

# Comparative Analysis of Pedagogical Perceptions and Learning Strategies in Physiology: A Cross-Sectional Study of 1<sup>st</sup> Year and 2<sup>nd</sup> Year Medical Students at Alioune Diop University

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## Abstract

**Background:** Medical pre-clinical education is a pivotal period during which students progressively construct the conceptual and epistemological foundations required for clinical practice. Physiology, as a bridge discipline between basic sciences and clinical reasoning, holds a central role in this process. Understanding how pedagogical perceptions and motivational profiles evolve between Year1 (Y1) and Year2 (Y2) of the medical curriculum is essential for evidence-informed curriculum design, particularly in sub-Saharan African institutions facing structural resource constraints.

**Objective:** To compare pedagogical perceptions and motivational profiles between Y1 (n=39) and Y2 (n=39) medical students at UADB, Senegal, across six thematic dimensions, and to identify longitudinal improvement pathways.

**Methods:** A cross-sectional comparative survey using an anonymous five-point Likert-scale questionnaire was simultaneously administered to both cohorts during the 2024-2025 academic year. Responses were aggregated into three categories (agreement, neutrality, disagreement). Mann-Whitney U tests were applied for inter-cohort comparisons. Thematic mean scores were computed by aggregating items within each dimension.

**Results:** The two cohorts differed notably in gender distribution (Y1: 69.2% female vs Y2: 53.8% male). Perceived difficulty of physiology fell sharply from 69.2% ('difficult') in Y1 to 20.5% in Y2, while 15.4% of Y2 rated it 'easy'. Intrinsic motivation increased significantly ( $\Delta=+0.43/5$ ;  $p<0.001$ ) and surface learning approaches declined sharply ( $\Delta=-0.59/5$ ;  $p<0.001$ ). Recognition of physiology's utility for medical practice reached 100%

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in Y2. Assessment perception improved significantly ( $p < 0.001$ ). In contrast, laboratory availability fell critically ( $\Delta = -37.5\%$ ;  $p = 0.001$ ) and participatory inhibition increased paradoxically in Y2.

**Conclusion:** Progression from Y1 to Y2 is accompanied by a remarkable motivational and epistemological maturation characterised by deep learning consolidation and full integration of physiology's medical value. This trajectory is, however, undermined by deteriorating material conditions and persistent participatory inhibition. Structural investment in Y2 infrastructure and targeted active-learning strategies are priority interventions.

**Keywords:** medical education; physiology; intrinsic motivation; deep learning; Alioune Diop University

## Introduction

Medical pre-clinical education is a formative period during which students build the conceptual scaffolding essential for clinical reasoning. Physiology, as a bridge discipline linking basic sciences to pathophysiology, holds a cornerstone role in this architecture [1, 2]. The transition from Year 1 (Y1) to Year 2 (Y2) of the pre-clinical curriculum represents an inflection point: exposure to greater content complexity, evolving peer dynamics, and accumulating assessment experience all interact to reshape perceptions and motivational orientations.

While current literature in sub-Saharan Africa predominantly focuses on overall academic performance, empirical data comparing student perceptions of specific physiology teaching modalities (e.g., lectures vs. practical sessions) across different pre-clinical levels remain scarce. [3]. This study addresses this knowledge gap by analyzing how pedagogical perceptions among medical students at Alioune Diop University of Bambey (UADB) influence the adoption of deep versus surface learning approaches, and how these perceptions shift between year 1 and year 2 of the curriculum.

The University Alioune Diop of Bambey, established in 2007, provides a unique naturalistic setting: its Department of Medicine currently trains two distinct pre-clinical cohorts sharing an institutional context but differing in cumulative physiology exposure.

The present study focuses on the medical education landscape at UADB, specifically examining the pedagogical challenges within the physiology curriculum. By conducting a simultaneous analysis of Year 1 (Y1) and Year 2 (Y2) cohorts, this study addresses four primary objectives: (1) to compare perceived difficulty of physiology between Year 1 (Y1) and Year 2 (Y2) students; (2) to compare intrinsic motivation levels and their associated learning strategies across the two cohorts; (3) to compare the prevalence of deep versus surface learning approaches in Y1 and

Y2; and (4) to compare students' perceptions of pedagogical content, tutorial and practical sessions, teacher-student interaction, assessment methods, and material conditions across the two cohorts. In addition to these primary objectives, this study pursues two secondary objectives: (i) to describe and compare the sociodemographic profiles of the Y1 and Y2 cohorts (gender, age, marital status, nationality) in order to contextualise between-cohort differences; and (ii) to explore whether students' perceptions of assessment methods differ significantly between cohorts, given the central role of evaluation in shaping study strategies.

