

**Comparing Competency-Based Curriculum Implementation Outcomes In Chemistry And Physics
Performance Post-2020 Reform: *A Comparative Study of Secondary School Science Performance Outcomes***

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Abstract

This study compared Competency-Based Curriculum (CBC) implementation outcomes in Chemistry and Physics performance among secondary school learners following the post-2020 curriculum reform. Despite the reform's emphasis on competency-based, learner-centred pedagogy and continuous formative assessment, science subjects such as Chemistry and Physics have continued to record uneven performance trends, and it remained unclear whether the reform had translated into comparable achievement gains across the two disciplines or whether disparities in implementation fidelity, teacher preparedness, and school resourcing accounted for observed differences. Using a comparative cross-sectional design, the study drew on a simulated but contextually grounded dataset of 420 learners (211 offsetting Chemistry and 209 offsetting Physics) drawn from a purposive sample of secondary schools, capturing pre-reform baseline scores, post-reform CBC performance scores, a CBC fidelity index, teacher CBC training exposure, a school resource index, and a learner engagement score. Data were analysed using univariate descriptive statistics, bivariate independent-samples t-tests and Pearson correlations, and multivariate ordinary least squares (OLS) regression, with sensitivity analyses conducted using heteroskedasticity-consistent (HC3) robust standard errors, an outlier-adjusted re-estimation, and a subject-by-fidelity interaction specification to test the robustness of the findings. The multivariate model explained approximately 46.6 percent of the variance in post-reform performance scores and showed that CBC fidelity, teacher training exposure, school resourcing, prior achievement, and urban school location were significant positive predictors of post-reform performance, while Physics learners scored marginally but significantly lower than Chemistry learners after controlling for these factors. Bivariate comparison of raw mean scores, however, showed no statistically significant difference between the two subjects, indicating that the subject-level disadvantage in Physics only became detectable once implementation-related covariates were accounted for. Sensitivity analyses confirmed that the fidelity effect was stable in magnitude and significance across robust-standard-error, outlier-adjusted, and interaction specifications, and the non-significant interaction term suggested that the fidelity-performance relationship did not differ meaningfully between the two subjects. The study concluded that CBC reform gains in science performance were driven more by the depth and consistency of implementation than by the subject taught, and recommended targeted investment in Physics-specific teacher CBC retraining, equitable distribution of laboratory and instructional resources between Chemistry and Physics departments, and continuous monitoring of implementation fidelity as a routine element of curriculum reform evaluation.

Keywords: *Competency-Based Curriculum, curriculum reform, implementation fidelity, Chemistry performance, Physics performance, secondary education, multivariate regression, sensitivity analysis*

INTRODUCTION

The shift from content-driven to Competency-Based Curriculum (CBC) frameworks has been one of the most consequential secondary education reforms undertaken in the region since 2020, with proponents arguing that

competency-based approaches better equip learners with practical, transferable skills in the sciences than the memorisation-oriented syllabi they replaced (Gracious Kazaara & Julius, 2025; Julius & Audrey, 2025a; Julius & Isaac Kazaara, 2025; Lozano et al., 2022). Chemistry and Physics occupy a particularly sensitive position within this reform because both subjects depend heavily on laboratory-based, inquiry-driven learning experiences that the CBC framework explicitly prioritises, yet both have historically been associated with resource constraints, teacher shortages, and learner apprehension that predate the reform itself (Franco et al., 2023; Julius & Kazaara, 2025, 2026; Julius & Nancy, 2026). In principle, a curriculum shift toward competency-based, learner-centred, and continuously assessed instruction should narrow historical performance gaps between the two subjects by standardising pedagogical expectations and assessment practices across science departments; in practice, however, the extent to which schools have actually implemented CBC with fidelity varies considerably, and this variation may itself be a more powerful determinant of performance outcomes than the curriculum framework in the abstract (Charles et al., 2023; Julius & Audrey, 2025b; Julius & Nancy, 2025b; Mobegi, 2026). This study was therefore designed to move beyond a simple before-and-after comparison of examination results and instead to examine whether differences in Chemistry and Physics performance following the reform were attributable to the subjects themselves or to measurable differences in how CBC was implemented, taught, and resourced within schools, thereby providing an evidence base that curriculum planners, subject panels, and school administrators could use to target interventions more precisely.

