

Academic capital and institutional stratification: determinants of graduate success in Moroccan higher education

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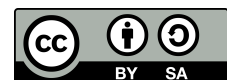
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ABSTRACT

In spite of the massification of higher education after the implementation of the licence–master–doctorate (LMD) reform, the graduation rates from open-access faculties remain low (under 30%), and the factors driving these low performance rates are not well understood. This study attempts to explain factors influencing the stratification of academic achievement of students graduating from Hassan I University (2012–2017), through the analysis of three factors: pre-university academic capital, institutional selectivity, and socioeconomic resources. On the baccalaureate grade, we use ordinary least squares (OLS) regression, analysis of variance (ANOVA), *t*-tests, and Chi-square analyses to find that it is the strongest predictor with $\beta = 0.481$ and $r = 0.595$ ($p < 0.001$), which is better than international benchmarks. The segregation effect by institution is the highest among the groups' effects, with selective institutions having an effect of over 2.5 grade points (when controlling for student inputs), indicated by the large group effect ($\eta^2 = 0.275$). Receipt of scholarships is a positive predictor of performance ($\beta = 0.213$ with $p = 0.031$); the employment in term-time is selected. 45.9% of grade variance is accounted for by the full model. We believe that academic disparities stem from secondary schooling and are exacerbated by disparities in faculty quality in the open market, and therefore secondary faculty preparation and open-access faculty resources must be addressed.

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1. INTRODUCTION

Massification of higher education has heightened scholarly interest in mechanisms of educational stratification [1], [2]. As enrollment expands across the Global South, systems must simultaneously manage access, equity, and academic quality objectives that frequently generate structural tensions. The resulting performance disparities between institutional types and student populations have become a central concern in comparative education research [3].

Knowledge of the determinants of academic achievement is a prerequisite for designing interventions that enhance equity and efficiency in human capital formation. In Morocco, the 2003 licence–master–doctorate (LMD) reform significantly raised enrollment, yet graduation rates in open-access faculties remain below 30% far below the rates observed in the country’s selective institutions [4], [5]. This stratification reflects the overall picture for the Middle East and North Africa (MENA) region: institutional differentiation is intertwined with socioeconomic inequality, thereby reinforcing educational inequality [6], [7].

The conceptualization of academic achievement in this study is based on three theoretical perspectives. The human capital theory suggests that pre-university achievement is a product of a cumulative process of cognitive skill acquisition that moves upward through the educational system [8]–[11] and empirical studies have found that prior academic results are the most robust predictors of tertiary outcomes. Institutional theories, on the other hand, emphasize the property limits of institutions, resource conditions, and the composition of peers as structural forces that affect individual performance [3], [12]. Socioeconomic frameworks focus on the competing claims of academic investment and financial need and employment responsibilities [13].

Although these are useful frameworks, current evidence syntheses are predominantly based on North American and European contexts [14] and Moroccan (and wider Francophone) higher education systems are significantly underrepresented in comparative literature. There have been few studies that have explored pre-university academic capital, selectivity of the institutions, and socioeconomic variables at the same time in relation to a North African massifying system. This study aims to fill this void, employing a combination of statistical methods (hierarchical regression, analysis of variance (ANOVA), and effect-size decomposition) and six graduation cohorts in order to derive an empirical foundation for higher education policy in a country experiencing rapid growth in the middle-income group.

The study makes three contributions to the existing literature, as it is the first quantitative, multi-cohort and multi-method study of determinants of academic performance in Moroccan higher education, based on an administrative dataset of 2,525 graduates from 6 consecutive cohorts (2012–2017), it is the first study to show the decomposition of performance variance into pre-university academic capital, institutional stratification and socioeconomic resources, which facilitates the direct comparison with international meta-analytic benchmarks, and it is the first study to provide evidence-based policy recommendations that can be directly applied to the Pacte ESRI 2030 reform agenda. Collectively, these contributions address a documented gap in the research literature on higher education in the MENA region and provide a methodological template that can be replicated in MENA’s higher education systems.

