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What Subject Nominations Can Tell Us About Curricular Review: A Secondary Analysis of Nine Basic Medical Sciences

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Abstract Published nominations from 350 final-year medical students offer four comparative views of nine basic medical sciences: most focused on, least focused on, easiest, and hardest. This secondary analysis asks how closely those views agree and how different priorities emerge when low attention and difficulty are considered together. We compared the four aggregate profiles using total-variation distance and correspondence analysis; examined the nondominated disciplines and every possible linear weighting of the two review criteria; and enumerated all 288 single-nomination reallocations. The most-focused profile was closer to the easiest profile than to the hardest profile, requiring 31 versus 224 aggregate relabelings to match. The first two correspondence axes represented 99.40% of table inertia. Histology, biochemistry, and pharmacology were nondominated on the two review criteria. Histology led when difficulty had weight below 0.5, pharmacology led above 0.5, and the two tied at 0.5; biochemistry did not lead under linear weighting. The nondominated set and the identities of the weighted leaders survived every single-nomination change, although the switching weight ranged from 0.48 to 0.52. Three transfers could reverse the least-focused leader. These patterns support a conditional shortlist for further review. Aggregate nominations cannot establish individual study behavior, the cause of difficulty, or the effect of a curricular intervention.

Index Terms medical education, basic medical sciences, subject nominations, curricular review, correspondence analysis, decision sensitivity

I. Introduction

Subject rankings are easy to read as curricular instructions, but the question behind each ranking matters. A most-focused nomination does not measure hours of study, and a hardest nomination identifies a comparative choice rather than the prevalence of difficulty. A subject can attract attention because it is familiar, heavily assessed, or clinically relevant. It can be rated difficult for reasons that the nomination does not reveal. Curricular review therefore needs to compare these judgments while keeping their meanings separate.

The published survey by Alhomsi and colleagues reports four choices for each of nine basic medical sciences among 350 final-year students at Damascus University [1]. Its discipline counts and separate perception items make it possible to ask how attention, ease, and difficulty compare across the whole set of subjects. The original survey addressed students' perspectives more broadly; the present study reanalyzes the reported aggregate tables for a narrower decision question. No respondent-level records are available for linking a student's answers to one another.

Basic-science knowledge gains educational value when students can use it to explain and address clinical problems [2]. Studies of retained knowledge and perceived relevance in an integrated curriculum [3], and students' attitudes at another university [4], underline the importance of local context. Perceived ease should also be distinguished from retention and transfer [5], [6]; a nomination cannot establish either learning or motivation [7]. These limits make the published choices useful as prompts for investigation, rather than direct measures of instructional quality.

This analysis asks whether the most-focused profile resembles ease or difficulty across disciplines, and which subjects remain candidates when low attention and difficulty are assigned different importance. We compare complete nomination profiles, summarize the count matrix, and examine both the nondominated subjects and the full interval of linear weights [8]. We then test the local sensitivity of those descriptions to a single changed nomination. The goal is to show what follows from the reported margins, what depends on an explicit decision preference, and what would require new student-level evidence.

II. Materials and methods

A. Data Source

This secondary descriptive analysis uses the published counts of 350 final-year medical students at Damascus University, Syria [1]. The questionnaire addressed demographic characteristics, academic interest, subject choices, general perceptions, and career intentions. Its preparation included forward–backward translation between English and Arabic and a clarity pilot with 40 students. These procedures support the interpretation of the item wording, but do not establish that the four subject choices measure a single underlying construct. Following the distinction between instrument development and validity evidence for a particular interpretation [9], the nomination headings are retained without redefining them as measures of engagement, cognitive load, or competence.

The primary matrix contains nine disciplines and four questions: most focused on, least focused on, easiest, and hardest. Each column sums to 350. The total of 1,400 nominations therefore represents four responses per member of the same cohort, rather than independent observations from 1,400 people. Equal totals allow direct comparison of the question profiles. The margins do not reveal which nominations came from the same student, so paired associations, demographic adjustment, and sampling errors that account for the recruitment design cannot be calculated. This specification of the analytical unit follows survey-reporting guidance [10].

