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Assessment Equity and Performance Gaps in Secondary Education: A Distributional Analysis of Pre-Board and Board Examinations

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Abstract

This study examines how preparatory school-based assessments influence educational equity in high-stakes secondary examinations by analysing changes in score distributions from pre-board to board examinations. Using a repeated cross-sectional design, the study draws on examination data from 393 students across six cohorts in a CBSE-affiliated school over three academic years (2023–2025), comprising Standard 10 (n = 223) and Standard 12 (n = 170) students. Rather than relying solely on average score gains, the analysis adopts an equity-focused framework employing distributional measures, including Gini coefficients, coefficients of variation, P90/P10 ratios, interquartile ranges, and quartile-based improvement analyses.

The findings reveal a consistent equity enhancing pattern in Standard 10 cohorts, where score inequality declined following board examinations, as reflected in reductions in Gini coefficients ranging from 0.025 to 0.038 across the three years. These changes were accompanied by a clear "lifting-the-bottom" effect, with students in the lowest pre-board quartile recording substantially larger improvements (12–17 percentage points) than those in the highest quartile (5–10 percentage points). In contrast, Standard 12 cohorts exhibited minimal and inconsistent equity shifts, with Gini changes close to zero and relatively uniform gains across performance quartiles. Quartile-based differences were statistically tested using ANOVA, with moderate to large effect sizes observed in Standard 10.

The results suggest that preparatory assessments can function as equity-supportive mechanisms when aligned with timely feedback and remediation, particularly at earlier stages of high-stakes assessment cycles. At later stages, such assessments appear to serve a predominantly predictive role, with limited influence on performance disparities. By foregrounding distributional outcomes alongside conventional performance indicators, this study demonstrates the value of integrating equity metrics into assessment evaluation and offers evidence-informed insights for assessment design, instructional practice, and policy in secondary education.

Keywords: pre board; board examination; assessment equity; Gini Index; performance gaps; longitudinal analyses

1. Introduction

Assessment plays a central role in formal education systems by shaping instructional practices, guiding student learning, and influencing academic progression. In high-stakes contexts, assessments do more than measure achievement; they also affect students' motivation, confidence, and access to future educational opportunities. As a result, concerns about fairness and equity have become integral to contemporary discussions on assessment design

and interpretation. Equity in assessment extends beyond the neutrality of test items. It also includes whether assessment practices help narrow or widen performance gaps among students across the achievement spectrum.

Within the Indian secondary education system, pre-board examinations conducted by schools affiliated with the Central Board of Secondary Education (CBSE) occupy a significant position. These assessments are designed to simulate the content, format, and difficulty level of the final board examinations. They are widely used to gauge student preparedness. In practice, pre-boards serve multiple functions. They familiarise students with examination conditions, provide teachers with diagnostic information about learning gaps, and guide remedial instruction before the board examinations. School practices often reflect an intentional use of pre-boards as a preparatory mechanism rather than merely an internal evaluation exercise.

Similar preparatory examination systems exist internationally under terms such as mock examinations, practice tests, or trial assessments, particularly in high-stakes systems in the United Kingdom, China, and parts of Southeast Asia. However, research in these contexts has also focused predominantly on predictive accuracy rather than distributional equity, leaving questions about their equity implications underexplored

In the Indian context, several studies have highlighted the importance of school-based assessments in shaping board examination outcomes. For instance, Kumar and Sharma (2022) observed a strong relationship between internal assessment scores and CBSE board performance, suggesting that pre-board examinations play a crucial diagnostic role. Similarly, Singh et al. (2023) reported that students who received structured remedial support after pre-board assessments showed noticeable improvement in their board results, particularly those who initially performed poorly. However, most of these studies focus mainly on average score improvement or predictive accuracy. There is still limited research exploring how such improvements are distributed across different performance groups. This highlights the need for an equity-focused approach, which the present study seeks to address.

Despite their widespread use, the effectiveness of pre-board examinations is most often judged through average score gains or correlations with board examination results. While such indicators offer useful information about predictive validity, they provide limited insight into how different groups of students benefit from the assessment process. Average improvements may conceal important distributional shifts. In particular, they may hide whether lower-performing students experience proportionately greater gains than their higher-performing peers. An equity-oriented analysis, therefore, requires attention to the entire score distribution rather than relying solely on central tendency measures.
The importance of examining assessment equity has become even more significant in the post-pandemic period. COVID-19 disruptions, including prolonged school closures and the shift to online learning, affected students unevenly. Differences in access to digital devices, home learning support, and learning environments contributed to widening academic gaps. National reports and classroom experiences have pointed to learning loss, especially among academically vulnerable students. In this context, pre-board examinations have gained renewed importance as diagnostic tools to identify learning gaps and guide focused remedial interventions before students appear for high-stakes board examinations.

Although substantial research exists on the predictive validity of mock or preparatory examinations, there remains limited empirical evidence examining whether such assessments systematically reduce or reinforce performance disparities across the full score distribution. This gap is particularly evident across grade levels and over time. Most existing studies focus on single cohorts or single assessment cycles. Few investigate longitudinal patterns of equity using distribution-based measures. As a result, the equity implications of preparatory assessments in high-stakes secondary education remain underexplored.