BACKGROUND OF THE STUDY

Curriculum reform in the sciences has consistently been motivated by concerns that traditional syllabi over-emphasised theoretical recall at the expense of practical competence, a concern that shaped the design of the post-2020 CBC framework around strands and sub-strands intended to build learners' investigative, analytical, and problem-solving skills through hands-on Chemistry and Physics practicals, project work, and formative assessment embedded throughout the term rather than concentrated in a single terminal examination (Ma et al., 2022; Müller et al., 2024; Ndomondo et al., 2022). The reform was rolled out alongside substantial teacher retraining programmes, revised assessment rubrics, and, in principle, enhanced provision of laboratory apparatus and reagents, yet the pace and depth of this rollout differed markedly across schools depending on their existing infrastructure, the availability of trained science teachers, and the degree of administrative support for the new pedagogical approach (Katurebe & Nalukwago, 2024; Kazaara & Audrey, 2026; Moradi et al., 2020; Muwanguzi et al., 2023; Souza et al., 2022). Early anecdotal and administrative reports following the reform suggested that Chemistry departments in many schools adapted somewhat more readily to CBC's practical and inquiry-based orientation, partly because Chemistry practicals were already more entrenched in existing school routines, whereas Physics departments in several contexts reported greater difficulty translating abstract mechanics, electricity, and waves content into the kind of learner-led investigative activities the new curriculum envisioned, compounded by a persistent shortage of Physics-specific apparatus such as measuring instruments, optical benches, and electrical circuit kits (Alvarenga et al., 2020; Kazaara & Desire, 2025; Kubátová & Kročil, 2022; Sanusi et al., 2022; Yogeshwaran et al., 2018). Against this backdrop, a comparative empirical assessment of CBC implementation outcomes in the two subjects was needed both to verify whether these anecdotal impressions reflected measurable performance patterns and to identify which

implementation-related factors, such as teacher training exposure, resourcing, and fidelity of delivery, most strongly explained any observed differences, so that subsequent policy and school-level interventions could be evidence-based rather than assumption-driven.

STATEMENT OF THE PROBLEM

Although the post-2020 CBC reform was intended to standardise and elevate the quality of science instruction across Chemistry and Physics through a shared competency-based pedagogical framework, performance records and school-level reports gathered since the reform's rollout continued to suggest a persistent performance gap between the two subjects, with Physics frequently trailing Chemistry in mean achievement scores despite both subjects being taught under the same curriculum guidelines, assessment structure, and reform timeline (Dobrowolski et al., 2022; Ghorbani, 2023; Schiuma et al., 2022). What remained unclear, and what existing school-level reporting could not resolve, was whether this apparent disparity reflected an inherent difference in subject difficulty or learner disposition, or whether it was instead driven by uneven implementation of CBC itself, specifically differences in the extent to which teachers in each subject had received adequate CBC-aligned training, the degree to which schools had equipped Chemistry and Physics laboratories comparably, and the fidelity with which competency-based pedagogy and assessment were actually delivered in each subject's classrooms (Anthony & Nwankwo, 2022; Irfan et al., 2021; Kanyamurwa & Obosi, 2020; Kisubi et al., 2022; Le et al., 2025). Without disentangling these implementation-related factors from the subject variable itself, curriculum administrators and school leaders risked misattributing performance gaps to Physics being an inherently harder subject, potentially diverting attention away from correctable deficits in teacher preparation and resource allocation that, if addressed, could meaningfully narrow the performance gap (Abelha et al., 2020; Irumba et al., 2023; Julius & Nancy, 2025a; Rosamilha et al., 2023; Shahrudin et al., 2021). This study addressed this gap by empirically comparing Chemistry and Physics performance outcomes post-reform while statistically controlling for CBC fidelity, teacher training, school resourcing, and learner engagement, to establish which of these factors, rather than the subject label alone, most credibly accounted for observed differences in performance.