Specifically, Self-Determination Theory [4] underpins our analysis of intrinsic vs. extrinsic motivation and students' perceived autonomy; Achievement Goal Theory [5] informs our interpretation of mastery vs. performance-oriented learning goals; and the deep vs. surface learning model [6] provides the conceptual framework for categorizing students' study strategies as measured by the questionnaire's motivation and learning strategy items.

## Material and Methods

### Study Design and Setting

This was a cross-sectional comparative study involving two independent cohorts, conducted within the Department of Medicine at UADB, Bambey, Senegal. Data collection occurred simultaneously in both cohorts at the end of the first semester of the 2024–2025 academic year, ensuring comparable temporal conditions.

### Participants

Both target populations comprised all students enrolled in Year 1 (Y1,  $n = 39$ ) and Year 2 (Y2,  $n = 39$ ), representing exhaustive, census-based samples of each cohort. All enrolled students completed the questionnaire in full; there were no refusals or incomplete submissions, yielding a response rate of 100% in both cohorts. Participation was voluntary and anonymous.

## Instrument

An anonymous self-administered questionnaire on KoboToolbox was administered identically to both cohorts. It comprised: (i) a sociodemographic section; (ii) six thematic sections (pedagogical content, tutorial/practical sessions, teacher-student interaction, material conditions, assessment methods, motivation and learning strategies); and (iii) global perception questions. Attitude items used a five-point Likert scale.

The questionnaire was developed using a structured content validation process. Items were adapted from validated instruments in medical education research, specifically the Course Experience Questionnaire (CEQ) and the Motivated Strategies for Learning Questionnaire (MSLQ). Following a French translation, item relevance was reviewed and confirmed by an expert panel consisting of two physiologists and one medical education specialist. Furthermore, this instrument was previously employed in a similar study among medical students in Saint-Louis (Senegal), ensuring its cultural and contextual suitability for our study population.

## Statistical Analysis

Data were analysed using Python (Pandas, SciPy, Matplotlib). To facilitate descriptive analysis, Likert responses were aggregated into three categories: 'Agreement' (Strongly Agree + Agree), 'Neutral', and 'Disagreement' (Disagree + Strongly

Disagree). For inter-cohort comparisons, responses were numerically encoded from 1 to 5 (1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly Agree). As Likert-scale data are ordinal in nature, the Mann-Whitney U test was employed to compare score distributions between the Y1 and Y2 cohorts. This non-parametric rank-based test was selected because it does not assume normality of the distribution, an assumption that is inappropriate for ordinal Likert responses and it is robust to the modest sample sizes of this study. Statistical significance was defined using the following p-value thresholds: ns ( $p \geq 0.05$ ), \* ( $p < 0.05$ ), \*\* ( $p < 0.01$ ), \*\*\* ( $p < 0.001$ ).

## Ethical Considerations

This study was conducted in accordance with the principles of the Declaration of Helsinki. Informed verbal consent was obtained from all participants before the questionnaire was administered. Students were informed that their participation was entirely voluntary, that their responses would be anonymized, and that non-participation would have no academic consequences. No personally identifiable information was collected.

## Results

### Sociodemographic Profiles

Table I presents the sociodemographic characteristics of both cohorts.

**Table I. Sociodemographic characteristics of Year 1 and Year 2 cohorts (n = 39 each).**

Variable	Category	Y1 n	Y1 (%)	Y2 n	Y2 (%)
Gender	Female	27	69.2%	18	46.2%
	Male	12	30.8%	21	53.8%
Mean Age ( $\pm$ SD)	–	20.2	$\pm 0.9$ yrs	20.6	$\pm 1.1$ yrs
Marital status	–	38	97.4%	37	94.9%
Nationality	Senegalese	32	82.1%	35	89.7%
	Mauritanian	4	10.3%	2	5.1%
	Comorian	2	5.1%	1	2.6%
	Togolese/Other	1	2.6%	1	2.6%

The two cohorts differed notably in gender distribution (Y1: 69.2% female vs Y2: 53.8% male. Mean age was marginally higher in Y2 ( $20.6 \pm 1.1$  vs  $20.2 \pm 0.9$  years). Marital status and nationality distributions did not differ significantly between cohorts ( $p > 0.05$

for all; chi-square tests). These sociodemographic differences, particularly the gender reversal, should be considered as potential confounders when interpreting inter-cohort comparisons.

**Table II: Thematic mean scores (/5) for Year 1 and Year 2 cohorts and Mann-Whitney U test results.**

Dimension	Y1 (/5)	Y2 (/5)	$\Delta$	Statistical significance (Mann-Whitney U)
Pedagogical Content	3.83	3.85	+0.02	ns (p = 0.449)
Tutorial & Practical Sessions	3.96	3.83	-0.13	ns (p = 0.480)
Teacher-Student Interaction	4.11	4.13	+0.02	ns (p = 0.462)
Material Conditions	3.32	3.20	-0.12	ns (p = 0.142)
Assessment Methods	3.61	3.82	+0.21	*** (p < 0.001)
Intrinsic Motivation	3.98	4.41	+0.43	*** (p < 0.001)
Surface Learning Approaches†	3.14	2.55	-0.59	*** (p < 0.001)

For Surface Learning Approaches, a lower Y2 score indicates rejection of superficial strategies (positive shift). Positive  $\Delta$  in green; negative  $\Delta$  in red.