From a developmental perspective, differences in equity outcomes may reasonably be expected across grade levels. Students in Standard 10, typically aged 15–16 years, encounter their first high-stakes board examination. They may therefore display greater responsiveness to feedback, remediation, and changes in study strategies. In contrast, Standard 12 students, aged 17–18 years, often exhibit more stable learning patterns shaped by prior examination experiences. This may limit short-term shifts in performance distributions. These developmental differences suggest

that preparatory assessments may function differently as equity mechanisms at different stages of secondary schooling.

This study also gains relevance in light of the National Education Policy (NEP) 2020, which advocates a shift from rote-based, high-stakes testing to more formative and competency-based assessment practices (Government of India, 2020). The policy emphasises using assessments as tools for improving learning rather than merely ranking students. By examining how pre-board examinations influence score distributions and equity outcomes, the present study provides empirical evidence that supports this policy vision of making assessment systems more inclusive and learner-centered.

Accordingly, this study investigates how pre-board assessments influence score distributions and performance gaps by analysing changes in equity-focused metrics from pre-board to board examinations across three consecutive cohorts in Standards 10 and 12. By adopting a longitudinal, distribution-based approach, the study extends assessment research beyond predictive accuracy. It examines how assessment practices interact with educational equity in high-stakes secondary education.

2. Research Objectives and Hypotheses

2.1 Research Objectives

The primary objective of this study is to examine whether school-based pre-board examinations function solely as predictive assessments or whether they also influence educational equity by altering score distributions in high-stakes board examinations. Moving beyond average score comparisons, the study adopts a distributional perspective to evaluate changes in performance gaps across the achievement spectrum.

Specifically, the study seeks to:

1. **Quantify distributional changes**
   To measure changes in score distributions from pre-board to board examinations in Standards 10 and 12 across three academic years (2023–2025), using equity-focused metrics such as the Gini coefficient, coefficient of variation, P90/P10 ratios, and interquartile ranges.
2. **Examine differential improvement across performance levels**
   To analyse whether students in lower pre-board performance quartiles exhibit larger score gains than those in higher quartiles, indicating a potential equity-enhancing or "lifting-the-bottom" effect.
3. **Compare grade-level equity dynamics**
   To assess whether the equity effects of pre-board assessments differ between Standard 10 and Standard 12 students, reflecting differences in developmental stage and prior exposure to high-stakes examinations.
4. **Assess temporal consistency of equity effects**
   To evaluate whether observed equity patterns remain stable, strengthen, or weaken across successive cohorts within each grade level over the three-year period.
5. **Inform assessment design and practice**
   To derive evidence-based implications for the design and use of preparatory assessments in secondary education, particularly with respect to balancing predictive validity and equity considerations.

2.2 Hypotheses

Grounded in prior research on formative assessment, assessment validity, and developmental differences in learning responsiveness, the study tests the following hypotheses:

H1 (Equity Enhancement in Standard 10):
Standard 10 cohorts will demonstrate a reduction in score inequality from pre-board to board examinations, as reflected in negative changes in Gini coefficients, indicating improved equity in score distributions.

H2 (Equity Neutrality or Variability in Standard 12):
Standard 12 cohorts will exhibit small, inconsistent, or negligible changes in Gini coefficients between pre-board and board examinations, indicating limited or unstable equity effects.

H3 (Differential Quartile Improvement):
In Standard 10, students in lower pre-board performance quartiles will show larger average score gains than students in higher quartiles, with improvements decreasing monotonically from the lowest to the highest quartile. In Standard 12, quartile-based differences in improvement will be smaller and non-monotonic.

H4 (Performance Gap Dynamics):
Performance gaps, as measured by P90/P10 ratios, will narrow from pre-board to board examinations in Standard 10 cohorts, whereas changes in Standard 12 cohorts will be inconsistent or minimal.

H5 (Temporal Stability of Equity Effects):
Equity-related changes in Standard 10 will be relatively stable across cohorts over the three-year period, while Standard 12 cohorts will display greater variability in equity outcomes over time.

3. Literature Review

3.1 Assessment Validity and Equity in Educational Measurement

Contemporary perspectives on educational assessment emphasise that validity is not an inherent property of a test, but rather a function of how assessment results are interpreted and used within specific contexts (Messick, 1989; Kane, 2013). Foundational work by Messick and later scholars has established that assessment validity must encompass not only technical accuracy but also the social consequences of assessment practices (Messick, 1989). Within this framework, equity has emerged as a critical dimension of validity (Messick, 1989; Wiliam, 2011), requiring attention to whether assessments reinforce or mitigate existing disparities in student achievement.