All 36 integer counts were checked against the published table. All percentages were calculated from these counts. A separate table retains the seven perception items, their agreement counts, means, and standard deviations. Agreement combines the agree and strongly agree categories; the remaining categories are not reported separately and are described as nonagreement where necessary. The perception items were neither pooled into a total score nor joined to the nomination counts. Career preferences and reasons for academic interest were outside the scope of the present discipline-profile comparison.

B. Nomination Profiles and Correspondence Analysis

Let X_{ij} be the count for discipline i under question j, where $i = 1, \dots, 9$ and $j = 1, \dots, 4$. The column profiles are

$$p_{ij} = \frac{X_{ij}}{350}, \qquad \sum_{i=1}^{9} p_{ij} = 1. \tag{1}$$

Each profile describes the distribution of one type of nomination across the nine disciplines. Because respondents select a discipline comparatively, a hardest share is not the prevalence of difficulty under an unrestricted question asking about every subject.

Total-variation distance compares profiles j and k:

$$D_{jk} = \frac{1}{2} \sum_{i=1}^{9} |p_{ij} - p_{ik}|. \tag{2}$$

The distance ranges from zero for identical distributions to one for disjoint support [11]. Here it is used as a descriptive comparison of observed margins. No independence assumption between questions is needed for this calculation.

Equal integer totals also allow the distance to be expressed as a count:

$$R_{jk} = 350 D_{jk} = \frac{1}{2} \sum_{i=1}^{9} |X_{ij} - X_{ik}|. \tag{3}$$

R_{jk} is the minimum number of nominations that must be reassigned to another discipline within one column to reproduce the other column. The interpretation follows from conservation of the column total: the summed surplus above the target counts equals the summed deficit. Each reassignment removes one unit of surplus and fills one unit of deficit. These hypothetical relabelings compare aggregate distributions; they are not observed changes in students' answers.

Correspondence analysis was used to summarize the structure of the complete count matrix [12]. Define $P = X/1400$, with row masses $r = P\mathbf{1}$ and column masses $c = P^{\mathsf{T}}\mathbf{1}$. Every column mass is $1/4$. The standardized residual matrix is

$$Z = D_r^{-1/2}(P - rc^{\mathsf{T}})D_c^{-1/2}, \tag{4}$$

where D_r and D_c contain the corresponding masses on their diagonals. This removes the allocation implied by the margins and scales the remaining differences before decomposition.

For the singular value decomposition $Z = U\Sigma V^{\mathsf{T}}$, the row and column principal coordinates are

$$F = D_r^{-1/2}U\Sigma, \qquad G = D_c^{-1/2}V\Sigma. \tag{5}$$

Axis inertia is $\lambda_a = \Sigma_{aa}^2$; its share of total inertia is $\lambda_a / \sum_b \lambda_b$. All three nonzero dimensions were retained in the numerical output, and the first two were plotted. The row and column coordinates are shown in separate panels. Distances within a panel approximate the corresponding chi-square profile distances, whereas distances between a discipline and a question in different panels have no direct interpretation [13]. Axis signs are arbitrary; easiest was placed on the negative side of axis 1 and least focused on the positive side of axis 2 for reproducible presentation.

A discipline's row mass is its share of all nominations across the four questions. It is not the proportion of students exposed to that discipline: the same student may nominate a subject under more than one heading. Consequently, the decomposition weights disciplines by their nomination totals rather than treating all nine disciplines equally. Neither row nor column scaling adjusts for teaching hours, examination weight, or opportunity to study. No significance test, confidence ellipse, or cluster assignment was applied to the coordinates. Inertia is interpreted solely as variation in the observed nomination matrix.

C. Review Criteria and Local Sensitivity

Least-focused counts L_i and hardest counts H_i were treated as separate reasons for curricular review. A discipline was classified as dominated when another had at least as many nominations on both criteria and strictly more on at least one. The nondominated set therefore retains disciplines that cannot be excluded through this comparison alone. Higher counts mean a stronger signal for review under the selected criteria, not greater educational value or an estimated benefit from intervention.