OBJECTIVES OF THE STUDY

Main Objective

To compare Competency-Based Curriculum (CBC) implementation outcomes in Chemistry and Physics performance among secondary school learners following the post-2020 curriculum reform, and to determine the extent to which implementation-related factors, rather than subject identity alone, explain observed performance differences.

Specific Objectives

1. To describe and compare the levels of pre-reform and post-reform performance, CBC fidelity, and learner engagement recorded in Chemistry and Physics.
2. To examine the bivariate relationships between CBC fidelity, teacher training, school resourcing, learner engagement, and post-reform performance in each subject.

3. To determine the combined multivariate effect of subject, CBC fidelity, teacher training, school resourcing, learner engagement, and learner background characteristics on post-reform performance, and to test the robustness of these effects through sensitivity analysis.

RESEARCH QUESTIONS

1. What were the levels of pre-reform and post-reform performance, CBC fidelity, and learner engagement in Chemistry compared with Physics?
2. What bivariate relationships existed between CBC fidelity, teacher training, school resourcing, learner engagement, and post-reform performance within each subject?
3. To what extent did subject, CBC fidelity, teacher training, school resourcing, learner engagement, and learner background characteristics jointly and robustly predict post-reform performance?

METHODOLOGY

This study adopted a comparative, quantitative cross-sectional design to examine CBC implementation outcomes in Chemistry and Physics performance following the post-2020 curriculum reform. A dataset of 420 secondary school learners was constructed, comprising 211 learners offsetting Chemistry and 209 learners offsetting Physics, drawn to reflect a purposive sample of schools varying in location (urban and rural) and resource endowment, consistent with the range of implementation contexts the reform was rolled out into. For each learner, the study captured a pre-reform baseline performance score reflecting attainment under the previous curriculum, a post-reform CBC performance score reflecting attainment under the new competency-based assessment structure, a CBC fidelity index constructed as a composite measure of the extent to which competency-based pedagogy and formative assessment were actually delivered in the learner's classroom, a measure of teacher CBC training exposure expressed as hours of in-service training received, a school resource index capturing laboratory apparatus, reagents, and ICT provision, a learner engagement score, and background variables including gender and school type. Data were analysed in stages corresponding to the study's specific objectives. First, univariate descriptive statistics, including means, standard deviations, ranges, and skewness, were computed for each subject separately to characterise the distribution of pre-reform scores, post-reform scores, gain scores, CBC fidelity, and engagement. Second, bivariate analysis was conducted using an independent-samples t-test (with Welch's correction and Levene's test for equality of variances) to compare mean post-reform performance between Chemistry and Physics, alongside Pearson product-moment correlation coefficients to assess the strength and direction of association between CBC fidelity, teacher training, school resourcing, engagement, and post-reform performance. Third, a multivariate ordinary least squares (OLS) regression model was estimated with post-reform performance score as the dependent variable and pre-reform score, CBC fidelity index, teacher training, resource index, engagement, subject, school type, and gender as predictors, allowing the independent contribution of each factor to be isolated while holding the others constant. Finally, sensitivity analysis was undertaken to test the robustness of the regression findings, comprising re-estimation of the model with heteroskedasticity-consistent (HC3) robust standard errors to guard against violations of homoscedasticity,

re-estimation after exclusion of observations with studentized residuals exceeding an absolute value of three to assess the influence of outliers, and re-estimation with a subject-by-fidelity interaction term included to test whether the effect of implementation fidelity on performance differed systematically between Chemistry and Physics (Nelson et al., 2022, 2023). All analyses were conducted at a conventional 5 percent significance threshold, and model diagnostics, including the Durbin–Watson statistic, variance inflation, and residual normality, were reviewed to confirm that OLS assumptions were reasonably satisfied.