Equity in assessment extends beyond ensuring that test items are free from cultural or demographic bias. It also concerns how assessment systems shape outcome distributions, particularly whether they narrow or widen performance gaps between higher- and lower-performing students (Kane, 2013; Wiliam, 2011). Traditional reliance on mean scores or pass rates often obscures distributional effects, making it difficult to determine who benefits most from assessment-driven interventions. As a result, scholars have increasingly advocated for distribution-based indicators—such as percentile ratios and inequality indices—to better capture equity-related outcomes in educational measurement (Ramsey & Venkat, 2020).

3.2 Distributional Approaches to Measuring Educational Inequality

Measures originally developed to study economic inequality, such as the Gini coefficient, have been increasingly applied to educational contexts to examine disparities in achievement, particularly in research examining widening achievement gaps across socioeconomic groups (Atkinson, 1970; Cowell, 2011; Reardon, 2011). In educational settings, Gini coefficients typically fall within a narrower range than income data, yet even small changes can reflect meaningful shifts in equity across student populations (Ramsey & Venkat, 2020). Studies have demonstrated that distributional metrics offer insights that are not evident from average score comparisons, particularly when evaluating interventions aimed at supporting lower-performing students (Reardon, 2011).

Percentile-based measures, such as P90/P10 ratios and interquartile ranges, further complement inequality indices by focusing on relative gaps between high and low achievers (Ramsey & Venkat, 2020). These measures are less sensitive to extreme values and allow researchers to examine whether changes in assessment outcomes reflect compression of score distributions or uniform shifts across performance levels. Despite their analytical value, such

metrics remain underutilised in school-based assessment research, particularly in longitudinal studies at the secondary level (Ramsey & Venkat, 2020).

3.3 Formative Assessment, Feedback, and Differential Student Gains

A substantial body of research on formative assessment highlights the role of feedback and diagnostic evaluation in promoting learning gains, especially among lower-performing students (Black & Wiliam, 1998; Hattie & Timperley, 2007; Sadler, 1989). Meta-analyses have consistently shown that timely, targeted feedback can produce larger effect sizes for students who begin at lower levels of achievement, thereby contributing to the reduction of performance gaps (Hattie & Timperley, 2007). These findings support the notion that assessment practices can function as equity-enhancing mechanisms when they are closely linked to instructional responses (Black & Wiliam, 1998).

However, much of the formative assessment literature is situated in low- or moderate-stakes classroom contexts. Fewer studies have examined whether similar equity effects occur within high-stakes assessment environments, where the primary function of testing is often summative rather than developmental (Wiliam, 2011). This raises important questions about whether preparatory assessments embedded within high-stakes systems can retain formative characteristics that support equity, or whether their impact is constrained by accountability pressures.

3.4 Preparatory and Mock Examinations in High-Stakes Contexts

Internationally, preparatory or mock examinations are widely used to predict student performance in high-stakes assessments. Research from the United Kingdom and the United States has demonstrated strong correlations between mock examination scores and final outcomes in public examinations and standardised tests (Thomas & Goldstein, 2002). These findings have reinforced the view that preparatory assessments serve an important predictive function within education systems.

In the Indian context, pre-board examinations play a similar role but are often more institutionally embedded and consequential for instructional planning. Existing studies and practitioner reports suggest that pre-boards are frequently designed to be more demanding than board examinations, with the intention of identifying learning gaps and motivating intensified preparation (Kumar & Sharma, 2022; Singh et al., 2023). While such practices are believed to contribute to overall score improvements, empirical evidence examining their impact on score distributions and equity remains limited. Most available studies focus on average gains or predictive validity, leaving unanswered questions about whether improvements are equitably distributed across performance levels.

3.5 Developmental Considerations and Grade-Level Differences

Developmental research indicates that students' responsiveness to feedback and intervention varies across adolescence (Hattie & Timperley, 2007). Early adolescents, typically represented by students in Standard 10, are still developing metacognitive and self-regulatory capacities, making them more receptive to structured feedback and instructional adjustment (Sadler, 1989). In contrast, older adolescents in Standard 12 often exhibit more stable learning behaviours shaped by prior assessment experiences, potentially limiting short-term redistribution of performance outcomes.

These developmental differences suggest that preparatory assessments may operate differently as equity mechanisms at different stages of secondary education. Yet, few empirical studies have explicitly compared equity effects of assessment practices across grade levels within the same institutional context (Wiliam, 2011). This represents a significant gap in the literature, particularly in systems where students encounter multiple high-stakes examinations over the course of their schooling.

3.6 Research Gap and Contribution of the Present Study

Although existing research has established the predictive value of preparatory assessments and the potential of formative feedback to reduce learning gaps, there is limited longitudinal evidence examining how preparatory assessments influence score distributions and equity over time. In particular, little is known about whether such assessments systematically benefit lower-performing students, whether equity effects differ across grade levels, and whether observed patterns remain stable across successive cohorts.

The present study addresses this gap by adopting a longitudinal, distribution-focused approach to analyse pre-board and board examination outcomes across three years in Standards 10 and 12. By integrating inequality indices, percentile ratios, and quartile-based improvement analyses, the study contributes to assessment research by foregrounding equity as a central evaluative criterion alongside predictive accuracy. In doing so, it offers a more nuanced understanding of how assessment practices interact with student performance distributions in high-stakes secondary education.