The present study analyzes the factors influencing academic performance among 2525 graduates of Hassan I University from 2012 to 2017, in order to meet the above goals. We first make use of rich administrative data from secondary schooling to university graduation, and answer the following research questions:

- RQ1: to what extent does baccalaureate how well does success in baccalaureate predict performance in university and how does the predictive validity of baccalaureate compare with international meta-analytic benchmarks?
- RQ2: how large is the effect of institutional stratification on academic performance across selective and open-access establishments?
- RQ3: what are the relationships between socioeconomic resources scholarship receipt and term-time employment and academic performance, after controlling for prior achievement?
- RQ4: does pre-university grade retention exert an independent long-term effect on higher education outcomes, or is this effect mediated by baccalaureate performance?

Drawing on the reviewed literature, we formulate the following hypotheses:

- H1: baccalaureate grade is the most significant individual-level predictor of university performance, with a correlation exceeding the meta-analytic pooled estimate ($r > 0.41$).
- H2: establishment type exerts a significant and large effect on graduation grades that persists after controlling for student input characteristics.
- H3: scholarship receipt is positively associated with academic performance, while term-time employment is negatively associated, net of prior achievement.
- H4: the bivariate effect of grade retention on university outcomes is mediated by baccalaureate performance in the multivariate model.

The remainder of the paper is organized as: section 2 describes the data, variables, and analytical strategy; section 3 reports the empirical results; section 4 interprets the findings in their theoretical and policy context; and section 5 presents the conclusions, limitations, and directions for future research.

2. METHOD

2.1. Data and sample characteristics

The data in this study is based on the results of an administrative follow-up survey of graduates (enquête de suivi des diplômés) conducted at Hassan I University, involving six successive classes of graduates (2012–2017). The analytical sample consists of $N = 2,525$ persons from all establishments of the university. Graduates with complete records of their pre-university academic history and university graduation grade were included to assure the integrity of the dependent variable and a complete set of predictors.

No sampling methods were used because the study was a population census of all the available graduates, not a representative sample of a larger population. This yields an $N = 2,525$ which is far greater than the regression minimum size ($N \geq 245$ for 13 predictors; [15]) and has high statistical power (> 0.99 for $\alpha = 0.05$ and $f^2 = 0.15$; [16]). A strength of this dataset compared to survey-based studies, which use retrospective self-reported data, is its longitudinal administrative structure.

The sample composition reflects Moroccan higher education's stratified structure: 926 graduates (36.7%) at Faculty of Legal, Economic and Social Sciences (FSJES), 760 (30.1%) at Faculty of Sciences and Techniques (FST), 406 (16.1%) at Faculty of Polydisciplinary Khouribga (FPK), 265 (10.5%) at National School of Commerce and Management (ENCG), 128 (5.1%) at Higher School of Technology of Berrechid (ESTB), and 40 (1.6%) at National School of Applied Sciences (ENSA). The variables include three domains: the pre-university measures (type of secondary school, baccalaureate track and grade, history of grade retention); the university-period measures (affiliation to the university, being a scholar, being employed); the outcome measures (final grade 0–20, distinction category: passable, fair, good, very good, and excellent).

2.2. Variable operationalization and measurement

The dependent variable is the university graduation grade (0–20, where 20 represents the highest possible grade), which is the official grade awarded upon completion of the programme. The independent variables are grouped into the three theoretically motivated domains described in the introduction. The human capital dimension of the framework is operationalized in the domain pre-university academic capital with the following variables: baccalaureate grade (continuous, 0–20), baccalaureate track (categorical: sciences as reference), secondary school type (binary: public as reference) and prior grade retention (binary: yes/no). The institutional factors domain includes university establishment (ENCG as the reference category, being the most selective institution in the sample) and diploma type, which serve as proxy variables for institutional quality, selectivity, and organizational context [4], [12], [17]. The socioeconomic resources domain includes two variables: scholarship status (binary) which measures financial support, and term-time employment (binary) which measures opportunity-cost mechanisms [13], [18], [19].

Construct validity is established through the linkage between theory and measurement. Baccalaureate grade reflects the accumulation of cognitive capital and examination readiness; type of institution reflects peer composition and institutional resources; scholarship status reflects financial support; and term-time employment captures socioeconomic constraints. The administrative origin of the data enhances measurement reliability by avoiding self-report bias for key variables. All categorical variables were dummy coded for analysis, with appropriate reference categories selected to facilitate interpretation.

