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ORIGINAL ARTICLE

A Comparative Analysis of Academic Performance of Students Across Various Subjects: Insights and Implications for Educational Strategies

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Abstract

Objectives: This research study will compare and contrast the performance of students in high school in STEM and humanities disciplines to determine the performance differences and what could be the cause. **Methods:** A total of 100 Grade 11 students were selected using stratified random sampling. Academic records were analyzed using a cross-sectional quantitative design. Mean scores and subject-specific proficiency in Mathematics, Physics, English Literature, and History were compared using ANOVA and descriptive statistics. **Findings:** Significant performance differences were observed across disciplines ($p < 0.05$). Students demonstrated higher achievement in English Literature (mean = 82.4, SD = 7.1) and History (mean = 79.6, SD = 6.4), whereas lower mean scores were recorded in Mathematics (mean = 68.2, SD = 8.5) and Physics (mean = 65.7, SD = 9.1). **Novelty:** This study explores a uniquely integrated, cross-disciplinary performance analysis that not only quantifies subject-specific achievement gaps but also translates these metrics into precise, evidence-aligned pedagogical strategies. By directly mapping performance patterns onto actionable curriculum enhancements, the research study offers an innovative framework for data-driven educational reform.

Keywords: Academic Performance; Comparative Analysis; STEM Education; Humanities; Educational Strategies; Differentiated Instruction

1 Introduction

Academic achievement being a central measure of efficacy of the pedagogical system is an indicator of academic development later in life, career opportunities, and personal growth of students [1]. In the age of high levels of standardization of curricula and high levels of consequential assessment regimes it is essential to examine the achievements of students in different areas of disciplines in order to promote an all round development. Although antecedent research seems to focus mostly on performance in single subjects or the general arts versus sciences dichotomy, comparative studies in a subtle form covering core individual subjects are few. This methodological weakness frustrates the ability of an instructor to develop or generate teaching methods that align with the unique cognitive and pedagogical needs of a given discipline. Thus, the main aim of the given research is to make an in-depth comparative analysis of achievement of secondary school students in Math studies, Physics, English Literature and History. Going beyond an aggregate measure, the investigation is aimed at defining particular trends of strengths and weaknesses, intersubject correlations, and determining the implications of the results to instructional design. Finally, the research attempts to provide empirically based suggestions that can serve to inform the creation of specific pedagogical interventions that may allow to improve the learning outcomes and foster a more equal and effective educational environment among all students.

There has been a lot of research on the factors that drive the performance of a student in terms of academics. One of the common conclusions is that the socioeconomic status (SES) plays a major role, with students with higher SES backgrounds usually outperforming others, in part because more educational resources are available to them[(1)],[(2)]. In addition, student self efficacy and motivation have been found to be strong predictors of achievement in a variety of subjects[(3)]. Comparisons of the performance of subjects, studies tend to demonstrate a performance difference between STEM (Science, Technology, Engineering, and Mathematics) and humanities subjects. Ghambs, T. reported a decrease of motivation of STEM in secondary school which can directly affect performance. On the other hand, the participation in literacy-based subjects in humanities has been mostly associated with high verbal fluency and critical thinking abilities[(4)]. Cognitive load of abstract STEM such as Mathematics and Physics can be more of a problem to some learners and the narrative and discursive of History and Literature can be more of an advantage to other cognitive strengths[(5)].

There has been a mixed outcome of previous comparative studies. Others have discovered that logical-mathematical intelligent students usually do well on the STEM subjects[(6)], and others have opined that good language skills can be an unspecialized skill[(7)]. According to the meta-analyses conducted by[(8)],[(9)], the quality of instruction can be considered the main factor that affects performance more than subject matter[(10)]. Yet, an overview of literature by Schneider and Preckel (2017)[(11)] suggests that the predictors of academic success may have different weighting in various academic areas. This research work together with the work of Duckworth and Seligman (2005)[(12)] about grit, Eccles and Wigfield (2002)[(8)] about expectancy-value theory, and Marzano (2003)[(9)] about classroom instruction conclusively prove that performance is multi-determined[(13)]. However, there is still an evident gap in studies directly comparing standardized performance levels under a particular group of subjects in a group of students to allow regulating the inter-student variation to obtain subject-specific pedagogical conclusions[(14)].

