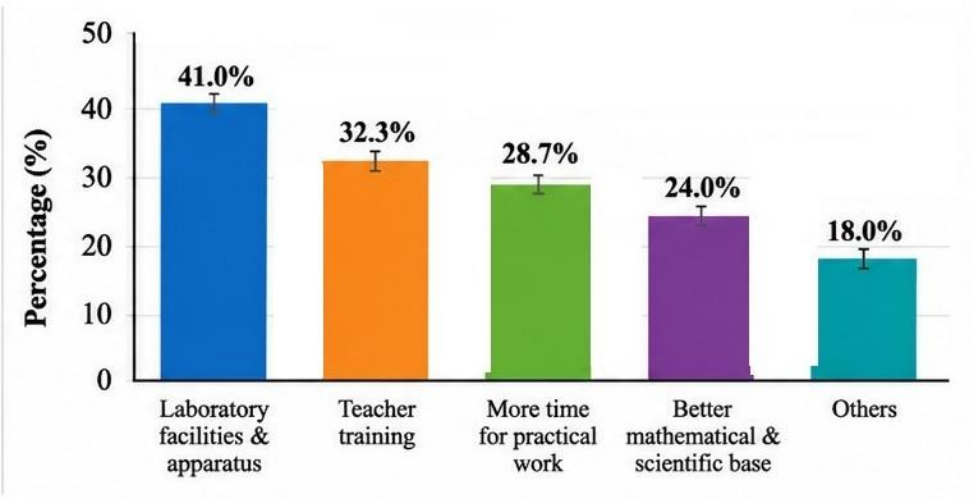


Figure 4. Teachers' recommendations for improving curriculum implementation

Other recommendations made included class size reduction or new classes (14.6 %); shorter or new syllabus (13.8 %); examination and assessment reform (11.7 %); workload reduction for teachers and avoiding out of field teaching assignments (11.3 %); and improvements in technology, ICT and electricity provision including solar power (10.0 %). Other recommendations included improved academic supervision and funding (9.6%), language support in English and Urdu (5.9%) and augmenting the number of qualified Physics teachers (4.6%).

Table 6. Teachers' Recommendations for Improving Physics Curriculum Implementation

Rank	Recommendation theme	n	% of respondents
1	Laboratories, apparatus and regular practical work	113	47.3
2	Teacher training and workshops	61	25.5
3	More teaching time/separate practical periods	61	25.5
4	Strengthening students' mathematical and scientific foundations	52	21.8
5	Smaller classes/additional sections	35	14.6
6	Shorter or revised syllabus	33	13.8
7	Examination and assessment reform	28	11.7
8	Reduced workload/avoidance of out-of-field teaching	27	11.3
9	Technology, ICT and electricity, including solar power	24	10.0
10	Academic supervision, administration and funding	23	9.6
11	Language support in English and Urdu	14	5.9
12	Recruitment of qualified Physics teachers	11	4.6

Note: n = 239 respondents who answered the open-ended question. Multiple themes could be assigned to a single response; therefore, percentages do not sum to 100%.

Pearson Correlation Matrix of the Study Variables

All five independent variables were significantly related to curriculum implementation at the $p < .001$ level and the direction of each relationship was as expected based on the conceptual framework. The problems most strongly associated with implementation were teacher-related problems ($r = -.463$), followed by laboratory resources ($r = .446$), instructional issues ($r = -.401$), administrative factors ($r = -.372$) and assessment problems ($r = -.281$). By using conventional benchmarks, the first four relationships were medium to large in size and the relationship with assessment problems was small to medium (Funder & Ozer, 2019). There were positive relationships between the four problem scales ($r = .319$ to $.390$) and negative relationships between the problem scales and laboratory resources ($r = -.204$ to $-.292$). Teachers who indicated more serious issues with one area therefore often indicated more serious issues with another area and the poorer resources. The correlation values of the Spearman rank-order correlations (Table 7) were very similar in magnitude and direction and significant at the same level, indicating that the results were not a reflection of the highly skewed distribution of the dependent variable.