2.3. Analytical strategy and statistical techniques

The analytical approach is a two-step process, progressing from simple bivariate associations to a parsimonious multivariate explanation of variance. It is a method that is in line with the best practice in educational production function studies and enables the incremental effect of each domain to be evaluated systematically, as outlined in [20]. In stage 1, bivariate analyses (Pearson r and Spearman ρ) are compared to determine the relationship between the continuous baccalaureate predictor and the graduation grade; the Spearman correlation is used as a robustness check for distributional violations. For all binary predictors, the group means are compared using independent-samples t -tests, and effect sizes are reported as Cohen's d (small: $d = 0.2$; medium: $d = 0.5$; and large: $d = 0.8$) [21]. One-way ANOVA is used when the categorical predictor is multi-level; the proportion of variance explained is calculated as eta-squared (η^2) and the pairwise group

differences are determined using Tukey post hoc tests, with the family-wise error rate controlled. Chi-square tests test associations between categorical variables, such as academic distinction and baccalaureate track and institutional affiliation.

The estimating equation is given in (1):

$$Y_i = \beta_0 + \beta_1 \text{BAC}_i + \beta_2 \text{SCHOL}_i + \beta_3 \text{WORK}_i + \beta_4 \text{REDOUB}_i + \beta_5 \text{PRIV}_i + \sum_j \gamma_j \text{TRACK}_{ij} + \sum_k \delta_k \text{ESTAB}_{ik} + \varepsilon_i \quad (1)$$

The variables are: Y_i is the graduation grade; BAC is the baccalaureate grade; SCHOL and WORK are sets of dummy variables; REDOUB and PRIV are sets of dummy variables; TRACK and ESTAB are sets of dummy variables; and ε_i is the error term, which is assumed to be independently and identically normally distributed with a mean of zero. Model fit is checked with adjusted R^2 ; there are no problems with multicollinearity (variance inflation factor or $\text{VIF} < 5$); and residual checks (Q–Q plots and Breusch–Pagan tests) confirm approximate homoscedasticity and normality of errors. All analyses were done in R (v4.3.0) with the packages car, effectsize, and psych.

3. RESULTS

3.1. Descriptive overview

The descriptives of the samples are presented in Table 1. In the sample, secondary education is mainly state-funded (96.1%), with two thirds of the graduates having science baccalaureates (67.4%), which is caused by the technical nature of some of the constituent institutions of secondary education. The mean baccalaureate grade is 13.71 ($SD = 1.79$) and the mean university graduation grade is 12.94 ($SD = 1.83$) [22]. The distribution of academic distinction is focused at the lower two honour grades; fair (38.2%) and passable (32.1%). The high rate of scholarship (79.3%) coverage was accompanied by a low rate of term-time work (10.9%).

Table 1. Sample characteristics and distributions (N = 2,525)

Variable	Category	n	%
Baccalaureate track	Sciences	1,297	67.4
	Letters	314	16.3
	Economics	187	9.7
	Technical	127	6.6
University establishment	FSJES	926	36.7
	FST	760	30.1
	FPK	406	16.1
	ENCG	265	10.5
	ESTB	128	5.1
	ENSA	40	1.6
Scholarship recipient	Yes	2,002	79.3
	No	523	20.7
Employed during studies	Yes	275	10.9
	No	2,250	89.1
		Mean	SD
Baccalaureate grade		13.71	1.79
University graduation grade		12.94	1.83

Source: authors' calculations based on Hassan I University administrative graduate survey (2012–2017)

3.2. Bivariate associations

3.2.1. Pre-university achievement and university performance

There is a significant, positive correlation between baccalaureate grade and university graduation grade ($r = 0.595$; $p < 0.001$; $N = 1,457$) with 35.4% of the variance in the outcome explained by this correlation. This association is significantly higher than the meta-analytically pooled one of $r = 0.41$ reported by

Blasco *et al.* [11] for high-stakes terminal exams, suggesting that these exams possess very high predictive ability in credential-based selection systems. This finding is statistically significant in the uninformative Spearman rank correlation, as the rank correlation ($\rho = 0.606$, $p < 0.001$) is robust across distributional assumptions.

