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Research Protocol

Comparing the Effectiveness of Heutagogy-Driven Micro- module Creation with (Versus) Traditional Teaching-Learning Methods in Early Medical Education: A Mixed-Method Protocol

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ABSTRACT

Background: Phase 1 MBBS medical education in India is traditionally content-heavy and teacher-centred, frequently causing student dissatisfaction and cognitive overload. While the National Medical Commission (NMC) mandates active, student-centred strategies, empirical evidence regarding heutagogy—self-determined learning—remains sparse within the Indian context. Grounded in Self-Determination Theory (SDT), this study introduces student-designed micro-modules to foster critical metacognitive reflection, peer learning, and active learner capability.

Objective: To implement and compare the effectiveness of heutagogy-driven micro-module creation against traditional didactic teaching-learning methods on the self-directed learning readiness and psychological need satisfaction of first-year medical students.

Methods: This 8-week mixed-methods quasi-experimental study will be conducted at the Parul Institute of Medical Sciences, Vadodara, India. A sample of 150 first-year MBBS students will be divided into intervention (n = 75) and control (n = 75) groups using purposive stratification. The intervention group will collaboratively design 10–15 minute anatomy micro-modules, while the control group undergoes standard didactic lectures. Quantitative data includes pre- and post-intervention scores from the refined 30-item Self-Directed Learning Readiness Scale (SDLRS) and Autonomy, Competence, Relatedness (ACR) questionnaires. Qualitative insight will be gathered through thematic analysis of student reflection logs and focus group discussions.

Results: The detailed results will be published in subsequent reports.

Conclusions: Shifting the pedagogical paradigm toward heutagogy via microlearning mini-projects holds significant promise for cultivating lifelong learning capabilities. This approach successfully balances instructional innovation with formal curriculum requirements, directly supporting the operationalization of India's competency-based medical education framework.

KEYWORDS: Heutagogy, Microlearning, Medical Education, Self-Determined Learning, Self-Directed Learning Readiness.

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INTRODUCTION

For decades, undergraduate medical education in India, particularly the foundational Phase 1 MBBS curriculum, has remained highly teacher-centric and heavy on core content. Students stepping into medical colleges are suddenly introduced to a vast sea of anatomical and physiological concepts. This volume often forces them into passive rote memorization rather than building conceptual clarity.

To address this issue, the National Medical Commission (NMC) rolled out the Competency-Based Medical Education (CBME) framework. This major policy shift explicitly mandates a transition toward student-centred pedagogies, cutting down traditional lecture hours to make room for active learning strategies like Early Clinical Exposure and integrated instructional modules [1].

However, despite these clear policy goals, a practical implementation gap persists in daily classroom dynamics. First-year medical undergraduates still experience minimal autonomy over how they learn or what creative resources they can build. The challenge before educators today is to find active learning tools that balance strict regulatory alignment with meaningful learner independence.

Theoretical Framework:

Heutagogy and Self-Determination Theory

This study proposes a deliberate shift beyond basic pedagogy and self-directed andragogy toward heutagogy (self-determined learning). While andragogy lets learners work independently within teacher-defined boundaries, heutagogy empowers them to navigate their own learning tracks, design resources, and engage in “double-loop learning”. This is a reflective process where students question their own underlying assumptions and adapt their learning styles accordingly [2,3].

As established by Blaschke and Hase, heutagogy focuses on building lifelong capability rather than simple content competency. This intervention is theoretically anchored in Self-Determination Theory (SDT) by Deci and Ryan, which posits that a learner’s intrinsic motivation and academic achievement thrive when three basic psychological needs are met:

· **Autonomy:** Having a genuine voice and choice in the learning process.

· **Competence:** Engaging with optimal challenges that build professional confidence.

· **Relatedness:** Experiencing connection and belonging with peers and mentors[3].

Prior empirical assessments, such as those by Feri and colleagues (2016) [4], demonstrate that autonomous motivation directly predicts academic success in medical students. Furthermore, recent global synthesis by Panta and colleagues (2025) [2] underscores that while heutagogy fosters agency, its effectiveness remains context-dependent, highlighting a clear need for structured institutional trials.

The Rationale for Student-Designed Micro learning

To introduce heutagogy smoothly without inducing cognitive fatigue, this study utilizes microlearning—the practice of breaking down complex, extensive topics into compact, bite-sized units. Instead of merely consuming pre-fabricated digital media, the intervention requires students to become creators.

When first-year MBBS students collaboratively design 10-to-15-minute anatomy micro-modules, they step into higher-order cognitive domains within Bloom’s Revised Taxonomy. They are required to filter core clinical facts, organize complex information logically, select appropriate media, and anticipate peer learning gaps. This exercise moves the student from a passive spectator to an active instructional designer. Concurrently, the faculty member shifts from a traditional lecturer to a supportive, non-controlling coach.