### Overview of the Comparative Thematic Profile

Figure 1 presents the thematic comparative

profile Y1 and Y2, providing a clear visual summary of position of change for each dimension, with delta values and statistical significance.

Dimension Description	Year 1 mean score (/5)	Year 2 mean score (/5)	Change ( $\Delta$ ) Y1 → Y2	Significance Mann-Whitney U test
<b>Surface learning approaches†</b> Adherence to superficial study strategies (memorisation, minimal effort, skipping lectures)	3.14	2.55	-0.59 Decline (positive shift†)	p < 0.001 ***
<b>Intrinsic motivation</b> Spontaneous interest in physiology, pleasure and personal engagement in learning	3.98	4.41	+0.43 Significant increase	p < 0.001 ***
<b>Assessment methods</b> Perceived clarity, fairness and adequacy of examination practices	3.61	3.82	+0.21 Significant increase	p < 0.001 ***
<b>Material conditions</b> Classroom suitability, equipment availability, laboratory access and practical resources	3.32	3.20	-0.12 Non-significant	p = 0.142 ns
<b>Teacher-student interaction</b> Communication quality, respect, availability and participatory classroom climate	4.11	4.13	+0.02 Stable, no change	p = 0.462 ns
<b>Tutorial and practical sessions</b> Perceived utility of directed tutorials (TD) and laboratory practical sessions (TP)	3.96	3.83	-0.13 Non-significant	p = 0.480 ns
<b>Pedagogical content</b> Syllabus clarity, course quality, workload and supporting learning resources	3.83	3.85	+0.02 Stable, no change	p = 0.449 ns

**Surface Learning Approaches:** A lower Year 2 score indicates that students in the senior cohort reject superficial strategies (e.g., memorising only key chapters, limiting work to the strict minimum, or considering deep understanding as a waste of time). The decline of -0.59 is therefore a positive pedagogical shift.

**Significance levels (Mann-Whitney U test, two-tailed):** \*\*\* p < 0.001 (highly significant) ns = not significant (p ≥ 0.05)

Figure 1: Comparative thematic profile of Year 1 and Year 2 medical students across seven pedagogical dimensions – Physiology course, University Alioune Diop de Bambey (UADB). Each cohort: n=39.

Figures 1 reveal a clear differentiation in the magnitude and direction of change across dimensions. Two domains show large, statistically significant positive shifts: Intrinsic Motivation

( $\Delta = +0.43$ ;  $p < 0.001$ ) and Surface Learning Approaches ( $\Delta = -0.59$ ;  $p < 0.001$ ). Assessment Methods show a moderate significant improvement ( $\Delta = +0.21$ ;  $p < 0.001$ ). Material Conditions exhibit a non-significant decline ( $\Delta = -0.12$ ) that masks critical item-level drops detailed in Section 3.5. Pedagogical Content, Teacher-Student Interaction, and Tutorial/Practical Sessions remain largely stable.