3.2.2. Academic track effects

One-way ANOVA reveals significant variation in university graduation grades across baccalaureate tracks ($F(3, 1599) = 48.49$, $p < 0.001$, $\eta^2 = 0.083$), indicating that track type accounts for 8.3% of outcome variance at the bivariate level. Science graduates achieve the highest mean grade ($M = 13.13$), followed by economics ($M = 12.86$), technical ($M = 12.74$), and letters ($M = 11.66$). Post-hoc Tukey tests identify the letters track as performing significantly below all other tracks, consistent with the hypothesis that science curricula develop more transferable analytical competencies that confer advantages in university-level assessment.

3.2.3. Institutional stratification

University establishment emerges as the dominant group-level predictor, with one-way ANOVA yielding highly significant between-group variance ($F(5, 2189) = 166.30$, $p < 0.001$, $\eta^2 = 0.275$). Selective institutions demonstrate markedly superior outcomes ENCG ($M = 14.72$, $SD = 1.48$), ESTB ($M = 14.66$, $SD = 1.55$), and ENSA ($M = 14.43$, $SD = 1.40$) relative to open-access faculties, notably FSJES ($M = 11.94$, $SD = 1.48$) and FPK ($M = 12.73$, $SD = 1.69$). The difference between the ENCG and the FSJES (2.78 grade points) is very large by social science standards [21] and represents about 1.5 standard deviations. These distributions are illustrated in Figure 1, which also shows that variances within the different groups of selective institutions are generally smaller, consistent with the hypothesis of compositional homogeneity resulting from competitive admissions, in support of the hypothesis outlined in H2.

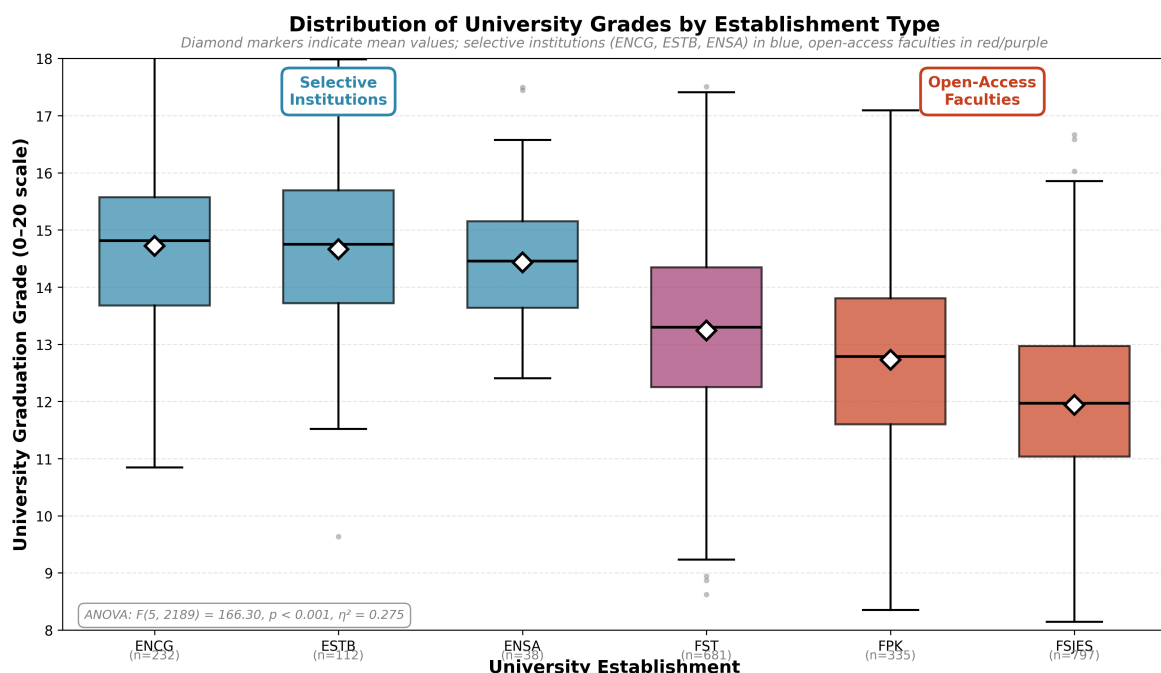


Figure 1. Distribution of graduation grades by type of higher education institution (Source: authors' visualization based on Hassan I University administrative graduate survey data 2012–2017)