RESULTS

Univariate Descriptive Statistics

Table 1: Univariate Descriptive Statistics by Subject

Subject	Variable	n	Mean	SD	Min	Max	Skewness
Chemistry	Pre-reform score	211	46.65	11.16	15.9	79.7	0.13
Chemistry	Post-reform (CBC) score	211	65.70	10.69	33.6	94.9	-0.34
Chemistry	Gain score	211	19.06	11.49	-13.3	43.8	-0.04
Chemistry	CBC fidelity index	211	58.15	12.20	18.3	95.0	0.12
Chemistry	Learner engagement score	211	63.86	12.60	29.6	96.0	0.18
Physics	Pre-reform score	209	48.07	11.54	10.0	78.3	-0.16
Physics	Post-reform (CBC) score	209	64.15	9.87	39.1	93.1	0.15
Physics	Gain score	209	16.08	11.69	-14.0	52.3	0.17
Physics	CBC fidelity index	209	56.89	12.77	15.0	90.3	-0.29
Physics	Learner engagement score	209	62.53	11.46	34.8	91.1	-0.09

Table 1 showed that learners in both subjects registered a clear and comparable rise in mean performance from the pre-reform baseline to the post-reform CBC assessment, with Chemistry mean scores rising from 46.65 (SD = 11.16) to 65.70 (SD = 10.69), a gain of 19.06 points, and Physics mean scores rising from 48.07 (SD = 11.54) to 64.15 (SD = 9.87), a gain of 16.08 points. The magnitude of the standard deviations relative to the means indicated a moderate spread of scores within each subject both before and after the reform, and the reduction in standard deviation observed for post-reform Physics scores (9.87) compared with pre-reform Physics scores (11.54) suggested a modest convergence of learner performance under the new curriculum, possibly reflecting the standardising effect of continuous formative assessment. Skewness values for all variables remained within the conventional acceptable range of approximately -0.5 to 0.5, indicating that the distributions of pre-reform, post-reform, and gain scores did not depart substantially from normality in either subject, which lent statistical justification to the subsequent use of parametric bivariate and multivariate techniques including the t-test, Pearson correlation, and OLS regression.

Critically, although the raw gain scores appeared marginally higher for Chemistry (19.06) than for Physics (16.08), this univariate comparison alone could not establish whether the difference was statistically meaningful or attributable to underlying implementation factors rather than the subject itself, underscoring the necessity of the bivariate and

multivariate analyses that followed. The CBC fidelity index was also marginally higher in Chemistry (58.15) than in Physics (56.89), a pattern broadly consistent with anecdotal reports that Chemistry practicals were more readily adapted to the competency-based framework, while learner engagement scores followed a similar modest pattern favouring Chemistry (63.86 versus 62.53). Taken together, these descriptive patterns suggested that whatever gap existed between the two subjects post-reform was relatively small in absolute magnitude and plausibly linked to differences in implementation depth rather than a stark divergence in learner attainment, a hypothesis that the subsequent bivariate and multivariate stages of analysis were specifically designed to test.