4. Methodology

4.1 Study Design and Setting

This study employed a repeated cross-sectional longitudinal design to examine changes in score distributions associated with preparatory assessments over a three-year period (2023–2025). Rather than tracking the same students longitudinally, the design compared independent cohorts from the same institutional context across successive years, allowing for the examination of temporal consistency in equity patterns while maintaining student anonymity.

The study was conducted in a single CBSE-affiliated secondary school that follows a standardized curriculum and assessment framework for both Standard 10 and Standard 12. The institutional context remained stable across the study period, including curriculum coverage, examination structure, and internal assessment practices, thereby reducing contextual variability across cohorts.

4.2 Participants and Data Sources

The study analysed examination records from 393 students across six cohorts. Of these, 223 students were enrolled in Standard 10 and 170 students in Standard 12. Cohort sizes ranged from 65 to 81 students in Standard 10 and from 55 to 58 students in Standard 12 across the three years.

All students included in the analysis:

- Were enrolled in the school during the relevant academic year,
- Appeared for both the pre-board and board examinations, and
- Had complete and valid percentage score records.

The data were obtained from institutional academic records maintained in spreadsheet format. Scores represented aggregate percentages across subjects, ensuring comparability between pre-board and board assessments within each cohort.

4.3 Measures and Equity Indicators

To move beyond mean-based comparisons, the study adopted a distribution-focused equity framework, operationalised through the following measures:

1. **Gini Coefficient**
   Used to assess overall inequality in score distributions, where lower values indicate greater equity.
2. **Coefficient of Variation (CV)**
   Calculated as the ratio of the standard deviation to the mean, providing a measure of relative dispersion.
3. **P90/P10 Ratio**
   Representing the ratio of scores at the 90th and 10th percentiles, capturing performance gaps between high- and low-performing students.
4. **Interquartile Range (IQR)**
   Calculated as the difference between the 75th and 25th percentiles, reflecting the spread of the middle 50% of scores.
5. **Quartile-Based Improvement**
   Individual student improvement was computed as the difference between board and pre-board scores (Board % − Pre-board %). Students were grouped into quartiles based on pre-board performance, and mean improvements were calculated for each quartile.

4.4 Analytical Procedures

The analysis proceeded in five stages.

First, descriptive and distributional statistics were calculated for pre-board and board scores in each cohort, including means, standard deviations, skewness, kurtosis, and equity indicators.

Second, equity changes were examined by comparing pre-board and board Gini coefficients and coefficients of variation within cohorts. Given that inequality measures are distribution-level statistics, changes were interpreted descriptively and supplemented with bootstrap confidence intervals (1,000 resamples) to assess robustness rather than relying solely on inferential significance testing.

Third, quartile-based improvement patterns were analysed using one-way ANOVA to compare mean score gains across quartiles. Where assumptions of homogeneity of variance were violated, Welch's ANOVA was applied. Post-hoc comparisons were conducted using Tukey's HSD test.

Fourth, performance gap dynamics were evaluated by comparing P90/P10 ratios before and after board examinations. Changes in gap magnitude were interpreted directionally (narrowing or widening) and supported by resampling-based confidence intervals.

Finally, temporal patterns in equity outcomes were examined across the three cohorts within each grade level. Given the limited number of time points, trend analyses were interpreted cautiously, with emphasis placed on consistency and direction rather than formal statistical inference.

All analyses were conducted using Python-based statistical packages. A significance threshold of $\alpha = .05$ was applied where inferential tests were used, and effect sizes were reported to support practical interpretation.

4.5 Ethical Considerations

The study utilised anonymised academic records approved for institutional research use. No personal identifiers were included, and results are reported only in aggregate form. The repeated cross-sectional design ensured confidentiality while allowing meaningful analysis of assessment patterns over time.

5. Results

The analysis examined pre-board and board examination outcomes for 393 students across six cohorts over three academic years (2023–2025), comprising Standard 10 (n = 223) and Standard 12 (n = 170) students. Results are presented using descriptive statistics and equity-focused distributional measures to highlight changes in performance patterns across assessment stages.

5.1 Descriptive and Distributional Characteristics

In most cohorts, students performed better in the board examinations than in the pre-board examinations; however, one Standard 12 cohort (2024) showed a slight decline in average scores, and the magnitude and distribution of change varied by grade level. Standard 10 cohorts displayed greater dispersion and inequality in pre-board scores, followed by noticeable compression of score distributions in the board examinations. In contrast, Standard 12 cohorts showed relatively stable distributions across both assessment stages.