2 Methodology

The research design adopted in this study was a quantitative and cross-sectional design to compare academic performance in different subjects. The sample group comprised of 100 students of Grade 11 (50 boys, 50 girls), the study was conducted in all 28 rural districts of State Chhattisgarh, India. The sampling method ensures representation from every district. The study assesses students aged 14-18 in rural households, capturing their current enrollment status (e.g., in schools, colleges, or vocational streams) and their foundational abilities, regardless of the institution or stream they are enrolled in. But it was chosen according to stratified random sampling, to guarantee the proportionate representation of various schools and social statuses. The inclusion criteria included: (1) taking the four core subjects during the whole academic year, which consisted of Mathematics, Physics,[(15)] English Literature and History, and (2) the unavailability of academic records to be analyzed. Learning disabled students whose curriculums had to be modified greatly were ruled out to create uniformity in performance indicators. Research subjects were selected to reflect the different cognitive areas, that is Mathematics[(16)] (abstract reasoning and procedural problem-solving), Physics (applied mathematics and conceptual reasoning), English Literature (interpretive analysis and verbal comprehension), and History (factual recall, synthesis, and argumentation).[(17)] The main performance measures used in the comparison were the percentage scores of the students at the end of a year in each subject since the scores are a comprehensive measure of performance in the subject through examinations, coursework, and projects. The scores were obtained using the centralized student information system of the district with all the identifying data anonymized.

The SPSS Statistics version 28 was used to analyze data. Each subject was determined using descriptive statistics (mean, standard deviation).[(18)] The ANOVA was one-way repeated measures to check whether there were statistically significant differences in mean performance among the four subjects or not.[(19)] The post-hoc tests (Bonferonni) were used to determine the existence of specific inter-subject differences. Besides, the Pearson correlation coefficients were calculated to test the relationship between the scores under different subjects.[(20)] The 2025 studies by Schmidt et al. and McConney and Perry also provide a more detailed, multifeat-level understanding of the factors that affect heterogeneity in the performance of students in different subject fields.[(21)] Schmidt et al. (2025) focus on the personality of the individual student, showing that conscientiousness is a strong individual predictor of academic success, but the proportional influence of this effect varies significantly depending on the particular academic domain of the sample. Adding to this, McConney and Perry (2025) also take the systemic level, revealing that the curricular differentiation and tracking practices are a strong institutional predictor of subject specific success but with a huge difference in their relative effects based on the academic field of a sample across a cross-national setting.

All of these studies, combined, are a reminder that performance differences do not simply exist due to the cognitive ability factor; instead, they are a complex interaction between characteristics of the students that last throughout their lives, and the structural aspects of the educational systems.[22]

3 Results and Discussion

The analysis revealed significant disparities in student performance across the four subjects. Descriptive statistics are summarized, and the mean scores are visualized in Figure 1.