Linear weighting was then examined over its complete interval:

$$S_i(w) = (1-w)L_i + wH_i, \qquad 0 \le w \le 1. \tag{6}$$

Here w is the chosen weight on difficulty and $1-w$ is the weight on low attention. These weights express decision preferences; they are not estimated from the survey. The two inputs have the same denominator, so percentages give the same rankings as counts. Pairwise score intersections supplied all breakpoints within $[0,1]$. The maximizing discipline was identified at each breakpoint and throughout every interval between them, ensuring that no narrow range of weights was missed.

Local sensitivity and reproducibility. Local sensitivity was assessed by moving one nomination from one discipline to another within a single question. Each of the four columns admits nine donor disciplines and eight different recipients. All cells are positive, giving $4 \times 9 \times 8 = 288$ admissible changes. For every modified matrix, correspondence inertia, the closest profile pair, the nondominated set, and the weighted leaders were recalculated. This enumeration defines the scope of the sensitivity analysis explicitly [14]. It examines the effect of a single changed nomination; it is neither a sampling distribution nor a model of likely response errors.

For each question, the minimum number of relabelings required for a strict change in leader was also calculated. If the two largest counts are a and b, the threshold is

$$q = \left\lfloor \frac{a-b}{2} \right\rfloor + 1. \tag{7}$$

A transfer from the leader to its nearest rival reduces their difference by two, the largest possible reduction from one relabeling. A tie is not counted as a reversal. Calculations used Python and NumPy [15].

III. Results

A. Nomination Profiles and Correspondence Structure

Anatomy and physiology accounted for 240 of 350 most-focused nominations (68.6%) and 258 easiest nominations (73.7%), but only 16 hardest nominations (4.6%; Table 1). Pharmacology and biochemistry showed the reverse pattern: together they received 161 hardest nominations (46.0%) and 34 most-focused nominations (9.7%). Histology led the least-focused column with 68 nominations, only four more than embryology. Pharmacology led the hardest column with 89, followed by biochemistry with 72 and histology with 63.

The four profiles are displayed on a common percentage scale in Figure 1. Most-focused and easiest nominations are concentrated in anatomy and physiology, whereas least-focused and hardest nominations are distributed more broadly. The latter two columns also differ in their leading disciplines: embryology receives many least-focused nominations but comparatively few hardest nominations; pharmacology shows the opposite balance.

Table 1: Discipline nominations among 350 final-year medical students; source: Alhomsi et al. [1]

Discipline	Most focused	Least focused	Easiest	Hardest
Anatomy	136	10	143	13
Physiology	104	3	115	3
Biochemistry	23	56	7	72
Pharmacology	11	42	8	89
Immunology	14	38	23	26
Pathology	9	38	8	31
Histology	16	68	7	63
Microbiology	13	31	17	28
Embryology	24	64	22	25
Total	350	350	350	350

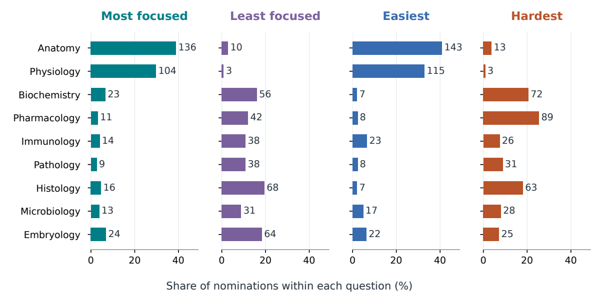

Figure 1: Nomination profiles across nine basic medical sciences. Bar length gives the percentage of 350 nominations in each question; labels give counts

The most-focused and easiest profiles were the closest pair, requiring 31 relabelings to match ($D = 0.0886$). Least-focused and hardest profiles required 66 ($D = 0.1886$). All four remaining comparisons required at least 224 changes (Figure 2). In particular, matching most focused to hardest required 224 relabelings, 193 more than matching most focused to easiest. Study attention thus resembled ease much more closely than difficulty at the discipline-distribution level.