Table 1. Descriptive statistics and equity indicators for pre-board and board examinations (2023–2025)

Grade	Year	N	Pre-board Mean (SD)	Board Mean (SD)	Pre-board Gini	Board Gini	Gini Change
Std 10	2023	77	73.7 (12.5)	82.8 (10.9)	0.096	0.071	–0.025
Std 10	2024	65	67.0 (12.6)	81.9 (11.3)	0.106	0.075	–0.030
Std 10	2025	81	66.2 (14.8)	78.8 (11.4)	0.119	0.082	–0.038
Std 12	2023	57	79.7 (8.2)	80.8 (8.3)	0.058	0.057	–0.001
Std 12	2024	58	84.4 (7.0)	82.8 (8.0)	0.047	0.055	+0.008
Std 12	2025	55	82.4 (6.9)	84.4 (5.9)	0.047	0.040	–0.007

Note. Values are percentages. SD = standard deviation

5.2 Changes in Score Equity

Equity changes were assessed using the Gini coefficient to capture shifts in overall score inequality. As shown in Table 1, all three Standard 10 cohorts exhibited consistent reductions in Gini coefficients following the board examinations, with declines ranging from **0.025 to 0.038**. These reductions indicate a movement toward more equitable score distributions.

In contrast, Standard 12 cohorts demonstrated minimal and inconsistent changes in Gini coefficients (ranging from **−0.001 to +0.008**), suggesting that overall levels of score inequality remained largely unchanged between the pre-board and board examinations. Figure 1 shows the changes in Gini coefficients from pre-board to board examinations across cohorts.

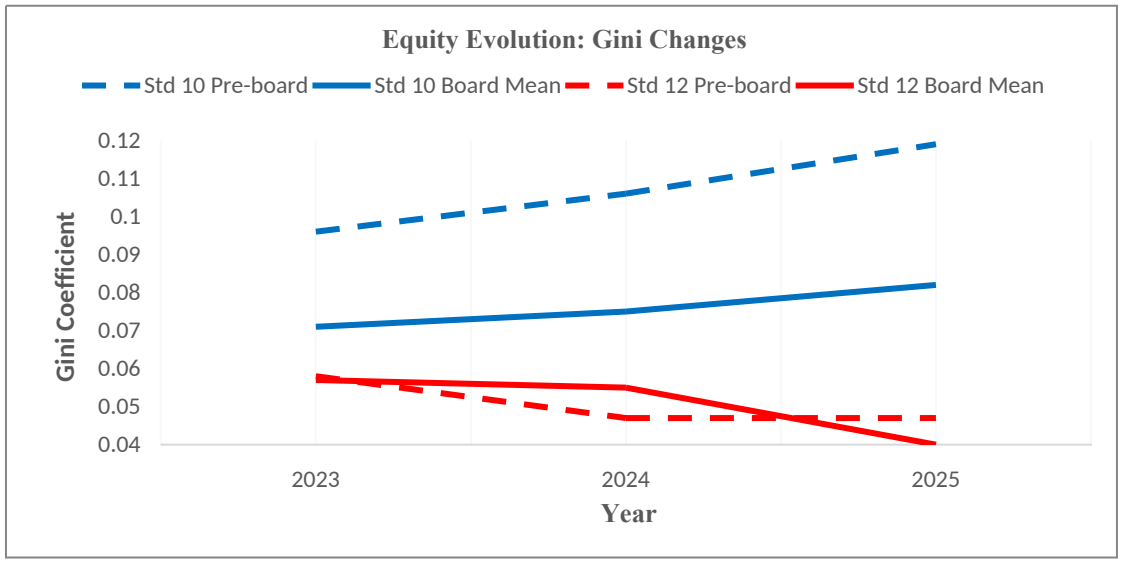

Figure 1. Changes in Gini coefficients from pre-board to board examinations across cohorts

5.3 Quartile-Based Change Patterns

To examine whether changes were equitably distributed across performance levels, students were grouped into quartiles based on pre-board examination scores, and mean score changes (Board − Pre-board) were calculated for each quartile.

As presented in Table 2, Standard 10 cohorts displayed a clear monotonic pattern of improvement. Students in the lowest quartile recorded the largest gains (**12–17 percentage points**), while progressively smaller gains were observed in higher quartiles, with the smallest improvements (**5–10 percentage points**) among students in the highest quartile. This pattern was consistent across all three years.

In contrast, Standard 12 cohorts showed smaller and uneven quartile-based changes, ranging from slight declines to modest gains, with no consistent ordering across quartiles.

Table 2. Mean score improvement (Board − Pre-board) by pre-board performance quartile

Grade	Year	Q1	Q2	Q3	Q4
Std 10	2023	12.09	10.56	8.33	5.14
Std 10	2024	16.65	17.76	14.38	10.47
Std 10	2025	15.59	15.10	11.05	8.48
Std 12	2023	1.32	2.04	–0.09	1.26
Std 12	2024	–2.64	–1.21	–1.91	–0.49
Std 12	2025	4.14	1.79	1.08	0.86