3.2.4. Socioeconomic resources

Independent-samples *t*-tests show that there are statistically significant relationships between the binary predictors, as seen in Table 2. Scholarship recipients achieve 0.57 grade points more than non-recipients

($t(2193) = 6.03, p < 0.001, d = 0.313$); consistent with financial aid research that demonstrates a positive effect of financial aid on academic engagement and persistence [23], [24]. This finding partly supports the financial support mechanism proposed in H3 on a bivariate level.

Table 2. University grade by binary predictors: independent samples t -tests

Variable	Group	M	SD	t	p	Cohen's d
Scholarship	Yes	13.08	1.82	6.03	$p < 0.001$	0.313
	No	12.51	1.77			
Employment	Yes	12.21	1.74	-7.39	$p < 0.001$	-0.402
	No	13.03	1.82			
Grade retention	Yes	11.49	1.61	-14.26	$p < 0.001$	-0.781
	No	13.11	1.79			
School type	Private	13.94	1.66	4.32	$p < 0.001$	0.599
	Public	12.91	1.83			

Employed students average 0.82 points below non-employed peers ($t(2522) = -7.39, p < 0.001, d = -0.402$), consistent with time-allocation models [18], [19]. Grade retention exhibits the largest bivariate effect in the table ($t(2193) = -14.26, p < 0.001, d = -0.781$), with retained students underperforming by 1.62 grade points suggesting that secondary academic difficulties generate persistent disadvantages that extend into tertiary education [25]. These results partially support H3, while also motivating the multivariate decomposition in the following section.

3.2.5. Categorical associations with academic distinction

A strong and significant distinction track/baccalaureate track association is confirmed with the Chi square data ($\chi^2(12) = 229.23, p < 0.001$), as is a strong and significant association between academic distinction and university establishment ($\chi^2(20) = 860.36, p < 0.001$). Students who did well in the science degree are overrepresented in the higher categories, and students who did well in the letters degree are concentrated in passable. Likewise, students from ENCG and ESTB tend to have a higher proportion in good and above grades whilst students from FSJES tend to be mostly Passable, a pattern that is consistent with the institutional stratification seen in the continuous outcome analyses.

3.3. Multivariable regression results

The complete ordinary least squares (OLS) regression model for predicting the grade for leaving university is displayed in Table 3. It shows that the model is significant on a global scale ($F(13, 1443) = 94.37, p < 0.001$), with an adjusted R^2 value of 0.454, which is comparable to the values for graduation grades obtained in educational production function models, which are typically in the range from 0.25 to 0.45 [20]. Model diagnostics: residuals were plotted to test for approximate homoscedasticity and normality, and all VIF values are below 3.0, which means that there is no concern of multicollinearity.

The only other significant continuous predictor is baccalaureate grade ($\beta = 0.481, p < 0.001$), meaning that for each one-unit increase in secondary performance, the university graduation grade gains nearly 0.481 points, while all other factors remain constant. However, among the track dummies, only the sciences dummy is significant, with a coefficient of 0.426, and a p -value of less than 0.001, thus confirming the bivariate findings that there is an effect of science-track preparation that is transferable to the sciences reference category. Important, grade retention and private school attendance are no longer significant in the multivariate analysis model, suggesting that they are more of a mediator of baccalaureate performance than a determinant of baccalaureate performance. This pattern confirmed H4.