Table 7: Pearson Correlation Matrix of the Study Variables

Variable	1	2	3	4	5	6
1. Teacher-related problems	—					
2. Laboratory resources	−.292**	—				
3. Instructional issues	.339**	−.273**	—			
4. Administrative factors	.390**	−.226**	.329**	—		
5. Assessment problems	.349**	−.204**	.321**	.319**	—	
6. Curriculum implementation	−.463**	.446**	−.401**	−.372**	−.281**	—
M	3.16	3.17	3.73	3.48	3.78	3.90
SD	0.78	0.65	0.60	0.64	0.59	0.51

Note. N = 300. Pearson correlation coefficients. ** $p < .01$ (two-tailed).

Discussion

Overall challenges in implementing the National Physics Curriculum 2023

The results suggest that the challenges of implementing the National Physics Curriculum 2023 in government secondary schools in Quetta are interrelated in terms of both teaching and learning, assessment, administrative and resource issues. Assessment problems (3.78±0.14) and instructional issues (3.73±0.13) were the most prominent concerns, followed by administrative factors (3.48±0.18). The scores for teacher-related issues (3.16±0.09) and laboratory resources (3.17±0.14) were moderate. This trend indicates that curriculum implementation is not only related to teachers' skills and school facilities, but also to the extent to which school structures, such as the learning objectives, assessment systems, and institutional support, support the curriculum's goals.

Rogan and Grayson (2003) stress that it is the interaction between curriculum expectations, school capacity, and external support that affect curriculum implementation. The National Curriculum 2023 encourages scientific enquiry, practical work, links to other curriculum areas and the use of mathematics and technology (National Curriculum Council, 2023; UNESCO, 2023; Teig et al., 2018). The current results indicate that there is a mismatch between these expectations and what teachers have to work with in the schools they teach in.

Instructional challenges and students' learning preparedness

The most common instructional barriers reported were students' limited mathematical skills (89.0%) and their poor understanding of basic concepts in science (84.3%). Other issues of concern included language difficulties, irregular attendance, differences in students' abilities, and low motivation. The results show the need for pupils' fundamental skills in the context of a strong, conceptually-focused, mathematically-rich Physics curriculum.

The physics learning process involves interpreting scientific concepts, understanding the mathematical relationships, manipulating equations and relating abstract concepts to observable phenomena. Lacking a strong grasp of the concepts in the basic level of knowledge can then limit their access to the more challenging concepts and activities of inquiry. This can also be hindered by a large class size: 44.3 % of teachers indicated that overcrowding constituted a significant problem and 64.4 % had a class size of more than 45 students. This can present challenges to providing individual support and student-centred activities. The results obtained are similar to (Nawaz and Akbar, 2019; Taber, 2018; Wieman et al., 2008) who identified the differences between intended and implemented Physics curriculum in public secondary schools in Pakistan. There should be therefore a reinforcement of the foundation of mathematics and

science and coping with language barriers and the improvement of learning conditions in the classroom during the implementation of curriculum.

Laboratory readiness and practical Physics

The results reflect laboratory availability but do not necessarily mean that the system is ready for use. 80.7% of teachers stated that their schools had a Physics/science lab for practical activities, but only 38.3% said that the apparatus provided was in good working order. 35.7% of laboratory assistants, 43.3% of reliable electricity and 35.3% of ICT facilities were reported. In general, 46.3% felt their laboratory facilities were satisfactory.

The relationship between the presence of a laboratory and meaningful experimental learning is not guaranteed. Functional equipment, consumables, technical assistance, appropriate safety arrangements and reliable utilities are essential to the practical teaching. Laboratory activities are important for scientific investigation and for linking theory with experiment, as (Hofstein and Lunetta, 2004; Smith, 1991; Skaalvik & Skaalvik, 2011) stress. Their effectiveness, however, is reliant on the thoughtful design and incorporation in the teaching process. Likewise, Abrahams and Millar (2008) and Sims et al. (2023) explain that the practical activities might not produce conceptual understanding, and that the student needs to be supported in relating the observations to the scientific ideas. The improvement of the laboratories needs to thus focus on equipment, maintenance, consumables, technical support and regular opportunities for students to have experiments (Semali & Mehta, 2012; Sims et al., 2023; Shahzadi et al., 2023).