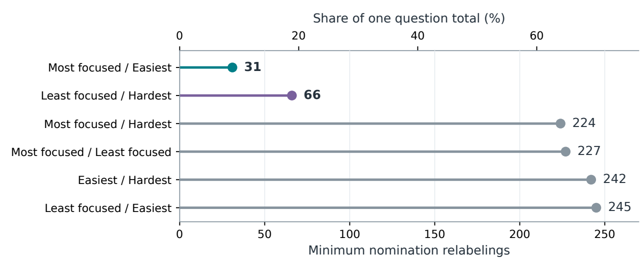

Figure 2: Distances between the four nomination profiles. Points show the minimum number of within-column relabelings needed to match each pair; the upper axis expresses the same distance as a percentage of 350. Smaller values indicate more similar distributions. These are aggregate comparisons, not observed switches by individual students

The 31 changes can be understood by inspecting the column surpluses. Relative to the easiest profile, most-focused nomi-

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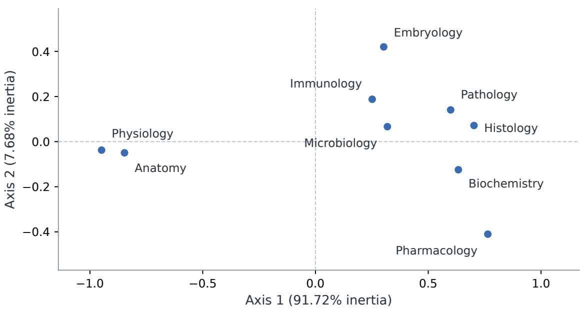
nations include 16 extra for biochemistry, nine for histology, three for pharmacology, two for embryology, and one for pathology. Reassigning these surpluses to disciplines with deficits reproduces the easiest distribution. This arithmetic does not reveal how many respondents actually selected the same discipline under both questions. Likewise, the 66-change distance between least focused and hardest shows that the two concerns share a broad pattern without being interchangeable. *Correspondence structure.* Total inertia was 0.548762. The first axis represented 91.72%, the second 7.68%, and the third 0.60%; the two displayed axes therefore accounted for 99.40% (Table 2). Anatomy and physiology were on the negative side of axis 1, opposite the remaining disciplines. In the question panel, most focused and easiest were negative, while least focused and hardest were positive (Figure 3). Anatomy and physiology contributed 59.45% of the first-axis inertia.

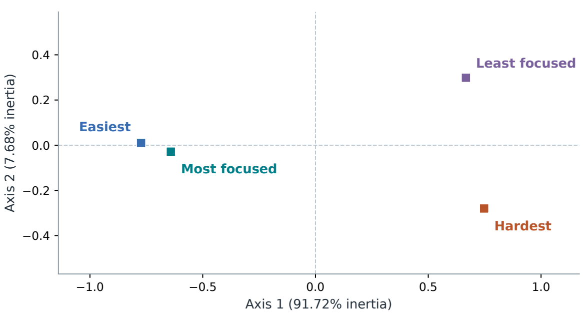
Table 2: Inertia of the three correspondence axes

Axis	Inertia	Share (%)	Cumulative (%)
1	0.503326	91.72	91.72
2	0.042162	7.68	99.40
3	0.003274	0.60	100.00

Inertia describes the nomination matrix. It is not variance explained in student achievement, nor a measure of predictive accuracy.



(a) Discipline principal coordinates.



(b) Question principal coordinates.

Figure 3: Correspondence analysis of the nomination matrix. The panels share axis limits and equal coordinate scaling. Dashed lines mark zero. The first two axes represent 99.40% of total inertia. Distances describe relationships within each panel; cross-panel discipline–question distances should not be interpreted

Pharmacology and embryology drove the second-axis contrast. Their coordinates were approximately -0.410 and 0.420, respectively, and their combined contribution to this axis was 83.13%. Pharmacology had 89 hardest and 42 least-focused nominations; embryology had 25 and 64. Biochemistry lay toward the difficulty end of this contrast, while histology occupied an intermediate position. Although the second axis represented a much smaller share of inertia, it distinguished two substantively different reasons for reviewing a discipline.