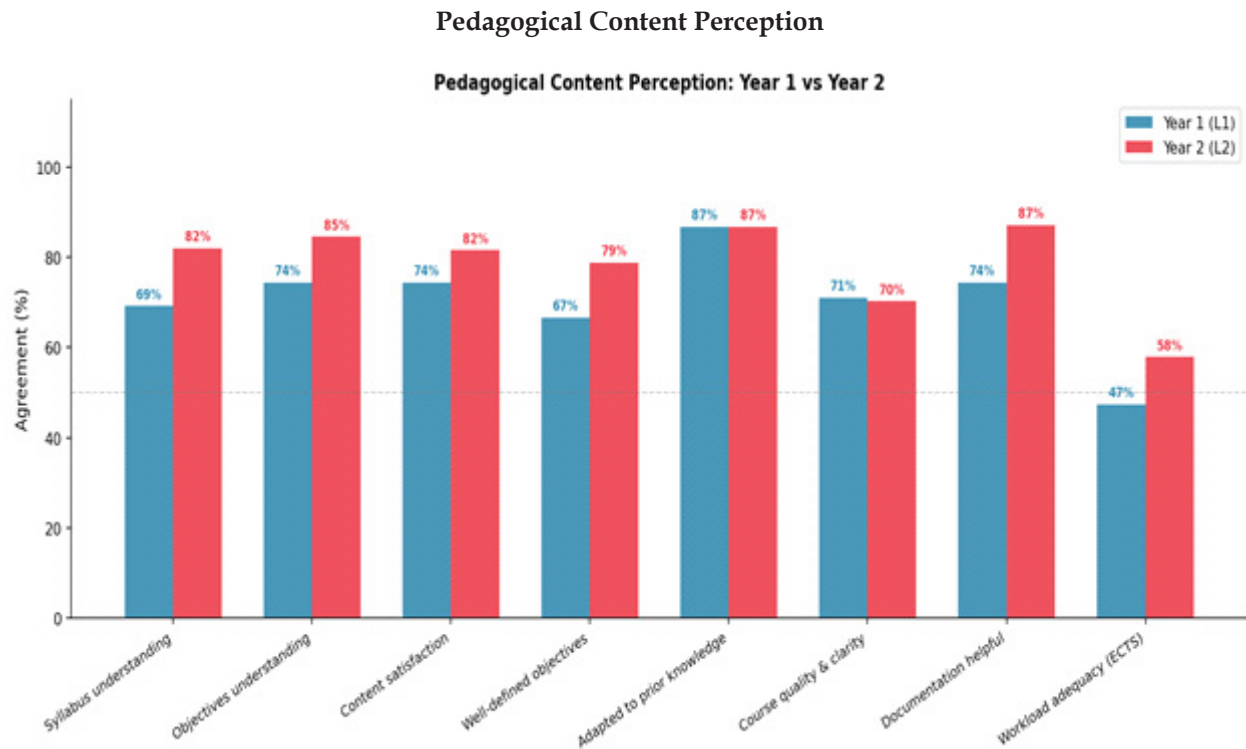
**Table III. Evolution of global perceptions of physiology between Year 1 and Year 2.**

Global Question	Response	Y1 (n = 39)	Y1 (%)	Y2 (n = 39)	Y2 (%)	Test & p-value
Perceived difficulty of physiology	Difficult	27	69.2%	8	20.5%	$\chi^2(2) = 20.30$ $p < 0.001$ *** (Chi-square test)
	Moderate	12	30.8%	24	61.5%	
	Easy	0	0.0%	6	15.4%	
Significant learning achieved in this course	Yes	19	48.7%	33	84.6%	$\chi^2(2) = 12.51$ $p = 0.002$ ** (Chi-square test)
	No	12	30.8%	2	5.1%	
	Not sure	7	17.9%	3	7.7%	
Overall appreciation of physiology teaching	Yes	36	92.3%	37	94.9%	$\chi^2(2) = 1.33$ $p = 0.513$ ns * Expected < 5
	No	1	2.6%	0	0.0%	
	Not sure	1	2.6%	2	5.1%	
Attending lectures is necessary to understand physiology	Yes	27	69.2%	17	43.6%	$\chi^2(2) = 6.54$ $p = 0.038$ * (Chi-square test)
	No	10	25.6%	14	35.9%	
	Not sure	2	5.1%	8	20.5%	
Physiology provided useful competencies for medical training	Yes	26	66.7%	39	100.0%	$G^2 = 14.59$ $p < 0.001$ *** (Likelihood-ratio; cell exp. < 5)

Statistical tests: Chi-square ( $\chi^2$ ) used for all variables; when expected cell counts < 5 (Q3, Q5), the likelihood-ratio statistic ( $G^2$ ) is additionally reported. Significance: \*\*\*  $p < 0.001$ , \*\*  $p < 0.01$ , \*  $p < 0.05$ , ns = not significant. All tests are two-tailed. Y1 n = 39, Y2 n = 39.

Perceived difficulty differed significantly between cohorts ( $\chi^2(2) = 21.4$ ,  $p < 0.001$ ): 69.2% of Y1 students rated physiology as 'difficult', compared to 20.5% in Y2; 15.4% of Y2 students rated it 'easy' while none in Y1 did so. Recognition of significant learning achieved rose from 48.7% in Y1 to 84.6% in

Y2 ( $p < 0.001$ ). The perceived utility of physiology for medical practice reached 100% in Y2, compared to 66.7% in Y1 (Fisher's exact test,  $p < 0.001$ ). The perceived necessity of attending lectures was reported by 69.2% of Y1 vs 43.6% of Y2 students ( $p = 0.028$ ). (table III).



**Figure 2. Pedagogical content perception: Year 1 vs Year 2 (% agreement). Dashed line at 50%.**

At the thematic level, pedagogical content perception is stable (3.83 vs 3.85/5;  $p=0.449$ ). Meaningful item-level shifts include: understanding that course progression reflects topic importance ( $\Delta=+16.1\%$ ;  $p = 0.492$ , ns), syllabus understanding

( $\Delta=+12.9\%$ ), and documentation quality ( $\Delta=+12.8\%$ ;  $p = 0.132$ , ns). Two items decline: clarity of exam expectations ( $\Delta=-13.9\%$ ;  $p = 0.129$ , ns) and adequacy of workload preparation for assessments ( $\Delta=-5.1\%$ ;  $p = 0.377$ , ns) (figure 2).