Theoretical Model: Self-Determined Learning (Heutagogy)

The Concept of Heutagogy and the PAH Continuum

The conceptual framework of this study is rooted in Heutagogy, a term originally coined by Stewart Hase and Chris Blaschke, which defines learning as a self-determined process. Within the traditional Indian medical

education setup, instructional delivery typically relies on *Pedagogy* (teacher-directed learning, where the faculty decides what and how to learn). As students progress, they encounter *Andragogy* (self-directed learning, where students gain independence but still operate within teacher-defined boundaries and structures) [2,5,6].

Heutagogy represents the final evolution of this continuum—the Pedagogy-Andragogy-Heutagogy (PAH) continuum. It shifts the focus entirely from teacher-centric content delivery to learner-determined capability development. Under this model, first-year MBBS students do not just absorb static anatomical information; they exercise absolute agency over their learning tracks, collaborate on resource creation, and define their own evaluative processes [3,6].

The Double-Loop Learning Mechanism

A key differentiator of the heutagogical model is its reliance on Double-Loop Learning, a concept critical to forming lifelong medical professionals.

· **Single-Loop Learning:** Focuses on detecting an error and fixing it to achieve a specific, immediate outcome (e.g., memorizing the branches of the brachial plexus to pass an anatomy viva).

· **Double-Loop Learning:** Takes reflection a step deeper. It requires learners to look inward and question their own underlying assumptions, learning methodologies, and mental models (e.g., reflecting on *how* they processed the anatomical structures, identifying gaps in their spatial understanding, and modifying their study strategies for future complex topics) [7].

Theoretical Synergy with Self-Determination Theory (SDT)

Heutagogy operationalizes the psychological principles of Self-Determination Theory (SDT) by Deci and Ryan. SDT argues that intrinsic motivation and deep cognitive engagement are unlocked only when a learning environment satisfies three basic psychological needs:

· **Autonomy:** Students are given the freedom to choose their topics, design micro-modules, and manage their peer learning loops.

· **Competence:** The act of synthesizing vast clinical and anatomical data into a concise, 10–15 minute micro-module provides an optimal, highly rewarding cognitive challenge.

· **Relatedness:** Working in self-selected teams of 4–5 fosters peer-to-peer connection, collaborative problem-solving, and a strong sense of community. [5]

The application of this theoretical model in contemporary medical education is supported by a robust literature base:

· **Learner Agency and Capability:** Recent global literature syntheses, such as the comprehensive review by Panta et al. (2025) [2], highlight that heutagogy excels at fostering learner agency, encouraging deep self-reflection, and seamlessly integrating digital tools to support autonomous study designs.

· **The Indian Context and Feasibility:** While historically underutilized in Indian medical colleges due to rigid curricular boundaries, studies like those by Bansal et al. (2020) [7] have mapped undergraduate medical students' perceptions, showing that learners naturally desire a shift up the PAH continuum toward greater autonomy.

· **Validation of Heutagogical Tools:** The movement toward local adaptation is further backed by Poorvi Kulshreshtha et al. (2025) [8], who successfully developed and validated comparative questionnaires specifically designed to assess heutagogical methods within the Indian medical education landscape.

· **Predicting Success via SDT:** In medical environments, Feri et al. (2016) [4] demonstrated that high levels of autonomous motivation directly predict superior academic achievement. Interestingly, their work also highlighted that *relatedness* serves as a massive predictor of clinical decision-making performance, underscoring why collaborative module creation is pedagogically superior to isolated self-study.

The Research Gap

While international literature demonstrates the value of heutagogical frameworks in health professions education, empirical studies with in the Indian MBBS ecosystem remain scarce. Indian medical faculties frequently encounter a tension between experimenting

with educational innovations and adhering to tight curriculum schedules or strict assessment rigour. Conversely, our previous work reveals that first-year students are open to greater autonomy in learning design.

This study bridges this gap by embedding structured, student-led microlearning mini-projects within the standard anatomy curriculum, utilizing well-validated tools like Guglielmino's Self-Directed Learning Readiness Scale (SDLRS) to measure concrete quantitative and qualitative outcomes.

Study Questions and Objectives

To address these issues systematically, this protocol seeks answers to the following core questions:

1. What are the operational feasibility and implementation barriers to introducing heutagogy in early MBBS curricula?

2. Does student-designed micro-module creation significantly enhance self-directed learning readiness scores compared to traditional didactic learning?

3. How do students perceive the development of their basic psychological needs (autonomy, competence, relatedness) through these heutagogical mini-projects?

4. What is the pedagogical quality and value of student-created anatomical learning resources?

AIM

To evaluate the effectiveness of a heutagogy-driven micro-module creation framework compared with traditional didactic teaching-learning methods in early medical education.

METHODOLOGY

Study overview: This protocol outlines a mixed-methods educational intervention designed to examine the operational feasibility and pedagogical impact of shifting from teacher-led instruction to self-determined learning (heutagogy) in early medical education. The study addresses the heavy cognitive load inherent to Phase 1 of the Bachelor of Medicine, Bachelor of Surgery (MBBS) curriculum in India by introducing student-led digital micro-modules. Framed within Self-Determination Theory (SDT), the protocol evaluates whether active resource design cultivates intrinsic motivation, learner autonomy, and long-term lifelong learning readiness. The study is designed to align strictly with the National Medical Commission's (NMC) Competency-Based Medical Education (CBME) framework and complies with the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines.