Note. Q1 = lowest quartile, Q4 = highest quartile

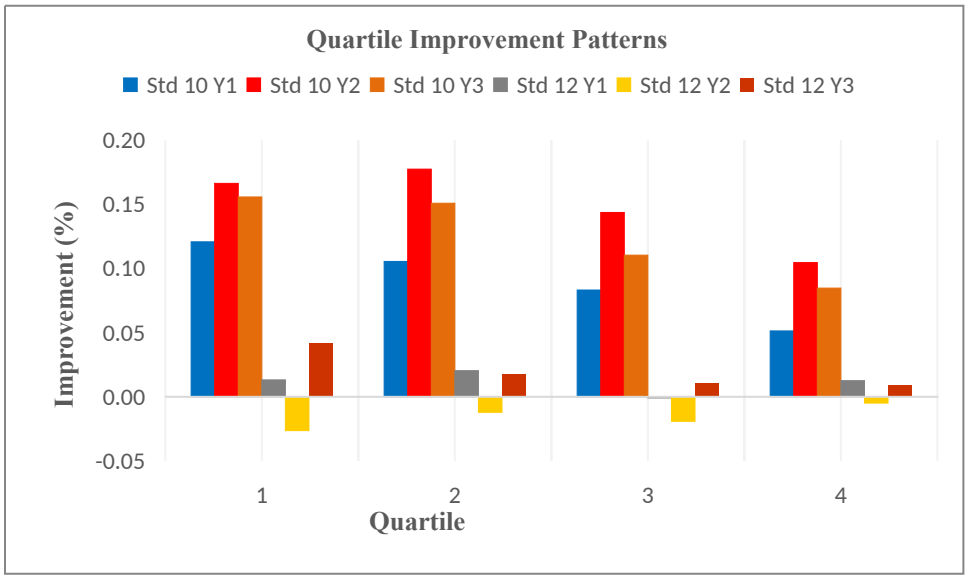

Figure 2. Mean score improvement by pre-board performance quartile

5.3.1 Statistical Analysis of Quartile Differences

One-way ANOVA confirmed significant differences in mean score changes across pre-board performance quartiles for all Standard 10 cohorts (2023: $F(3,73) = 8.42$, $p < .001$, $\eta^2 = 0.26$; 2024: $F(3,61) = 4.15$, $p = .009$, $\eta^2 = 0.17$; 2025: $F(3,77) = 6.78$, $p < .001$, $\eta^2 = 0.21$), indicating large to moderate effect sizes. Tukey's HSD post-hoc tests revealed that Q1 gains were significantly greater than Q4 gains in all three years ($p < .01$).

In contrast, Standard 12 cohorts showed non-significant or weak quartile differences (2023: $F(3,53) = 0.45$, $p = .72$; 2024: Welch's $F(3,22.4) = 1.23$, $p = .32$; 2025: $F(3,51) = 2.01$, $p = .12$), confirming relatively uniform changes across performance levels

5.4 Performance Gap Dynamics

Performance gaps between higher- and lower-performing students were further examined using the P90/P10 ratio. As shown in Table 3, Standard 10 cohorts demonstrated consistent narrowing of performance gaps from pre-board to board examinations across all three years. The P90/P10 ratio declined in each cohort, indicating reduced disparity between the top and bottom ends of the score distribution. In Standard 12, changes in P90/P10 ratios were small and inconsistent. Two cohorts exhibited slight widening of gaps, while one cohort showed marginal narrowing, resulting in no clear overall trend.

Table 3. P90/P10 ratios before and after board examinations

Grade	Year	Pre-Board	Board	Gap Direction
Std 10	2023	1.55	1.45	Narrowed
Std 10	2024	1.65	1.47	Narrowed
Std 10	2025	1.73	1.52	Narrowed
Std 12	2023	1.30	1.31	Widened
Std 12	2024	1.25	1.31	Widened
Std 12	2025	1.24	1.19	Narrowed

Note. P90/P10 represents the ratio of the 90th to the 10th percentile.