Assessment practices and examination-related constraints

The mean score for assessment problems (3.78±0.13) was the highest. For teachers, part of the concern was examination pressure: 87.0% indicated that the pressure of preparing for board/examinations or annual examinations took away time for them to conduct practical work. In addition, 80.6% agreed that more training was needed in conceptual and application-based assessment, and 79.6% felt that the practical exams failed to assess students' practical skills. 81.4% felt that the marks given for practical work were inadequate to promote practical teaching.

The results indicate potential discrepancies between the curriculum's focus on inquiry, and skills-based assessments, and teachers' experiences of these assessment practices. Preparation for examination may focus on recall and syllabus coverage, which may limit opportunities for experimentation, scientific reasoning and application. Black and Wiliam (1998) and Rutten et al. (2012) showed the benefits of formative assessment and feedback to assist learning. Therefore, Physics assessment must measure conceptual understanding, problem-solving, analysis of evidence and practical skills, and not be based primarily on memorization. Addressing this challenge may be achievable by developing teachers' assessment literacy and ensuring congruence between curriculum outcomes and assessments (both classroom and external).

Administrative and institutional conditions

Administrative factors were also found to be a major challenge (3.48±0.11). 70.7% of teachers reported disruption to the academic calendar due to security issues, weather or school closures. 68.3% reported insufficient timetable provision for practical activities and 56.3% noted a concern about emphasis on inspection rather than academic support in supervision. The late notification of curriculum changes and extra workloads due to teacher shortages were also reported.

These factors may make it difficult to provide a consistent curriculum, due to the need for preparation, appropriate scheduling, equipment and time needed for practical lessons. Only 25.6% of teachers agreed that head teachers actively supported practical activities. This meant that administrative problems did not necessarily reflect school leadership issues; the issues of staffing, scheduling, supervision, funding and communication were also pertinent. The successful implementation of effective strategies requires supportive institutional arrangements as well as appropriate curriculum design (Rogan and Grayson, 2003; Shulman, 1986).

Teacher workload and professional support

The overall teacher-related problem score was moderate (3.16±0.13) but individual responses indicated important teacher constraints. Teachers reported that workload was a significant issue that reduced time available for planning practical activities for 74.0% of them. Furthermore, 59.7% indicated low awareness of innovative teaching and 60.0% said that there was low participation in collaborative working and lesson planning by other Physics teachers.

The results indicate that the implementation capacity is affected by teachers' working conditions and their subject knowledge. Time for lesson preparation and professional collaboration, access to teaching materials and relevant training are essential for effective implementation. Limited curriculum-related professional development of Physics teachers in Pakistan was also pointed out by Nawaz and Akbar (2019). Professional development should therefore focus on developing the skills of inquiry-based instruction, hands-on teaching, and design of assessments, and institutional arrangements should be made to allow teachers to make use of these skills.

Reported implementation and the practical-work gap

Despite the constraints found, teachers overall indicated that curriculum was implemented moderately well (3.90). The highest mean (4.21±0.21) was for encouraging students to ask questions and make predictions, and using demonstrations when practical work was not possible (3.94±0.18). Prescribed experiments carried out regularly, however, scored the least (3.67±0.12). The results of practical-work frequency data revealed that 50.7% of teachers performed practical work once a month or less and 2.7% never performed practical work.

The difference indicates that questions, discussion, demonstrations, and syllabus coverage could be more uniform among teachers than among students conducting experiments. Demonstrations are useful to complement conceptual explanations when laboratory facilities are at a premium but cannot be used to completely substitute for student opportunity to manipulate apparatus, make measurements, record observations, and interpret results. Practical activities should relate what they can see with scientific knowledge that pupils are expected to know, as emphasized by Abrahams and Millar (2008) and Schober et al., 2018. Student involvement in experiments should thus be seen as a valuable measure of curriculum implementation, on frequency and quality.