### Tutorial and Practical Sessions

**Table IV. Comparative perceptions of tutorial and practical sessions (Y1 vs Y2).**

Statement	Y1 agree (%)	Y2 agree (%)	$\Delta$	Sig.
Tutorial sessions (TD) improve understanding of physiology	76.9%	63.9%	-13.0%	ns
Practical sessions (TP) consolidate lecture concepts	60.5%	63.9%	+3.4%	ns
More motivated during TD/TP than during lectures	65.8%	57.1%	-8.7%	ns
Coursework prepares adequately for assessments	71.8%	66.7%	-5.1%	ns

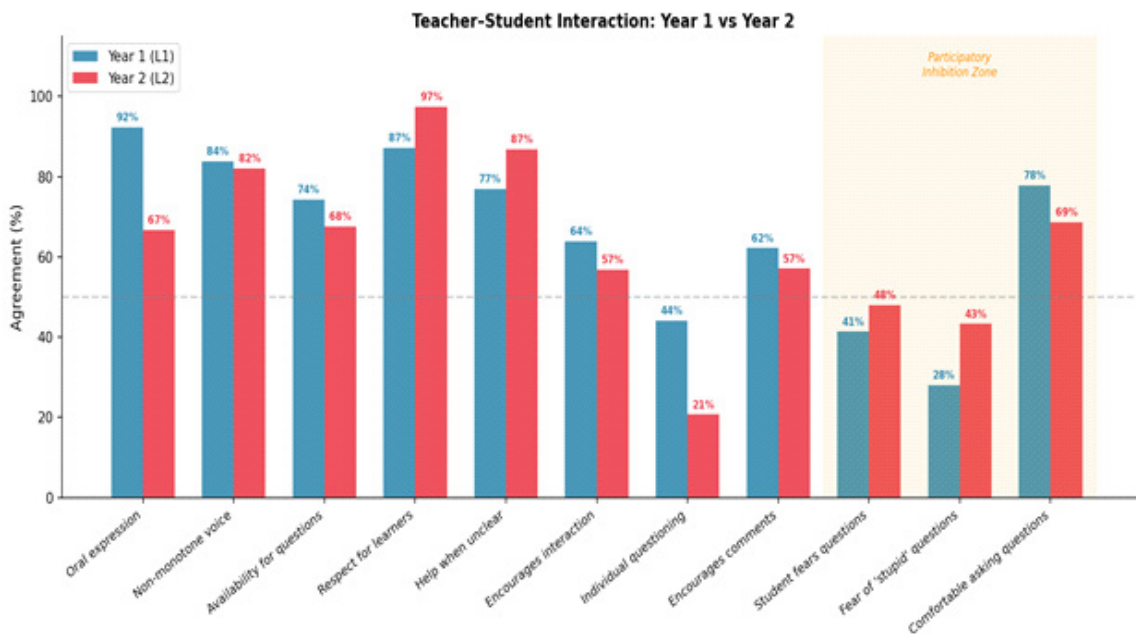
All differences are non-significant (Mann-Whitney U).

Agreement that TD improve understanding declines from 76.9% to 63.9% ( $\Delta=-13.0\%$ ; ns). Practical sessions are marginally better rated in Y2 ( $\Delta=+3.4\%$ ), despite material constraints (Section 3.5) (table IV).

### Teacher-Student Interaction

Interaction is stable overall (4.11 vs 4.13/5;  $p=0.462$ ). Strongest positive changes: respect for learners

( $\Delta=+10.2\%$ ; reaching 97.4% in Y2), interest in students ( $\Delta=+10.5\%$ ), and support when unclear ( $\Delta=+9.9\%$ ). Notable declines: blackboard use ( $\Delta=-25.6\%$ ), non-monotone voice ( $\Delta=-17.8\%$ ), and individual student questioning ( $\Delta=-23.4\%$ ). A key paradox: Y2 students more readily consult the instructor ( $\Delta=+20.1\%$ ) but simultaneously fear asking questions more ( $\Delta=+6.6\%$ ) and acknowledge greater difficulty understanding lectures (48.1% vs 29.0%) (figure 3).



