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# Translating Student Needs into Ergonomic Design: An Importance-Performance Analysis (IPA) for a University Student Desk

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## Abstract

**Background:** The university classroom functions as a high-risk work environment characterized by prolonged static sitting, leading to a high prevalence of musculoskeletal disorders (MSDs) among students. This issue is exacerbated by the mismatch between static, one-size-fits-all furniture and the ergonomic needs of modern laptop use, which also negatively impacts academic focus.

**Objective:** This study aims to demonstrate a systematic framework for identifying and prioritizing student needs for a new ergonomic desk design.

**Methods:** This study employs the Importance-Performance Analysis (IPA) methodology. A (hypothetical) cross-sectional survey was designed to gather quantitative data from (hypothetical) 250 students (N=250). Participants (hypothetically) rated the 'Importance' and 'Performance' (satisfaction) of various desk attributes. Mean scores for each attribute were plotted on a two-dimensional, four-quadrant IPA grid to identify strategic priorities.

**Results:** The (hypothetical) analysis identified four critical attributes in Quadrant I ("Concentrate Here"): "Height Adjustability," "Postural Support (for laptop use)," "Stability," and "Portability." These attributes were deemed highly important by students but had very low performance scores, indicating a significant failure of current furniture. Conversely, "Aesthetic Finish" was found in Quadrant IV ("Possible Overkill"), suggesting a potential misallocation of resources.

**Conclusion:** This paper presents a replicable IPA framework that successfully identifies critical performance gaps in university furniture. The findings provide a data-driven directive that the next generation of student desks must be dynamic, adjustable, and portable to support student well-being and academic performance. This study serves as a methodological demonstration using hypothetical data.

**Keywords:** Ergonomics, Importance-Performance Analysis (IPA), Product Design, University Furniture, Musculoskeletal Disorders (MSDs)

## 1. Introduction

The modern university classroom functions as a student's primary working environment [1]. This setting, however, is increasingly characterized by occupational hazards typically associated with sedentary office work [2].

The foremost risk is prolonged static sitting, a behavior endemic to academic life [3]. Students are often required to sit for extended lectures, while studying, and while completing assignments, frequently using computers or tablets [4]. Research quantifying this behavior has revealed alarming durations; one study of university students found they remained seated for an average of 13.4 hours per day [4].

This excessive sedentary behavior has well-documented physiological consequences [4]. Prolonged sitting is a direct contributor to the development of musculoskeletal disorders (MSDs) [5]. The prevalence of pain and discomfort among student populations is high, with the most frequent complaints localized in the head, neck, shoulders, and lumbosacral region [4].

A primary catalyst for these MSDs is the significant mismatch between the static, one-size-fits-all nature of traditional classroom furniture and the wide-ranging anthropometric characteristics of a diverse student body [1]. This incongruence forces students to adopt awkward or unnatural body positions for extended periods, leading to physical discomfort, joint stiffness, and poor posture [1].

The consequences of poor ergonomics in the classroom are not merely physical; they are intrinsically linked to academic outcomes. The design of the learning environment, particularly its furniture, has a profound impact on a student's ability to learn and engage [6]. Physical discomfort and pain function as significant distractions, negatively impacting the ability to focus, reducing concentration, and potentially leading to a lack of interest in the subject material [1]. Ergonomics, therefore, functions as a critical mediator for student engagement and learning outcomes [7].

Conversely, ergonomic interventions have demonstrated measurable benefits. Studies implementing adjustable-height desks and posture-supportive chairs found that students exhibited higher engagement and improved task performance [6]. A separate analysis noted that ergonomic design improvements led to significant decreases in muscle activity (40% in the neck, 44% in the lower back) and corresponding improvements in self-reported comfort and engagement [8]. This evidence supports the concept of "educational ergonomics," a field focused on the interaction between educational performance and educational design [9]. In this context, investing in ergonomic furniture is not a simple facilities upgrade but a direct, long-term investment in student well-being and academic success [6]. As higher education institutions increasingly focus on redesigning physical learning spaces to meet modern pedagogical demands [10-12], the ergonomic quality of student furniture becomes a central component of effective educational design.

The ergonomic challenge has been compounded by the technological evolution of the classroom. Traditional student desks were designed for static tasks like reading textbooks and writing in notebooks. They were not designed for the ubiquitous use of laptops, which are now standard educational tools [13]. The design of a laptop, with its screen and keyboard fixed in close proximity, is inherently non-ergonomic and a known contributor to pain in the wrists, neck, and back [13].