The results in this section should be treated with care as these data were self-reported by teachers rather than observed in the classroom or assessed independently by a child's learning outcomes. Classroom observations, lab audits, and student performance metrics could be combined in future studies to offer a more complete picture.

Teachers' suggestions and implications

The quantitative results were corroborated by teachers' open-ended responses. Of those who gave suggestions, 47.3% suggested good facilities for functional laboratories, good apparatus and regular practical work. Twenty-five point five percent pointed to teacher training, and another 21.8% to improving students' mathematical and scientific backgrounds, respectively. Other recommendations were made such as the reduction of class size, revision of the syllabus, a change in an assessment system, less workload, better provision of electricity and ICT facilities, and better academic supervision.

These recommendations point towards an integrated approach to curriculum improvement. The availability of a laboratory shouldn't be the primary consideration, but rather the availability of equipment, consumables, safety, electricity and technical assistance. Professional development should be on the following topics: inquiry-based teaching, experiment preparation, conceptual assessment, and low cost practical activities. Time and emphasis in curriculum and examination arrangements should be given to practical learning and appropriate emphasis should be given to the building of the necessary basic mathematics and science skills.

In general, the results show that teachers have relatively high levels of engagement with some of the curriculum related classroom practices, but assessment problems are still a significant issue, as are students' learning readiness, the functionality of the laboratory, and the lack of practical work. These problems need to be resolved in a coordinated way between curriculum planning, teacher preparation, assessment and school resources. The findings and implications are reported from the participating government secondary schools in Quetta, and cannot be automatically extrapolated to the rest of the schools in the district or Balochistan or Pakistan.

Conclusion

This study focused on the problems of implementation of National Curriculum 2023 for the subject Physics in Government secondary schools of Quetta city of Balochistan, Pakistan. The results show that while teachers generally felt that the curriculum was being carried out at a fairly high level, there are significant limitations in the way the curriculum is being assessed, taught, supported at school level, and experienced in the classroom. The most pressing problems for assessment and teaching were related to assessment problems, especially the pressure in the examination, also the weak mathematical and scientific foundations of students and the need for more teacher training in conceptual and application-based assessment.

One of the primary issues was the disparity between availability in the lab and functional readiness. While all the teachers who participated in the study had access to a school laboratory, the laboratory apparatus, laboratory assistance, electricity and ICT facilities were insufficient for effective practical teaching. As a result, the use of practical work in the classroom was less regular than the other reported practices; around half of the teachers carried out experiments once per month or less. Additional recommendations by teachers included functional laboratory facilities, subject specific professional development, more time for practical activities, increased student base, and enhancement of assessment and school level support.

The results showed that translating the National Curriculum 2023 into a successful implementation calls for more than dissemination of the curriculum and providing laboratory rooms. It calls for integrated enhancements to functional resources, assessment integration, instruction time, teacher supports, and students' base skills. Schools should emphasise the need for the provision and upkeep of practical facilities, enhance teachers' ability to teach in an inquiry approach and to assess learning, and ensure that school timetables and examination arrangements facilitate the practice and learning of the curriculum.

This study is a cross sectional survey of 300 Physics teachers of government secondary schools in Quetta District. The results do not necessarily represent actual classroom experiences and practices by teachers, and should not be viewed as direct measures of student or classroom success. Further studies are recommended in other districts and classrooms of Balochistan and the use of the Teacher Survey along with Classroom Observation, Laboratory Evaluation and Student Learning Evaluation. This evidence would enable the development of contextually appropriate solutions to enhance Physics education in Pakistan and find ways to implement curriculum expectations in everyday classroom practice.

Author's Contribution:

Naveshta Afzal: Conceptualization, methodology, investigation, data analysis, and original draft.

Abdul Nasir Kiazai: Supervision, methodology, validation, and review and editing.

Muhammad Zakir: review and editing. All authors approved the final manuscript.

Data and Material Availability

All data generated or analyzed during this study are included in this published article. Additional datasets, supporting materials, and analytical details are available from the corresponding author upon reasonable request.

Conflicts of Interest

The authors state that they have no direct or indirect financial interest that would be considered as a potential competing interest.

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