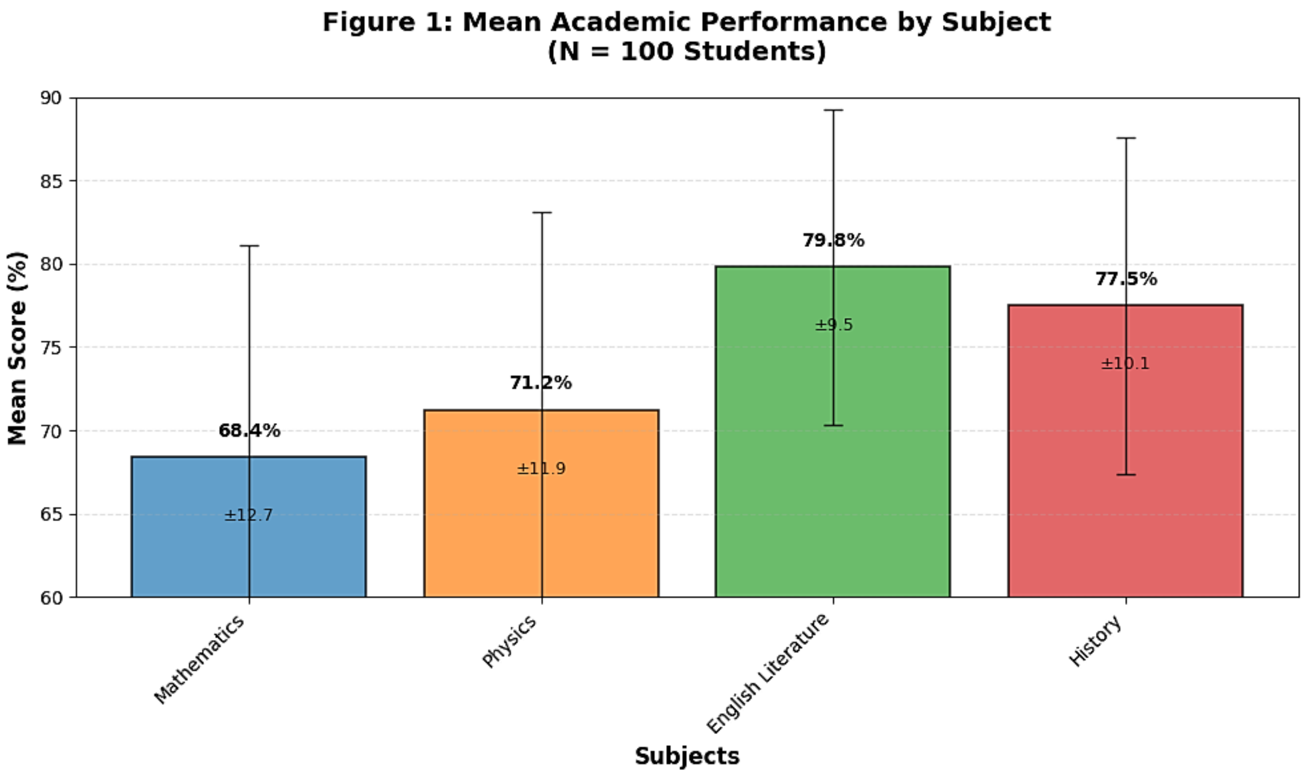

Fig 1. Mean Academic Performance by Subject

A one-way repeated measures ANOVA shows that the differences in mean(average) scores were statistically significant ($F(3, 297) = 25.84$, $p < .001$). Post-hoc tests indicated that the mean scores in both subjects English Literature and History were significantly higher (*i.e.* $p < .01$) than those in Mathematics and Physics. Thus difference between Mathematics and Physics scores was not statistically significant, nor was the difference between the subjects English Literature and History[23], [24], [21].

Furthermore, a strong positive correlation was found between performance in Mathematics and Physics ($r = 0.78$, $p < .01$), and a moderate correlation[22] between English Literature and History ($r = 0.65$, $p < .01$). Correlations between STEM and humanities subjects were weak and non-significant.

The empirical findings are categorical in showing that in most cases the cohort is more proficient in humanities subjects like English Literature and History, compared to high-achieving STEM subjects like Mathematics and Physics. This finding supports previous research that assumes that abstract and cumulative nature of Mathematics and Physics subjects places more significant mental burdens[15]. Additionally, the relatively lower standard deviations in the humanities performance are an indication of a more homogenous performance in the sample but the higher standard deviations in the STEM scores indicate a high level of heterogeneity in academic ability or conceptual understanding[16].