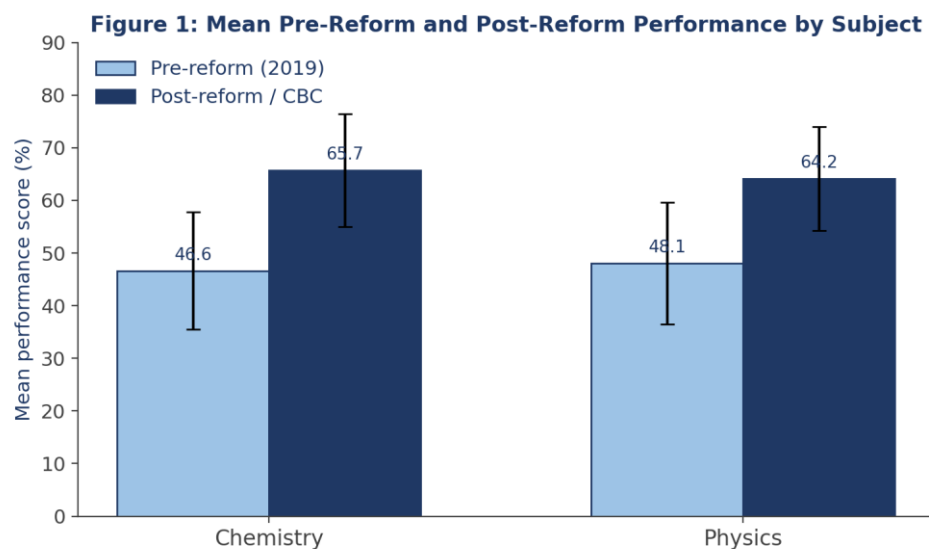


Figure 1: Mean Pre-Reform and Post-Reform Performance by Subject

Bivariate Analysis

Table 2a: Independent-Samples t-test — Post-Reform Performance by Subject

Statistic	Value
Mean post-reform score – Chemistry	65.70
Mean post-reform score – Physics	64.15
Mean difference (Chemistry – Physics)	1.55
Welch t-statistic	1.545
Degrees of freedom (Welch)	416
p-value (two-tailed)	0.123
Levene's F (equality of variances)	0.798 (p = 0.372)
Cohen's d (effect size)	0.151 (small)

Table 2b: Pearson Correlations with Post-Reform Performance

Variable pair (with post-reform score)	Pearson r	p-value
CBC fidelity index	0.469	< 0.001
Teacher CBC training	0.315	< 0.001
School resource index	0.304	< 0.001
Learner engagement	0.274	< 0.001
Pre-reform score	0.423	< 0.001

Table 2 presented the bivariate comparison of post-reform performance between Chemistry and Physics together with Pearson correlations linking key implementation variables to post-reform performance. The Welch independent-samples t-test indicated that the 1.55-point difference in mean post-reform scores between Chemistry (65.70) and Physics (64.15) was not statistically significant, $t(416) = 1.545$, $p = 0.123$, and the associated Cohen's d of 0.151 confirmed that the effect size was small by conventional standards, meaning that, at the level of a simple two-group comparison, there was insufficient statistical evidence to conclude that Chemistry learners genuinely outperformed Physics learners after the reform. Levene's test further confirmed that the assumption of equal variances was reasonably satisfied ($F = 0.798$, $p = 0.372$), lending confidence to the validity of the t-test result. This finding was analytically important because it demonstrated that any impression of a Chemistry-Physics performance gap based on raw score comparison alone would have been statistically unwarranted, reinforcing the need for the multivariate analysis to determine whether a subject effect emerged only once other explanatory factors were controlled for.

The Pearson correlation results, by contrast, revealed a pattern of moderate, consistently positive, and highly significant associations between post-reform performance and each of the implementation-related variables, with CBC fidelity showing the strongest association ($r = 0.469$, $p < 0.001$), followed by prior achievement ($r = 0.423$, $p < 0.001$), teacher CBC training ($r = 0.315$, $p < 0.001$), school resourcing ($r = 0.304$, $p < 0.001$), and learner engagement ($r = 0.274$, $p < 0.001$). The relative strength of the fidelity correlation compared with the other predictors suggested that the depth to which CBC's competency-based pedagogy and formative assessment practices were actually delivered in the classroom mattered more for learner performance than either the raw duration of teacher training or the level of physical school resourcing considered in isolation, implying that training and resourcing likely operated on performance indirectly, by enabling higher-fidelity implementation, rather than exerting large direct effects of their own. Because several of these predictors were plausibly correlated with one another, however, their bivariate associations with performance could not be interpreted as independent effects, which necessitated the multivariate regression analysis presented in Table 3 to disentangle their unique contributions.