Scholarship status retains a significant positive coefficient ($\beta = 0.213, p = 0.031$) after controlling for prior achievement and institutional affiliation, suggesting that financial support is associated with approximately a 0.21-point improvement in graduation grade. Although modest in magnitude, this effect carries policy relevance as evidence supporting the expansion of scholarship programmes. The multivariate coefficient for employment is negligible and non-significant ($\beta = -0.006, p = 0.967$), indicating that the bivariate negative association is a product of selection bias working students are disproportionately drawn from lower-achieving strata enrolled in open-access faculties rather than a direct causal penalty from employment. H3 is thus partially confirmed: scholarship is significant but employment is not.

Table 3. OLS regression: determinants of university graduation grade

Predictor	β	SE	t	p
Intercept	6.934	0.360	19.27	$p < 0.001^{***}$
<i>Pre-university achievement</i>				
Baccalaureate grade	0.481	0.022	21.97	$p < 0.001^{***}$
Track: letters	0.182	0.159	1.15	0.252
Track: sciences	0.426	0.128	3.32	$p < 0.001^{***}$
Track: technical	0.198	0.188	1.05	0.294
Grade retention (yes)	-0.194	0.168	-1.16	0.248
Private school (yes)	0.100	0.177	0.56	0.573
<i>Socioeconomic resources</i>				
Scholarship (yes)	0.213	0.099	2.16	0.031*
Employment (yes)	-0.006	0.135	-0.04	0.967
<i>Institutional factors</i>				
Establishment: ENSA	-0.517	0.379	-1.36	0.173
Establishment: ESTB	-0.065	0.188	-0.35	0.729
Establishment: FPK	-1.504	0.148	-10.18	$p < 0.001^{***}$
Establishment: FSJES	-1.658	0.136	-12.18	$p < 0.001^{***}$
Establishment: FST	-0.937	0.135	-6.96	$p < 0.001^{***}$

$N = 1,457$; $R^2 = 0.460$; Adjusted $R^2 = 0.454$; $F(13, 1443) = 94.37$, $p < 0.001$

Reference categories: economics (track), ENCG (establishment)

*** $p < 0.001$, * $p < 0.05$

The institutional coefficients reveal substantial and persistent stratification. All open-access faculties carry negative coefficients relative to ENCG (reference), with the largest penalties at FSJES ($\beta = -1.658$, $p < 0.001$), FPK ($\beta = -1.504$, $p < 0.001$), and FST ($\beta = -0.937$, $p < 0.001$). The non-significant coefficients for ESTB and ENSA validate performance equivalence to ENCG in a selective group of establishments. Due to the continued influence of large institutional effects after controlling for prior achievement, the influence of institutional context seems to be independent and mediated by the quality of peers, classroom pedagogy, classroom size, and classroom resources [12], [26].

4. DISCUSSION

This section explains the results in light of the four research questions, places the results in the context of other theories and principles, and identifies policy implications based on the results. The exceptional predictive validity of the baccalaureate grade ($r = 0.595$ against the average from the meta-analyses of other credential-based selection architectures, $r = 0.41$) [11] can be attributed to a systemic amplification effect specific to credential-based selection architectures. This result is consistent with the recent study conducted in the Moroccan case which showed that regression models applied to achievement scores can be used to make accurate predictions, and that pre-university achievement scores can be used as reliable predictors for achievement models and to classify dropouts [27]. The baccalaureate in Morocco at the same time serves as a secondary graduation certificate, a university entrance requirement and a sorting mechanism that not only contains domain knowledge but also metacognitive abilities like examination resilience and disciplined study habits that are easily transferable to the university examination context. This relationship is further strengthened by the tracking of secondary structure, which restricts student-programme mismatches. The finding that grade retention is large bivariate ($d = -0.781$) but negligible in the multivariate model is consistent with the recovery mechanism we hypothesize: the students who are retained and eventually obtain their baccalaureate are able to overcome the initial performance disadvantage at the time of retention, which means that there is no additional penalty beyond the penalty of having a lower baccalaureate [25].