Students attempt to compensate for this poor design by adopting various postures—such as sitting cross-legged or in a semi-fowler's position—which can lead to persistent and irreversible discomfort when maintained for long periods [13]. This highlights a critical design gap: the need for furniture that is not only ergonomically sound in a traditional sense but is also adaptable to modern technology use [13]. Furthermore, modern pedagogy emphasizes flexible and collaborative learning [14], requiring furniture that is movable and can be reconfigured, a feature not present in most heavy, static desk designs [15].

The inadequacy of current furniture presents a clear product design opportunity. However, to be successful, a new design must be rigorously grounded in the specific, prioritized needs of its end-users: the students.

Therefore, this study aims to identify and prioritize student needs for a new desk design. To achieve this, the study employs the Importance-Performance Analysis (IPA) methodology, which is a cornerstone of customer-oriented needs analysis [16-18] and a core competency within the field of Industrial Engineering [19].

This study will use the IPA technique to quantitatively analyze (hypothetical) questionnaire data. The goal is to identify and prioritize student needs for a new desk by evaluating the 'importance' they place on specific attributes against the 'performance' (or satisfaction) of their current furniture [16]. This IPA approach ensures that future design efforts can be strategically focused on the attributes that matter most to students and are currently failing.

## 2. Method

### 2.1. Research Framework

This study utilized a quantitative design. The methodology was structured in a single phase of data collection and analysis. A cross-sectional survey was designed to be administered to a representative sample of university students, paralleling data collection methods used in similar ergonomic and student comfort studies [1]. The data from this (hypothetical) survey serve as the quantitative input for the Importance-Performance Analysis (IPA).

### 2.2. Importance-Performance Analysis (IPA)

#### 2.2.1. Data Collection and Instrumentation

A hypothetical questionnaire was developed to gather student perceptions. The instrument's attributes were derived from a review of literature on educational ergonomics, MSDs, and furniture design [1], as well as from (hypothetical) preliminary focus groups with students to capture the Voice of the Customer (VOC). This aligns with standard practices for attribute selection in IPA studies.

For each identified attribute (e.g., "Adjustable height," "Sufficient work surface," "Portability," "Stability"), participants would be asked to provide two ratings on separate 5-point Likert scales:

- **Importance:** "How important is this feature to you in a student desk?" (1 = Not at all Important, 5 = Extremely Important).
- **Performance (Satisfaction):** "How satisfied are you with this feature on your current student desk?" (1 = Not at all Satisfied, 5 = Extremely Satisfied).

#### 2.2.2. Analytical Technique (IPA)

The study employed Importance-Performance Analysis (IPA), a strategic planning technique first proposed by Martilla and James (1977) [20]. IPA is widely used for needs analysis and strategic planning in product design [16] because it allows for the simultaneous evaluation of consumer satisfaction as a function of both expectations (importance) and perceived performance [20].

For the analysis, the mean score for "Importance" and the mean score for "Performance" were (hypothetically) calculated for each attribute. These paired means were then plotted as coordinates on a two-dimensional grid. The Y-axis represented "Importance," and the X-axis represented "Performance". The grid was then divided into four quadrants by cross-axes. Following standard procedure, these axes were set at the grand mean scores for all attribute importance ratings and all attribute performance ratings, respectively [21, 22].

#### 2.2.3. IPA Quadrant Definitions

Each of the four quadrants on the IPA grid corresponds to a distinct strategic action directive, providing a clear map for design prioritization [20].

- **Quadrant I:** "Concentrate Here" (High Importance, Low Performance). Attributes that fall into this quadrant are critical to students but are perceived as being very poorly delivered by current solutions [23]. These attributes represent the highest priority for improvement and resource allocation. Focusing design efforts here is expected to yield the greatest increase in student satisfaction [16].
- **Quadrant II:** "Keep Up the Good Work" (High Importance, High Performance). Attributes in this quadrant are key strengths. They are highly valued by students, and their performance is perceived as high [23]. The design mandate for these attributes is to maintain this high level of performance.
- **Quadrant III:** "Low Priority" (Low Importance, Low Performance). These attributes are unimportant to students, and their performance is also low [23]. They represent minimal concerns and should not be a focus of design efforts.
- **Quadrant IV:** "Possible Overkill" (Low Importance, High Performance). Attributes in this quadrant are performing well, but students do not place a high value on them [23]. This suggests that resources (e.g., cost, manufacturing complexity) may be over-allocated to these features and could potentially be diverted to address the critical deficiencies in Quadrant I.

The primary output of this IPA phase is a strategically validated list of customer needs. The attributes identified in Quadrant I ("Concentrate Here") form the focused "Voice of the Customer" (VOC) requirements that serve as the basis for design recommendations.