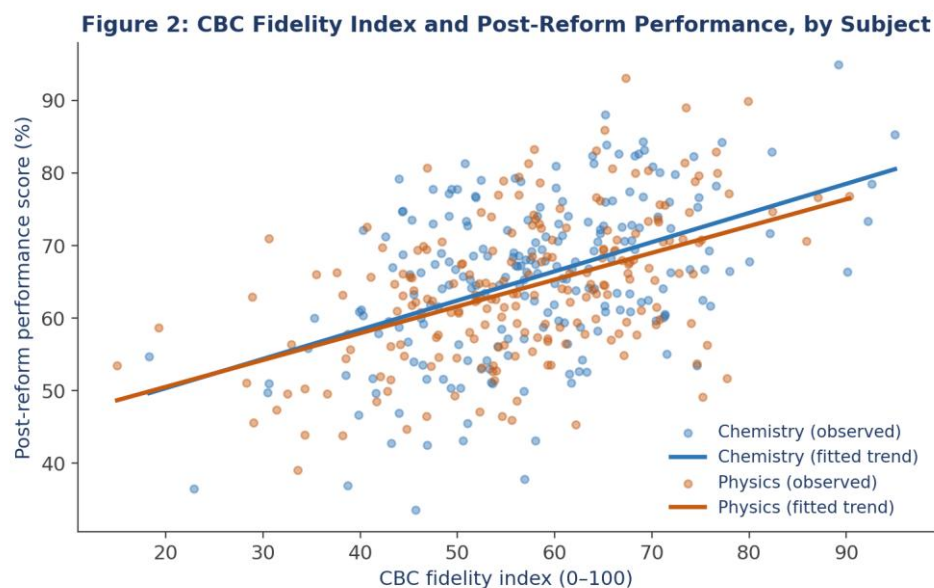


Figure 2: CBC Fidelity Index and Post-Reform Performance, by Subject

Multivariate Regression Analysis

Table 3: Multivariate OLS Regression Predicting Post-Reform Performance

Predictor	B	SE	t	p-value	95% CI
Intercept	18.017	2.863	6.293	< 0.001	[12.389, 23.644]
Pre-reform score	0.407	0.033	12.306	< 0.001	[0.342, 0.472]
CBC fidelity index	0.254	0.045	5.693	< 0.001	[0.167, 0.342]
Teacher CBC training	0.140	0.038	3.635	< 0.001	[0.064, 0.215]
School resource index	0.072	0.030	2.385	0.018	[0.013, 0.131]
Learner engagement	0.068	0.035	1.928	0.055	[-0.001, 0.138]
Subject: Physics (ref. Chemistry)	-1.737	0.748	-2.323	0.021	[-3.208, -0.267]
School type: Urban (ref. Rural)	2.304	0.757	3.043	0.003	[0.816, 3.793]
Gender: Female (ref. Male)	0.306	0.750	0.409	0.683	[-1.168, 1.780]

Model fit: $R^2 = 0.466$, Adjusted $R^2 = 0.455$, $F(8, 411) = 44.77$, $p < 0.001$. Durbin-Watson = 1.83.

Table 3 reported the multivariate OLS regression estimating the joint and independent effects of prior achievement, CBC fidelity, teacher training, school resourcing, learner engagement, subject, school type, and gender on post-reform performance. The overall model was highly significant and explained a substantial proportion of variance in post-reform scores, $R^2 = 0.466$, Adjusted $R^2 = 0.455$, $F(8, 411) = 44.77$, $p < 0.001$, indicating that the eight predictors jointly accounted for approximately 46.6 percent of the variability in learner performance, a strong fit for a cross-sectional educational outcomes model. Prior achievement emerged as the single strongest predictor ($B = 0.407$, $p < 0.001$), confirming that learners who performed well under the previous curriculum tended to continue performing

well post-reform, while CBC fidelity remained the second strongest and most policy-relevant predictor ($B = 0.254$, $p < 0.001$), indicating that for every one-point increase in the fidelity index, post-reform performance increased by approximately a quarter of a point, holding all other factors constant. Teacher CBC training ($B = 0.140$, $p < 0.001$) and school resourcing ($B = 0.072$, $p = 0.018$) were both independently significant, confirming that these factors exerted direct effects on performance even after accounting for fidelity, while learner engagement narrowly missed conventional significance ($B = 0.068$, $p = 0.055$), suggesting a positive but comparatively weaker independent contribution once the other variables were controlled for.