The most substantively significant finding of the study is the gap in institutional quality ($\eta^2 = 0.275$; ENCG–FSJES gap of 2.78 points) remains even after controlling for student inputs. For definitive causal attribution, experimental designs are not available here, but evidence points to a hybrid mechanism: high ability peers are concentrated in cohorts in selective admissions, which benefit from pedagogical structures that are obligatory where they are not open to large classes (more than 300 students) [4], [5], [28] such as in open-access faculties, as well as from the continuous assessment and tutorial infrastructure that is not found in the latter. For definitive causal attribution, experimental designs would be required. However, the available evidence

suggests a hybrid mechanism: high-ability students concentrated in selective institutions benefit from stronger pedagogical structures, smaller class sizes, continuous assessment, and more extensive tutorial support than those in open-access faculties. The policy option most readily transferable to open-access settings would be to reduce first-year class sizes, implement continuous assessment, and strengthen academic advising without altering admission requirements.

The reversal of the employment effect from bivariate ($d = -0.402$) to multivariate ($\beta = -0.006$) reveals that the apparent employment penalty is attributable to confounded selection: working students are disproportionately enrolled in open-access faculties and enter with lower baccalaureate grades. Once these confounders are controlled, employment per se is inconsequential for graduation grade, implying that underlying socioeconomic disadvantage rather than the time demands of employment is the operative mechanism. This finding calls for more granular data collection on employment intensity and hours worked to enable proper dose–response analysis in future studies. The enduring scholarship effect ($\beta = 0.213$, $p = 0.031$) points to a real resource mechanism operating through reduced financial anxiety, diminished employment necessity, and strengthened institutional belonging [23], [24].

Four evidence-based policy recommendations follow from these findings: i) early warning systems: the high predictive validity of the baccalaureate grade makes it a cost-effective risk-stratification tool; institutions should implement baccalaureate-based early warning systems upon enrolment and provide targeted academic support to letters and technical track students with projected low grades; ii) quality equalization in open-access faculties: reducing first-year class sizes, introducing continuous assessment, and deploying academic advisors in FSJES and FPK would address the largest single source of modifiable stratification; iii) expanded scholarships with academic scaffolding: coupling financial aid with structured mentoring and peer study groups is likely to amplify the scholarship effect documented here; and iv) institutional monitoring: the multi-method analytical template employed in this study combining regression, ANOVA, and effect sizes across multiple cohorts is directly applicable to the annual graduate tracking mechanisms envisaged under Morocco's Pacte ESRI 2030 [29], [30].

5. CONCLUSION

This research analysed the stratification of academic performance among graduates of Hassan I University, seeking to understand the imbalance between elite and open-access institutions in Moroccan higher education. The results confirm that academic capital prior to university enrolment, especially baccalaureate grades, is the most powerful individual-level predictor of university grades, far beyond international performance standards. Institutional stratification is the strongest group-level predictor, and remains significant after controlling for individual-level characteristics, while receiving a scholarship has a small positive effect. Retention, however, has no impact on long-term academic outcomes when baccalaureate performance is considered.

This evidence confirms that academic inequalities emerge in secondary education and are exacerbated by differences in institutional quality, with obvious policy implications for higher education: increasing participation rates without redressing institutional resource inequalities will only serve to increase educational inequalities. Policy should focus on quality enhancement in open-access faculties, early intervention, and need-based scholarships. The study is limited in its representativeness (graduates from a single university) and its inability to draw causal conclusions (cross-sectional data). Future studies should use multi-university longitudinal and quasi-experimental designs to give causal estimates of institutional effects and apply these findings to other higher education systems.

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AUTHOR CONTRIBUTIONS STATEMENT

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C : Conceptualization

M : Methodology

So : Software

Va : Validation

Fo : Formal Analysis

I : Investigation

R : Resources

D : Data Curation

O : Writing - Original Draft

E : Writing - Review & Editing

Vi : Visualization

Su : Supervision

P : Project Administration

Fu : Funding Acquisition

CONFLICT OF INTEREST STATEMENT

The authors declare no conflicts of interest.

INFORMED CONSENT

All participants provided informed consent, and all data were anonymized prior to analysis.

ETHICAL APPROVAL

The study relied on anonymized data; therefore, no formal ethical approval was required.

DATA AVAILABILITY

Anonymized data are available from the corresponding author upon request.

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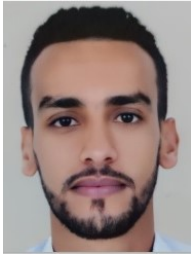
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