The correspondence map and the relabeling distances summarize different features of the same table. The map describes all four profiles jointly, with weighting by row masses; relabeling compares two complete columns on their original count scale. Their agreement on the broad attention–ease pattern does not make the measures equivalent. The inertia percentages describe the table's geometry, rather than variation in achievement or predictive accuracy.

B. Conditional Priorities and Local Sensitivity

Histology, biochemistry, and pharmacology formed the nondominated set in the least-focused–hardest plane (Figure 4). Their count pairs were $(68, 63)$, $(56, 72)$, and $(42, 89)$, respectively. Each increase in difficulty nominations along this set came with fewer least-focused nominations. The other six disciplines were dominated under these two criteria. For example, histology exceeded embryology by four least-focused and 38 hardest nominations.

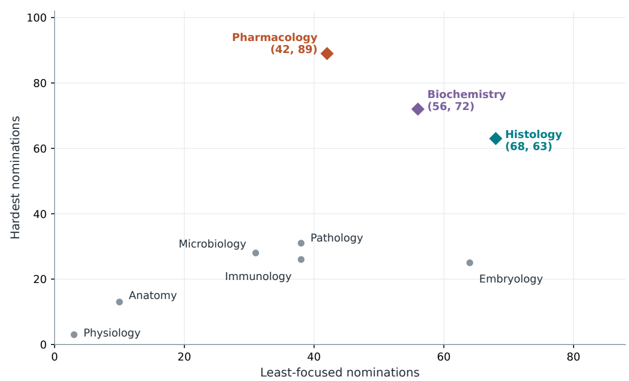


Figure 4: Low attention and difficulty as separate review criteria. Diamonds mark the three nondominated disciplines; circles mark disciplines exceeded on both criteria by at least one other discipline. Labels for the nondominated set give (least-focused, hardest) counts. Higher values indicate stronger review signals under the selected criteria

Across the full weighting interval, histology had the largest score for $0 \leq w < 0.5$, and pharmacology for $0.5 < w \leq 1$. They tied at 65.5 when $w = 0.5$. Biochemistry scored 64.0 at that weight and never maximized the linear score (Figure 5). Thus, belonging to the nondominated set did not guarantee selection by linear weighting.

Biochemistry would exceed histology only for $w > 4/7$ (approximately 0.5714), but would exceed pharmacology only for $w < 14/31$ (approximately 0.4516). No weight satisfies both conditions. Its equal-weight shortfall was nevertheless small: 1.5 weighted nominations, or 0.43 percentage points on the denominator of 350. This is a property of the decision rule, rather than evidence for excluding biochemistry from further review.

Every one of the 288 single-nomination changes preserved the closest profile pair, the three nondominated disciplines, and the identities of the two weighted leaders. The histology–pharmacology transition weight ranged from 0.48 to 0.52.

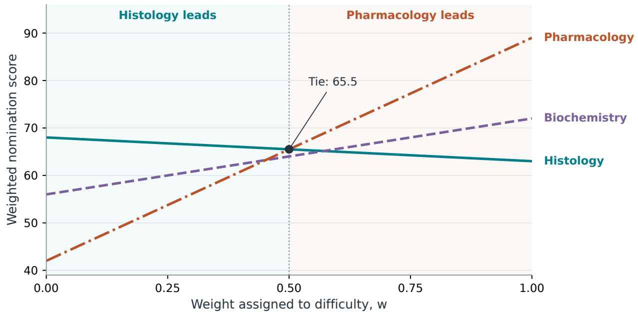


Figure 5: Weighted scores for the nondominated disciplines. The difficulty weight w ranges from zero (low attention only) to one (difficulty only). Histology leads below $w = 0.5$ and pharmacology above it; their scores tie at 65.5. Biochemistry remains below the leading score throughout. Line styles distinguish disciplines independently of color

Figure 6 shows that only changes in the least-focused and hardest columns affected the switching weight. The two other columns do not enter the weighted score. The dominant correspondence pattern was similarly stable: the first-axis share ranged from 91.43% to 92.01%. Individual question leaders were less uniformly stable (Table 3). Moving three nominations from histology to embryology reversed the least-focused lead. Reversing the hardest lead required nine transfers from pharmacology to biochemistry. Anatomy required 17 transfers to physiology to lose the most-focused lead and 15 to lose the easiest lead.