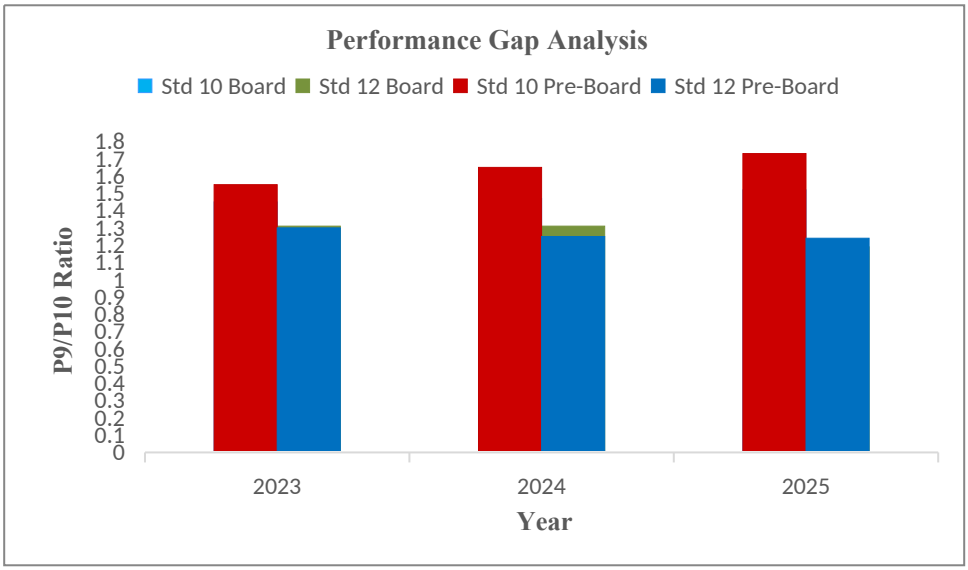

Figure 3. Performance gap dynamics measured using P90/P10 ratios

5.5 Variability and Distribution Shape

Changes in score dispersion were examined using the coefficient of variation (CV) and interquartile range (IQR). In Standard 10, both measures declined from pre-board to board examinations, indicating reduced variability and compression of score distributions. Additional distributional characteristics showed reduced skewness and kurtosis, suggesting a contraction of the lower tail of the score distribution. In Standard 12, measures of variability and distribution shape exhibited minimal change across assessment stages, reinforcing the observation that score distributions remained largely stable. Figure 4 displays the temporal comparison of score variability using coefficients of variation.

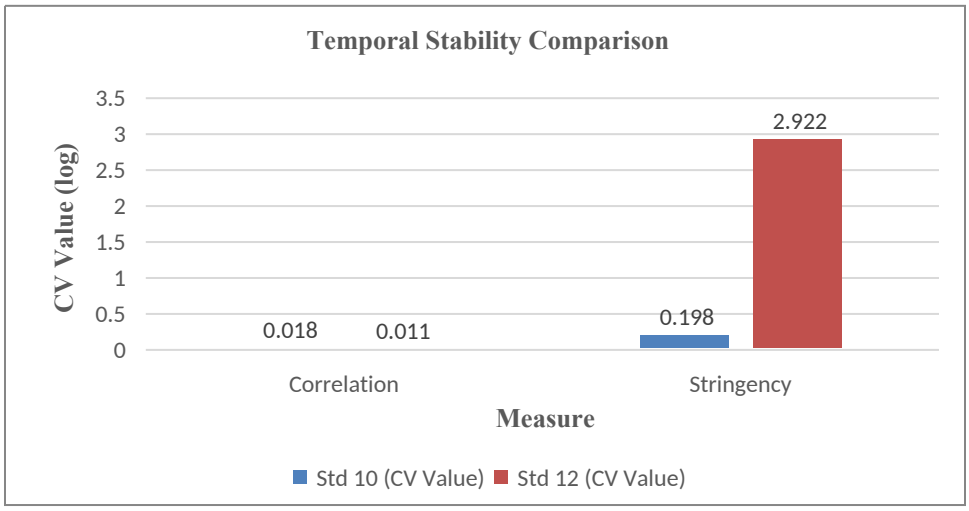

Figure 4. Temporal comparison of score variability using coefficients of variation

6. Discussion

This study set out to examine whether school-based pre-board examinations function merely as predictive tools or whether they also influence educational equity by reshaping score distributions in high-stakes board examinations. By adopting a longitudinal, distribution-focused approach across three cohorts in Standards 10 and 12, the study provides clear evidence that the equity implications of preparatory assessments are strongly grade-dependent.

The most prominent finding is the consistent equity enhancement observed in Standard 10. Across all three cohorts, reductions in Gini coefficients, narrowing P90/P10 ratios, and declining measures of variability indicate a systematic compression of score distributions from pre-board to board examinations. Importantly, these changes were not driven by uniform score inflation. Quartile-based analyses showed that students in the lowest pre-board performance quartile experienced substantially larger gains than their higher-performing peers, demonstrating a clear "lifting-the-bottom" pattern. This suggests that the preparatory assessment process in Standard 10 was associated with a redistribution of achievement outcomes rather than a simple upward shift in overall performance.

In contrast, Standard 12 cohorts exhibited largely stable score distributions across assessment stages. Changes in inequality, performance gaps, and variability were small, inconsistent, and often statistically non-significant. Although some cohorts recorded modest average improvements, these gains were relatively uniform across performance levels and did not translate into meaningful reductions in performance disparities. Taken together, these findings indicate that pre-board assessments at the Standard 12 level primarily served a predictive function, with limited influence on equity-related outcomes.

The divergence between Standard 10 and Standard 12 can be understood through a developmental and structural lens. Students in Standard 10 are typically encountering their first high-stakes public examination, and the interval between pre-board and board examinations represents a critical learning window. During this period, diagnostic feedback, targeted remediation, and intensified instructional support are more likely to translate into differential learning gains, particularly for students who begin with larger achievement gaps. In contrast, Standard 12 students have already experienced a board examination cycle and tend to exhibit more established study habits, performance expectations, and ceiling effects. These factors may constrain the potential for short-term redistribution of outcomes, even when preparatory assessments are rigorously designed.

The hypothesis testing results reinforce this interpretation. Evidence consistently supported equity enhancement, differential quartile improvement, gap narrowing, and reduced variability in Standard 10, while corresponding hypotheses for Standard 12 were supported only in terms of equity neutrality or inconsistency. The temporal stability of equity gains in Standard 10 further suggests that these patterns were not cohort-specific anomalies but recurring features of the assessment process within the institutional context studied.