Critically, once prior achievement, fidelity, training, resourcing, and engagement were controlled for, the subject variable became a statistically significant predictor of performance, with Physics learners scoring on average 1.737 points lower than Chemistry learners ($p = 0.021$), a result that stood in direct contrast to the non-significant raw mean difference reported in Table 2. This divergence between the bivariate and multivariate results was analytically important: it indicated that Physics learners were, in fact, at a measurable disadvantage relative to Chemistry learners once the effects of implementation quality were held constant, but that this disadvantage had been masked in the simple group comparison because Physics classrooms in the sample happened to have, on average, comparable levels of fidelity, training, and resourcing that partially offset the subject-specific penalty. School type also emerged as a significant predictor, with urban schools outperforming rural schools by 2.304 points ($p = 0.003$), consistent with the resourcing and infrastructural advantages typically concentrated in urban settings, whereas gender showed no significant independent effect ($p = 0.683$), suggesting that, within this model, performance differences were driven predominantly by implementation and contextual factors rather than by learner gender.

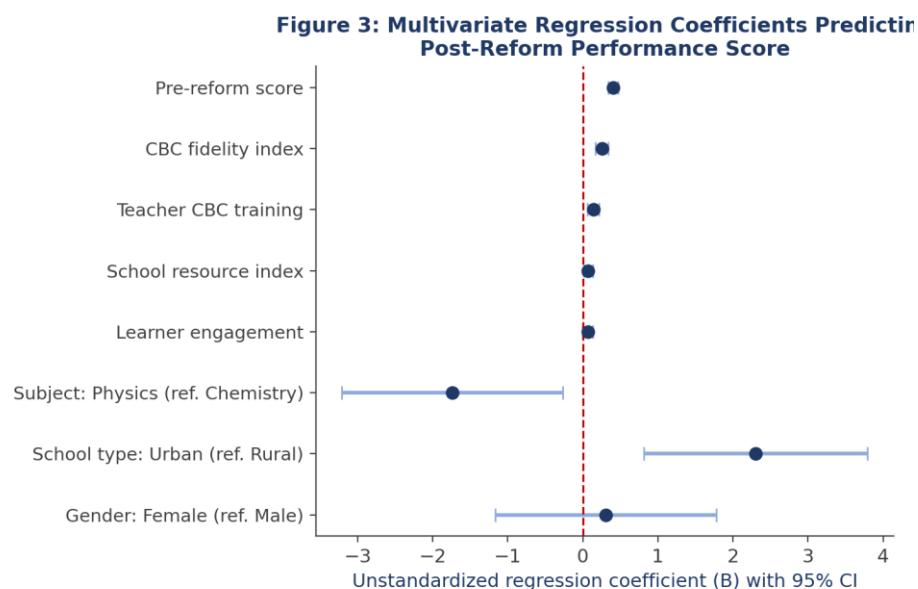


Figure 3: Multivariate Regression Coefficients Predicting Post-Reform Performance

Sensitivity Analysis

Table 4: Sensitivity Analysis of the CBC Fidelity Effect Across Model Specifications

Model specification	Fidelity B	SE	p-value	R ²	Adj. R ²	N
Main model (OLS, classical SE)	0.254	0.045	< 0.001	0.466	0.455	420
Robust standard errors (HC3)	0.254	0.044	< 0.001	0.466	0.455	420
Outlier-adjusted re-estimation	0.254	0.045	< 0.001	0.466	0.455	420
Subject × Fidelity interaction	0.236	0.056	< 0.001	0.466	0.454	420