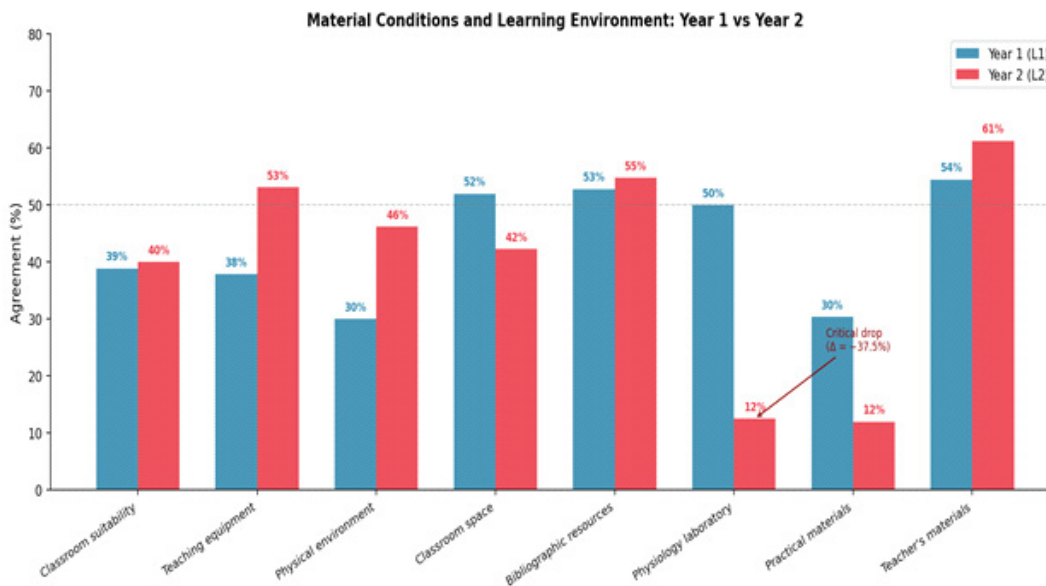
Orange zone highlights the participatory inhibition cluster.

Figure 3. Teacher-student interaction: Year 1 vs Year 2 (% agreement).

**Material Conditions and Learning Environment**

Two items show statistically significant and operationally critical declines. Laboratory availability collapses from 50.0% to 12.5% agreement ( $\Delta = -37.5\%$ ;

$p=0.001$ ). Practical materials availability falls from 30.4% to 12.0% ( $\Delta = -18.4\%$ ;  $p=0.023$ ). Classroom space adequacy also declines markedly.(figure 4).



Arrow marks critical laboratory availability drop ( $\Delta = -37.5\%$ ).

Figure 4. Material conditions: Year 1 vs Year 2.

**Assessment Methods**

Assessment perception improves significantly overall (3.61 vs 3.82/5;  $p<0.001$ ). Largest gains: sufficient exam duration ( $\Delta = +25.8\%$ ;  $p=0.006$ ),

question clarity ( $\Delta = +13.2\%$ ), and coherence with objectives ( $\Delta = +12.3\%$ ). The proportion finding questions within reach declines ( $\Delta = -14.8\%$ ), confirming increasing cognitive demand in Y2.

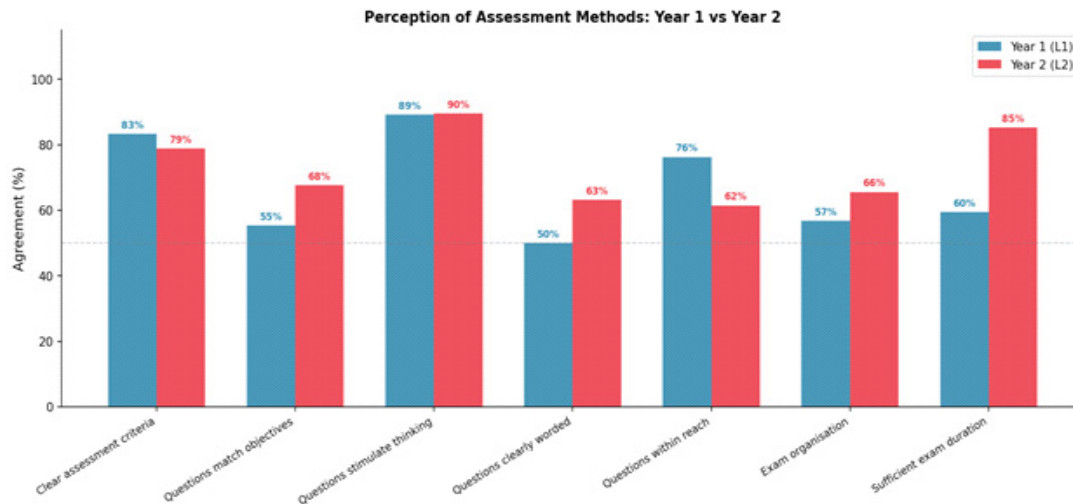
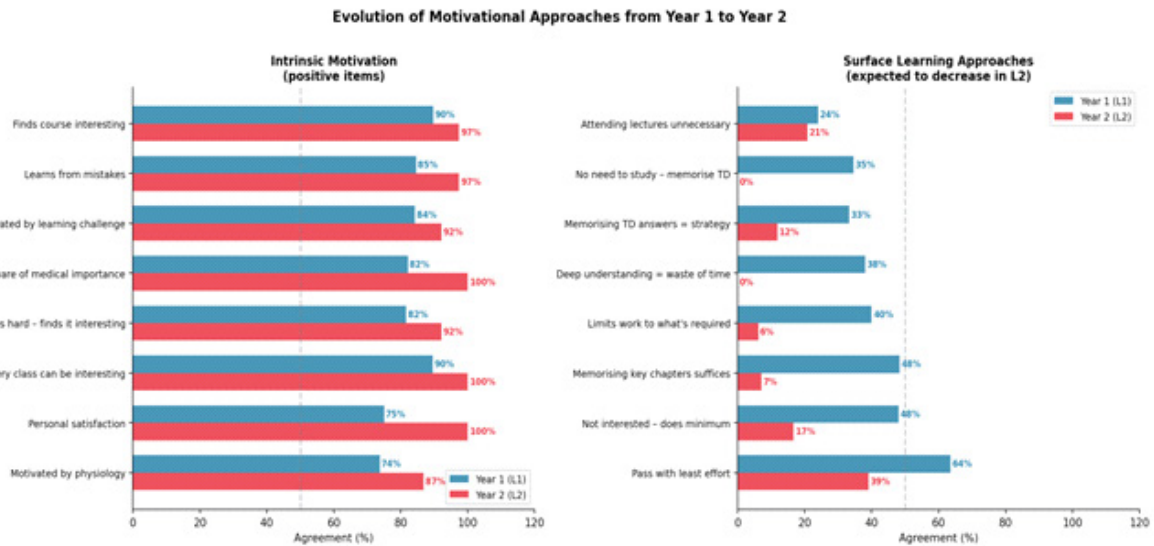