Histology's four-nomination lead over embryology therefore warrants a more cautious interpretation than a categorical claim that it was uniquely neglected. The two disciplines were close on low attention, while their difficulty counts differed substantially. The stability of the joint review set and the vulnerability of the least-focused ranking are compatible because they answer different questions.

Table 3: Minimum relabelings required to reverse each question's leading discipline

Question	Leader / nearest rival	Counts	Difference	Changes
Most focused	Anatomy / Physiology	136 / 104	32	17
Least focused	Histology / Embryology	68 / 64	4	3
Easiest	Anatomy / Physiology	143 / 115	28	15
Hardest	Pharmacology / Biochemistry	89 / 72	17	9

Each change moves one nomination from the leader to its nearest rival within the same question. A strict reversal, not a tie, is required. These are deterministic editing counts, not probabilities of ranking error.

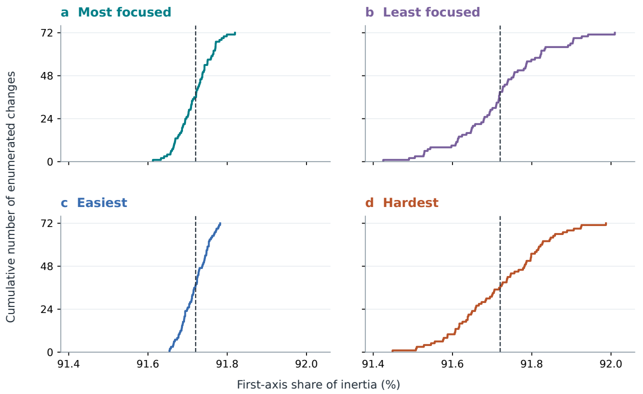


Figure 6: Sensitivity of the histology–pharmacology switching weight to one changed nomination. Each row gives the observed range across all 72 admissible changes within the named question. The vertical dotted line marks the unchanged weight, $w = 0.50$. These ranges are deterministic comparisons, not confidence intervals or probabilities of response errors

C. Perceived Value and Clerkship Preparation

Agreement was highest for the pathophysiology item (271; 77.4%), followed by importance for further medical education (263; 75.1%) and early clinical application (262; 74.9%). Only 73 students (20.9%) agreed that basic sciences had provided appropriate preparation for clerkship practice (Table 4). The difference between further-education importance and preparation was 54.3 percentage points. This compares two marginal percentages and is not a paired effect size.

Table 4: Perceptions of educational value and preparation for clinical training; source: Alhomsi et al. [1]

Statement (condensed)	Agreement, n (%)	Mean (SD)
Clinical relevance was sufficiently illustrated.	155 (44.3)	3.17 (0.95)
Basic sciences provided appropriate preparation for clerkship practice.	73 (20.9)	2.66 (0.97)
Basic-science knowledge is important for further medical education.	263 (75.1)	3.89 (0.84)
The knowledge gained is essential for the future physician role.	209 (59.7)	3.64 (0.98)
Knowledge of pathophysiological mechanisms is the most important facet of a good physician.	271 (77.4)	3.99 (0.84)
Application to clinical practice should be reinforced early.	262 (74.9)	3.96 (0.83)
Many facts should be learned first and their application later.	174 (49.7)	3.31 (1.15)

The remaining items also resist a single favorable-attitude interpretation. Clinical illustration received 155 agreements (44.3%), the future-physician item 209 (59.7%), and learning facts before their later application 174 (49.7%). The last item concerns sequencing, whereas early clinical application concerns reinforcement during training. Retaining the seven judgments separately preserves these differences. They provide context for curriculum review but cannot be linked to any student's discipline nominations from the available tables.