From a methodological perspective, the findings highlight the value of distributional metrics in assessment research. Analyses based solely on mean scores would have masked the equity dynamics revealed through Gini coefficients, percentile ratios, and quartile-based improvement measures. By examining how different segments of the score distribution respond to preparatory assessments, the study demonstrates that assessment effectiveness cannot be fully understood without attention to equity-related outcomes.

The results also have important implications for assessment design and practice. In Standard 10, deliberately challenging pre-board assessments appear to be effective when coupled with structured feedback and remedial interventions, enabling lower-performing students to close achievement gaps before the final examination. In Standard 12, however, the high stakes associated with post-school transitions may necessitate a stronger emphasis on predictive accuracy and alignment with board standards. In such contexts, equity objectives may be better addressed through complementary support mechanisms—such as targeted tutoring or diagnostic assessments—rather than through calibration of high-stakes preparatory tests alone.

Overall, the findings underscore that assessment is not a neutral process. The same assessment practice can produce markedly different equity outcomes depending on students' developmental stage, prior assessment experience, and the instructional responses that follow. By foregrounding distributional change rather than average performance

alone, this study contributes to a more nuanced understanding of how preparatory assessments interact with educational equity in high-stakes secondary education.

7. Conclusion

This study examined the equity implications of pre-board examinations by analysing changes in score distributions from pre-board to board assessments across three consecutive cohorts in Standards 10 and 12. By adopting a longitudinal, distribution-focused approach, the study moves beyond average performance indicators to provide a clearer understanding of how preparatory assessments interact with educational equity in high-stakes secondary education.

The findings demonstrate a clear grade-level divergence in equity outcomes. In Standard 10, pre-board assessments were consistently associated with reduced score inequality, narrowing performance gaps, and disproportionately larger gains among lower-performing students. These patterns indicate that, at this stage of schooling, preparatory assessments can function as equity-supportive mechanisms when embedded within a feedback and remediation framework. In contrast, Standard 12 cohorts exhibited largely stable score distributions, with minimal and inconsistent changes in equity indicators, suggesting that preparatory assessments at this level primarily serve a predictive rather than redistributive function.

Methodologically, the study highlights the importance of incorporating distributional equity metrics—such as Gini coefficients, percentile ratios, and quartile-based improvement measures—into assessment evaluation. Reliance on mean scores alone would have obscured the equity dynamics identified in this analysis. The consistency of findings across cohorts further strengthens the case for examining assessment practices through an equity lens over time.

From a practical perspective, the results support the adoption of grade-differentiated assessment strategies. For Standard 10, maintaining challenging pre-board assessments alongside structured instructional support can help sustain equity gains. For Standard 12, equity objectives may be more effectively addressed through complementary diagnostic or support-oriented interventions, without compromising the predictive role of high-stakes preparatory assessments.

In conclusion, the study underscores that assessment practices are not merely tools for measurement but can act as influential mechanisms shaping educational equity. By foregrounding distributional outcomes and recognising developmental differences across grade levels, educators and policymakers can better align assessment design with the dual goals of fairness and academic rigor in secondary education.

8. Limitations and Future Directions

While this study offers meaningful insights into the equity implications of pre-board assessments, certain limitations should be acknowledged.

First, the study was conducted within a single CBSE-affiliated school. Although the use of three consecutive cohorts strengthens internal consistency and reduces the likelihood of cohort-specific anomalies, the findings may not be directly generalisable to schools operating in different institutional contexts, regions, or with varying resource levels. Replication across multiple schools and educational boards would help establish broader external validity.

Second, the analysis relied on aggregate percentage scores across subjects, which limited the ability to examine subject-specific equity dynamics. It is plausible that equity effects differ across disciplines such as mathematics, sciences, and languages, where assessment structures and learning demands vary. Future research could extend this distributional framework to subject-level analyses to identify whether equity gains are uniform or discipline-dependent.

Third, demographic variables such as gender, socioeconomic background, and prior academic history were not incorporated into the analysis. While this decision helped maintain focus on assessment processes and preserved student anonymity, future studies could integrate demographic and contextual variables to better understand subgroup-specific equity patterns and intersections between assessment practices and social disadvantage.

Finally, the study adopted a repeated cross-sectional design, comparing independent cohorts rather than tracking individual students longitudinally. Although appropriate for examining cohort-level equity trends over time, future longitudinal studies following the same students across assessment cycles would provide deeper insight into the durability of observed equity gains and their long-term academic implications.

Future research should also consider mixed-method approaches, combining quantitative distributional analyses with qualitative data from teachers and students to explore the instructional and motivational mechanisms underlying observed equity patterns. Extending this approach across educational systems and over longer time horizons would further enhance understanding of how assessment design can support equitable learning outcomes.

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Declarations

Conflict of Interest:
The author declares no conflict of interest.

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Use of Artificial Intelligence Tools:

AI tools were used solely for language refinement and literature exploration. All statistical analyses, interpretation, and conclusions were carried out independently by the author using Microsoft Excel, SPSS, and Python.

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