Figure 5: Perception of assessment methods: Year 1 vs Year 2.

### Student Motivation and Learning Strategies

Intrinsic motivation strengthens across all items. Awareness of physiology's medical importance reaches 100% in Y2 (vs 82.1%;  $p < 0.001$ ). Personal satisfaction becomes universal in Y2 (100% vs 75.0%;  $p < 0.001$ ). Surface learning approaches collapse: belief

that deep understanding is a waste of time drops from 38.1% to 0%; memorization sufficiency belief from 48.3% to 7.1% ( $\Delta = -41.2\%$ ). Active class participation declines ( $\Delta = -19.5\%$ ) while collaborative learning increases ( $\Delta = +7.9\%$ ).



Left: intrinsic motivation items (higher Y2 = positive). Right: surface learning items (lower Y2 = positive). Dashed line at 50%.

Figure 6: Evolution of motivational approaches from Year 1 to Year 2.

### Discussion

This comparative study provides systematic evidence of the pedagogical and motivational trajectory across the pre-clinical cycle at UADB. Three major phenomena structure the findings.

### Epistemological and Motivational Maturation

The simultaneous, large-magnitude, statistically robust strengthening of intrinsic motivation and collapse of surface learning approaches (both  $p < 0.001$ ) precisely illustrate what Self-Determination

Theory [4] predicts: sustained exposure to a discipline, combined with discovery of its concrete medical value, promotes internalization of motivation and authentic intrinsic engagement. This trajectory mirrors Marton and Saljö's deep learning model [6] and the progressive professional identity formation described by Cruess et al. [7].

The lower prevalence of perceived difficulty in the Y2 cohort (20.5% vs 69.2% in Y1) suggests a higher level of epistemic tolerance and more established adaptive learning strategies among senior pre-clinical students [8]. This comparative maturation is further supported by the work of Manyacka Ma Nyemb et al. in Saint-Louis [9], who observed that medical students in more advanced years favor stimulating and intuitive pedagogical methods compared to their junior counterparts. Their findings indicate that while traditional lectures remain a baseline, students at higher curriculum levels exhibit a stronger receptivity to active reasoning and collaborative learning. By integrating these perspectives, the differences observed between Y1 and Y2 at UADB reflect a contrast between the passive discovery characteristic of the first year and the more mastery-oriented approach prevalent in the second year.

However, as Kusurkar et al. [10] emphasize, sustaining this autonomous motivation requires an educational environment that actively supports these emerging strategies, suggesting that the 'participatory inhibition' observed in our cohorts could be mitigated by adopting the Problem-Based Learning (PBL) models successfully implemented at the UFR 2S.

### **The Paradox of Participatory Inhibition**

Y2 students simultaneously consult their instructor more (+20.1%) yet report greater fear of asking questions and heightened vulnerability to social judgement. This contradiction reflects a well-described metacognitive developmental pattern [11]: as learners become more aware of their knowledge gaps, they feel stronger needs for clarification but also heightened social exposure. In African higher education contexts [12], implicit classroom norms that valorise apparent competence amplify this inhibition. Evidence-based interventions, anonymous digital question platforms, think-pair-share, near-peer tutoring, can reduce inhibition without requiring cultural transformation [13, 14].