IV. Discussion

A. What the Rankings Establish

The strongest aggregate pattern is that attention and ease were concentrated in the same disciplines. Their profiles required 31 relabelings to match, versus 224 for attention and difficulty. This describes the distribution of answers across subjects, not whether the same students made both choices. It also cannot tell whether study made a discipline feel easier, ease encouraged study, or teaching time and assessments influenced both. The difference between learning and perceived fluency [5], [6] remains relevant when interpreting these nominations.

The smaller second correspondence axis identified a different distinction: pharmacology received many hardest nominations, while embryology received many least-focused nominations. Histology combined substantial counts on both criteria. These patterns support different questions for a curriculum committee. A difficult discipline calls for closer examination of which concepts and tasks cause problems; a low-attention discipline calls for examination of opportunities to study it, its perceived relevance, and competing demands. Studies asking students specifically about histology and embryology show the kind of targeted evidence that a cross-discipline ranking cannot supply [16].

B. From a Shortlist to a Review Decision

Histology, biochemistry, and pharmacology formed a non-dominated set: none of the three had fewer nominations than another subject under both criteria. A linear score, which adds the two counts after assigning a difficulty weight, selected histology below $w = 0.5$ and pharmacology above it. Biochemistry never led because its weighted score lay below their upper envelope [8]. Its absence as a weighted leader is a feature of this particular decision rule; it does not establish that the subject needs no review. The weights describe committee preferences, not quantities estimated from students' responses.

The sensitivity exercise places useful limits on the rankings. One changed answer did not alter the three-subject set or the identities of the weighted leaders, yet it could shift their boundary from 0.48 to 0.52. The least-focused first place was more fragile: transferring three nominations from histology to embryology would reverse it. Neither result is a statistical confidence interval. The 288 changes exhaust a precisely defined local neighborhood of the count table, without modeling sampling variability or correlated answers.

The seven separate perception items broaden the review question without resolving it. Students often endorsed the importance of basic science for further education while rarely agreeing that it had prepared them appropriately for clerkship practice. The two percentages describe distinct items, and the published margins cannot show how each student answered both. The next review step would examine clinical tasks, course exposure, and measures of later performance. Research on integrated basic-science teaching [2], [3], and on retrieval and distributed practice in health-professions education [17], can guide the design of a subsequent evaluation once the local learning problem has been identified. Those studies do not demonstrate that a particular teaching method caused any ranking in this cohort.

C. Limits of the Secondary Analysis

The source is a single survey of final-year students looking back on basic-science courses. Its published margins contain neither respondent-level cross-tabs nor teaching hours, assessment weights, subject-specific attainment, or linked clerkship outcomes. Comparing four answers from the same 350 students does not create 1,400 independent people. Correspondence inertia summarizes this particular matrix and does not measure learning outcomes; the decision score measures weighted nominations and does not estimate intervention benefit. Recruitment by clerkship groups also cannot be incorporated into uncertainty estimates from the reported margins. Larger coordinated changes could affect the conclusions differently from the single-answer changes enumerated here.

The most useful follow-up would connect student-level choices to subject-specific exposure, the tasks students find difficult, and performance during later clinical application. That evidence could distinguish a problem of time, perceived relevance, understanding, or retention. Until then, the current results justify a transparent, conditional review shortlist rather than a fixed ordering of teaching priorities.

V. Conclusion

The published most-focused and easiest nominations had similar distributions across nine disciplines, while low attention and difficulty pointed to different review concerns. Histology, biochemistry, and pharmacology formed a conditional shortlist under those two criteria. The preferred weighted leader depended on the importance assigned to difficulty: histology led below a weight of 0.5 and pharmacology above it. Single-nomination changes preserved that shortlist but exposed uncertainty in the precise switching weight and the least-focused first place. These counts can identify questions for curricular review; choosing and evaluating teaching changes requires student-level and performance evidence.

Use of generative-AI assistance

Generative-AI tools assisted with drafting and editing.

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