## 3. Results and Discussion

### 3.1. Prioritizing Student Design Needs: IPA Results

The (hypothetical) analysis of the survey data (N = 250) yielded the Importance-Performance Analysis (IPA) grid, for which a selection of key attributes is presented in Table 1. The grand mean for Importance was (hypothetically) 3.85, and the grand mean for Performance was (hypothetically) 2.70, establishing the axes for the four quadrants.

**Table 1:** Importance-Performance Analysis (IPA) Matrix for Student Desk Attributes

| Quadrant | Attribute | Importance (Mean) | Performance (Mean) |
|---|---|---|---|
| I: Concentrate Here (High Imp, Low Perf) | 1. Height Adjustability | 4.72 | 1.85 |
| | 2. Postural Support (for laptop use) | 4.65 | 1.90 |
| | 3. Stability (does not wobble) | 4.40 | 2.45 |
| | 4. Portability (easy to move) | 4.10 | 2.15 |
| II: Keep Up the Good Work (High Imp, High Perf) | 5. Sufficient Surface Area | 4.55 | 4.10 |
| | 6. Durability / Robustness | 4.05 | 3.80 |
| III: Low Priority (Low Imp, Low Perf) | 7. Built-in USB/Power Ports | 2.80 | 2.05 |
| | 8. Complex Storage (drawers) | 2.50 | 2.30 |
| IV: Possible Overkill (Low Imp, High Perf) | 9. Aesthetic Finish (wood grain) | 2.95 | 3.90 |
| | 10. Brand Name | 1.75 | 3.10 |

The results from the IPA provide clear, actionable, strategic direction. The discussion focuses primarily on Quadrant I, which identifies the most critical design failures from the student's perspective.

The (hypothetical) placement of "Height Adjustability" and "Postural Support (for laptop use)" as the attributes with the highest importance and lowest performance directly corroborates the literature. This finding quantitatively confirms that the mismatch between static furniture and diverse student bodies [1] and the specific ergonomic risks of laptop use [13] are not just theoretical problems but are the primary sources of student dissatisfaction. The low performance scores (1.85 and 1.90) indicate an almost complete failure of current furniture to meet these critical needs.

Furthermore, the (hypothetical) placement of "Stability" and "Portability" in Quadrant I reveals a key tension in student needs. Students desire desks that are stable and do not wobble (a major source of distraction), but they also desire portability. This reflects the shift in learning environments from static lecture halls to flexible, collaborative spaces [14], a need not met by current heavy, fixed-position desks.

Conversely, Quadrant IV ("Possible Overkill") yields an equally important strategic insight. The (hypothetical) finding that "Aesthetic Finish" is performing well but is of low importance suggests that current manufacturing resources are being misallocated. Students, while appreciating a clean look, overwhelmingly prioritize functional ergonomics over superficial appearance. This insight allows the design team to justifiably divert costs and resources away from expensive finishes and toward the complex mechanisms required to address the Quadrant I attribute, such as "Height Adjustability."

## 4. Conclusion

This study successfully demonstrated a systematic Importance-Performance Analysis (IPA) framework for identifying and prioritizing latent and explicit student needs for a new ergonomic university desk. The methodology provides a replicable pathway for evidence-based product design in the educational sector.

The (hypothetical) IPA results identified a critical performance gap between student expectations and the reality of current university furniture. Key functional attributes, specifically "Height Adjustability," "Postural Support (for laptop use)," "Stability," and "Portability," were (hypothetically) identified as "Quadrant I" priorities—highly important to students but performing very poorly.

The primary implication of this study is a clear and data-driven design directive: the next generation of student desks must be dynamic, adjustable, and portable. Static, one-size-fits-all furniture is no longer adequate for the physiological and pedagogical needs of a modern university. The findings provide a strong justification for designing desks that can be adjusted to individual student anthropometry and accommodate the specific ergonomic challenges of prolonged laptop use.

For educational institutions and administrators, this study reframes the procurement of classroom furniture. Such purchases should not be viewed as a simple facilities expenditure but as a strategic, long-term investment in "educational ergonomics" [9]. By mitigating the significant health risks of MSDs [4] and reducing the physical distractions that impede focus [6], ergonomic furniture can yield tangible returns in student well-being, engagement, and overall academic performance [6].

## 5. Limitations and Future Research

This study presents a methodological framework based on (hypothetical) survey data. A primary limitation of the hypothetical study is that the sample would likely be drawn from a single institution, which may limit the generalizability of the specific attribute weightings.

The conclusions of this paper serve as the foundational "Product Definition" phase of the product development cycle. The logical next steps for future research are to proceed with this cycle. Specifically, future research should take the Quadrant I ("Concentrate Here") attributes identified in this IPA and translate them into measurable technical and engineering specifications. A common methodology for this translation is Quality Function Deployment (QFD), which would serve as the critical bridge between the identified student needs and the engineering blueprint for a functional prototype.

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