Moreover, our findings reveal a certain degree of participatory inhibition among students at UADB, a phenomenon that appears to be linked to the predominance of the lecture-based format and perceived material constraints. This observation aligns with the work of Manyacka Ma Nyemb et al. at the UFR 2S in Saint-Louis [15], who emphasize that active pedagogical approaches, such as Problem-Based Learning (PBL), serve as an effective lever to remove these barriers. Indeed, their study demonstrates that 92% of students consider these methods to be stimulating and intuitive, fostering adynamic interaction in small groups that reduces apprehension toward the discipline. Consequently, the introduction of Problem-Based Learning strategies in physiology at UADB could not only strengthen students' intrinsic motivation but also transform their posture from passive reception to an active and collaborative appropriation of complex concepts.

### **The Infrastructure Paradox**

The critical deterioration of laboratory access (-37.5%;  $p = 0.001$ ) and practical material availability (-18.4%;  $p = 0.023$ ) in Y2 represents a structural barrier precisely when students are most motivated for hands-on experimentation, recalling Vygotsky's Zone of Proximal Development [16]: the learning potential exists but the environment fails to provide the required scaffolding. WHO reports [17] consistently identify laboratory infrastructure gaps as primary barriers to biomedical science education quality in sub-Saharan Africa; the present data provide granular institutional evidence of this systemic challenge.

This institutional challenge is further corroborated by findings from the UFR 2S in Saint-Louis, where Manyacka Ma Nyemb and Ndoye [15] documented a similar tension between student engagement and material constraints. While their students reported high levels of interest in anatomy (scores > 9/10), the material conditions of the laboratories received significantly lower ratings (6.5/10), highlighting a regional trend where pedagogical enthusiasm often outpaces infrastructural support. By aligning our results with the Saint-Louis experience, it becomes evident that the 'Infrastructure Paradox' is not an isolated

occurrence at UADB but a recurring systemic barrier in Senegalese medical education. Addressing these gaps is therefore crucial, as local evidence suggests that while students remain resilient and motivated, the lack of adequate scaffolding, particularly during the transition to more advanced pre-clinical years, directly hinders the practical consolidation of fundamental physiological concepts.

### Strengths and Limitations

Strengths include simultaneous exhaustive sampling of both cohorts using an identical instrument, ensuring high internal validity. The multidimensional questionnaire (six domains, 80+ items) provides an unusually comprehensive profile. Non-parametric statistics appropriate to ordinal data are reported with effect magnitudes.

Limitations include the cross-sectional design (no true longitudinal tracking), cohort-specific confounding (notably the gender reversal), modest sample sizes ( $n=39$ ), self-report bias (partially mitigated by anonymity), and limited generalizability beyond comparable young African medical schools.

The modest sample sizes ( $n = 39$  per cohort) limit statistical power, particularly for subgroup analyses and detection of small effect sizes. Future studies should aim for larger, multi-institutional samples to enhance generalizability and power.

### Pedagogical Recommendations

**a. Infrastructure:** Urgent planned investment in Y2 laboratory facilities, practical equipment, and classroom capacity is required. The magnitude of laboratory decline ( $-37.5\%$ ) demands immediate institutional response; regional equipment-sharing partnerships should be explored.

**b. Participatory inhibition:** Structured, evidence-based strategies must be systematically implemented in Y2: anonymous digital question platforms, think-pair-share, interactive polling, and structured near-peer tutoring [13, 14, 18].

**c. Tutorial quality in Y2:** Progressive case-based formats, clearer TDlecture articulation, and structured feedback within tutorials would sustain the high motivation levels while reinforcing deep learning.

**d. Assessment communication:** Explicit communication of assessment expectations and criteria at the start of each Y2 semester would address the observed decline in perceived clarity of evaluation criteria.

### Conclusion

This cross-sectional comparative study documents a trajectory of remarkable pedagogical maturation from Year1 to Year2: consolidation of deep learning approaches, universal recognition of physiology's medical utility, and significant strengthening of intrinsic motivation, all statistically robust findings testifying to the fundamental effectiveness of the pre-clinical curriculum design despite significant resource constraints.

This positive trajectory is, however, structurally endangered by two persistent tensions: critical deterioration of practical material conditions in Y2, and the paradoxical intensification of participatory inhibition precisely when students are most motivated and metacognitively aware. Addressing these two challenges represents the highest-priority leverage for improving learning outcomes in the senior pre-clinical year.

Longitudinal studies tracking the same cohorts while incorporating academic performance metrics would allow causal inference and validation of these findings. The present study provides a robust empirical foundation and precise action agenda for evidence-informed physiology curriculum improvement across West African medical schools.

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