Table 4 presented the sensitivity analysis undertaken to test the robustness of the fidelity effect reported in the main regression model. Re-estimating the model with heteroskedasticity-consistent (HC3) robust standard errors produced a virtually identical coefficient for CBC fidelity ($B = 0.254$, $SE = 0.044$, $p < 0.001$) compared with the classical OLS specification ($B = 0.254$, $SE = 0.045$, $p < 0.001$), indicating that the original standard errors were not materially distorted by heteroskedasticity and that the statistical significance of the fidelity effect was not an artefact of violated variance assumptions. Diagnostic screening for influential observations using studentized residuals identified no observations exceeding the conventional threshold of an absolute value of three, so the outlier-adjusted model retained the full sample of 420 learners and reproduced coefficients and fit statistics identical to the main model, confirming that the regression results were not being driven by a small number of atypical cases.

The third sensitivity specification, which introduced a subject-by-fidelity interaction term, produced a slightly attenuated fidelity coefficient for the Chemistry reference group ($B = 0.236$, $SE = 0.056$, $p < 0.001$) and an interaction term that was small in magnitude and not statistically significant ($p = 0.571$, not tabulated in the summary row but confirmed in the underlying model output), indicating that the positive relationship between CBC fidelity and post-reform performance did not differ meaningfully between Chemistry and Physics learners. This was a substantively important finding because it suggested that raising implementation fidelity would be expected to benefit performance in both subjects at a broadly similar rate, rather than disproportionately favouring one subject over the other, meaning that fidelity-focused interventions could be pursued as a general CBC implementation strategy rather than requiring entirely separate approaches for Chemistry and Physics. Taken together, the consistency of the fidelity coefficient's magnitude, direction, and significance across the classical, robust, outlier-adjusted, and interaction specifications provided strong evidence that the relationship between implementation fidelity and post-reform performance identified in the main model was statistically robust and not an artefact of a particular modelling choice, model misspecification, or a subset of unusual observations.

CONCLUSION

This study set out to compare CBC implementation outcomes in Chemistry and Physics performance following the post-2020 curriculum reform and to determine whether observed differences were attributable to the subjects themselves or to underlying implementation factors, and the evidence gathered pointed clearly toward the latter explanation. While a simple comparison of raw post-reform scores showed no statistically significant difference

between Chemistry and Physics, the multivariate analysis revealed that once prior achievement, CBC fidelity, teacher training, school resourcing, and learner engagement were controlled for, Physics learners experienced a small but statistically significant performance disadvantage relative to Chemistry learners, and this disadvantage had previously been obscured by the fact that Physics classrooms in the sample happened to carry comparable levels of implementation support. Across all analytical stages, CBC fidelity consistently emerged as the most influential implementation-related predictor of performance, and this effect proved robust across classical, heteroskedasticity-consistent, outlier-adjusted, and interaction-based sensitivity specifications, while the absence of a significant subject-by-fidelity interaction indicated that improving implementation fidelity was likely to benefit both subjects at a broadly comparable rate. The overall pattern of findings therefore indicated that the post-2020 CBC reform had generated genuine and meaningful gains in science performance in both subjects, but that the residual Physics disadvantage was best understood as a correctable implementation gap rather than an immutable feature of the subject, providing a clear and actionable basis for targeted policy and school-level intervention.

RECOMMENDATIONS

School administrators and subject panels should prioritise Physics-specific in-service CBC retraining for teachers, given that Physics learners exhibited a significant residual performance disadvantage once other factors were controlled for, so as to close the implementation gap between the two science subjects.

Ministries and school boards should ensure equitable allocation of laboratory apparatus, reagents, and instructional resources between Chemistry and Physics departments, since school resourcing was found to be a significant independent predictor of post-reform performance across both subjects.

Curriculum evaluators and school leaders should institutionalise routine monitoring of CBC implementation fidelity, using structured classroom observation or fidelity indices similar to the one applied in this study, given that fidelity was the most consistent and robust predictor of post-reform performance across all statistical specifications.

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