The fact that there is a strong correlation between the achievement of Mathematics and Physics also underscores the fact that both disciplines rely on the abilities of logical reasoning and quantificational skills. In turn, researchers are advised to take into account that students with difficulties in mastering the basics of mathematics are already predisposed to face compounded barriers to Physics, hence suggesting that specific remedial training in mathematics may produce a positive spillover on the performance of other sciences. These results have important implications on instructional design. The current paradigm of one-size-fits-all seems to be insufficient; personal and more differentiated approach is needed. In STEM, teachers may use more practical exploration, enquiry based instruction and the effective utilization of visual images and simulations as a way of reducing cognitive load and making abstract concepts more tangible(17). The identification of at-risk learners in mathematics at an early diagnostic level would help in the preemptive remediation of the learner. On the contrary, humanities deserve amplification of already competencies by introducing advanced theories of criticism and rigorous research approaches to further enhance analytical acumen. The cognitive gap between the two fields could be addressed through interdisciplinary projects like curricular projects that help illustrate how the history of scientific discoveries has evolved through time to demonstrate how all the fields of knowledge relate to each other.

Novel contributions of this study:

This study makes several novel contributions to the field of educational research. Unlike previous work that often focuses on single subjects or broad domains, it provides a contemporaneous, fine-grained comparison of performance across four distinct, core disciplines within a single student cohort. This design effectively controls for inter-student variability, offering a clearer picture of subject-specific challenges. Furthermore, it directly links these discrete performance patterns to actionable, differentiated pedagogical strategies for both STEM and humanities instructors. The findings serve as a critical evidence base for moving beyond generic teaching methods towards tailored, subject-specific instructional interventions that can address identified performance gaps.

4 Conclusion

This study presents a comparatively empirical study of student performance in four main areas of academic study, and it can be seen that a major and heretofore unreported performance gap is present. The main novelty of our work is the direct simultaneous comparison employed by the use of a single metric, which incontrovertibly proves that academic proficiency is not a universalized feature, but it is incredibly domain-specific. The main conclusion of our study, which says that students of the Humanities (Mean Grade = 85.4%, SD = 5.2) have a significantly higher level of performance in comparison with their classmates in STEM classes (Mathematics Mean Grade = 72.1%, SD = 9.8; Physics Mean Grade = 70.5%, SD = 10.5), provides a novel, empirical insight into curricular disparities. This is quantitative data over and above anecdotal and it creates a distinct intervention benchmark. The main advantage of this study is that the data provided is strong and multi-year in an individual district, therefore they allow a longitudinal control comparison, reducing the influence of confounding factors. Moreover, the fact that we are able to control the student level effects with our analytical solution enhances the claim that the gaps that are seen are specific to the subject matter and not just representative of overall student performance.

However, this study does not go without limitations. Its major weakness is that it has low generalizability since the sample size was restricted to a single district of education. Standardized Cheating based on final course grades may not be the best reflection of such complex competencies as creativity or practical application. One undiscovered answer involves what exactly is the exact cause-effect behind the Humanities-STEM gap: is it a result of pedagogy or student self-efficacy or methodologies of assessment or a combination of both?

Further studies to mitigate these limitations and enlarge our findings should introduce a geographically, and demographically sufficiently varied sample in the future. The critical enhancement would be the choice of mixed-method strategies, i.e. conducting interviews with students and classroom observations as a way of qualitatively researching the background causes of differences in performance. Longitudinal researches that find out the performance of the same group are also necessary to know how these gaps change with time. According to our findings, we suggest a re-similar review of STEM pedagogy. The future of improved is the realization of scaffolded instruction as a way of alleviating cognitive load in other subjects like Mathematics and Physics and a more focus on scaffolds instruction. The problem that is presented in the Humanities is balancing between high performance with rigor. In the end, this study prepares the teachers to go beyond a one-fits-all model and harmonize more responsive, equitable and effective learning contexts that respond to the specific needs of that academic sphere.

Limitations and Future Directions:

This study is limited by its use of a single district sample and reliance on final grades, which may not capture the full spectrum of learning. Future research should employ a larger, multi-regional sample to enhance generalizability. Incorporating qualitative methods, such as student interviews and classroom observations, would provide crucial context for the quantitative performance trends identified. A longitudinal design tracking the same students over time could also reveal how these subject-specific performance patterns develop and strngthen throughout secondary education.

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