Design

This study employs a mixed-methods quasi-experimental design featuring a non-equivalent control group setup with an embedded qualitative inquiry. Methodological mixing follows an explanatory sequential strategy. Quantitative outcome strands will be gathered and analysed first to determine statistical significance and educational effect sizes. Subsequently, qualitative data will be collected and explored to provide deep, context-specific insights into how and why the heutagogical intervention influenced or altered student learning patterns.

Sample size

The study population consists of first-year undergraduate medical students. A total sample size of N = 150 students will be recruited through purposive sampling. To balance baseline variables and minimize the selection bias native to quasi-experimental designs, the sample will be stratified across academic performance quartiles based on entry-level parameters. Participants will then be allocated into two distinct cohorts: Intervention Group: n = 75 students who will engage in collaborative, heutagogy-driven micro-module design. Control Group: n = 75 students who will concurrently undergo standard, faculty-led didactic teaching.

Inclusion criteria

· Students officially enrolled in the first-year MBBS Phase 1 curriculum during the 2025–2026 academic year at the host institute.

· Students who maintain an attendance threshold of at least 80% across all scheduled study sessions (both intervention and control tracks).

· Students demonstrating voluntary willingness to complete all pre- and post-intervention

psychometric scales, topic exams, and reflection logs.

· Provision of written informed consent by the student (along with formal parental permission for any participant under 18 years of age).

Exclusion criteria

· Students with formally documented learning disabilities, unless specific institutional accommodations allow for equitable participation without altering study parameters.

· Students who explicitly choose to withdraw their consent or exit the study mid-intervention.

· Students who encounter prolonged logistical interruptions, resulting in consecutive absences exceeding 2 weeks during the 8-week intervention block.

Data Collection Scales

The study incorporates four distinct quantitative instruments to measure educational outcomes:

· **Refined 30-Item Self-Directed Learning Readiness Scale (SDLRS):** This refined instrument breaks down readiness into five core subdomains (6 items per domain) scored on a 5-point Likert scale, yielding a total score range of 30–150. It features strong internal consistency (Cronbach's alpha $\geq$0.75) and measures independent learning initiative and effective self-concept.

· **Autonomy, Competence, and Relatedness (ACR) Questionnaire:** A 12-item adapted scale (4 items per SDT domain) scored on a 6-point Likert scale to evaluate basic psychological need satisfaction. Reliability values range from Cronbach's alpha = 0.73 (autonomy) to alpha = 0.86 (relatedness).

· **Micro-Module Quality Assessment Rubric:** An analytical evaluation metric used by two independent, blinded faculty experts to assess student-created content across four criteria: accuracy/depth, pedagogical clarity, interactivity, and creativity. Each domain is scored from 0–25 points, totalling 100 points. Inter-rater agreement will be checked via Intra-class Correlation Coefficients (ICC).

· **Topic-Specific Academic Assessment Exam:** A validated testing instrument comprising multiple-choice questions (MCQs) and short-answer questions targeted at measuring short-term knowledge retention on the selected anatomical subjects.

Procedures

The study spans a tight chronological window of 8 weeks within the first semester, executed as follows:

· **Week 1:** Administration of baseline demographic forms, SDLRS, and ACR scales to both cohorts.

· **Week 2:** The control group initiates standard didactic tracks. The intervention cohort undergoes a structured orientation on heutagogical principles, double-loop learning, and micro-module architecture. Students assemble into self-selected teams of 4–5.

· **Weeks 3–6 (Active Creation Phase):** Intervention teams select a discrete anatomy topic (e.g., brachial plexus, coronary circulation) not yet covered via formal lectures. Teams execute literature searches, map learning objectives using Bloom's revised taxonomy, select digital media (infographics, quizzes), and draft a 10–15 minute digital module. Structured peer-feedback loops are completed weekly. The faculty facilitator functions exclusively as a non-controlling coach. Concurrently, control students receive standard anatomy lectures (2 hours) and practical laboratory demonstrations (2 hours) on parallel content.

· **Week 7:** Intervention teams deliver their completed micro-modules to their peers and facilitator during interactive feedback sessions.

· **Week 8:** Post-intervention data collection is finalized. Both groups sit for the identical topic-specific academic exam and complete post-intervention SDLRS and ACR questionnaires. Intervention students submit their final weekly reflection logs, and selected sub-samples from both cohorts proceed to focus group discussions.

Data analysis plan

Quantitative analyses will be conducted using statistical packages, with a primary significance threshold of alpha = 0.05 (two-tailed). Continuous data distributions will first undergo Shapiro-Wilk testing for normality and

Levene's testing for homogeneity of variance. Pre- to post-test adjustments within each group will be performed using paired t-tests (or Wilcoxon signed-rank tests for non-parametric data). Primary between-group comparisons for the post-intervention SDLRS, ACR, and exam scores will be performed using independent-samples t-tests and Analysis of Covariance (ANCOVA), treating baseline scores as covariates to isolate the net intervention effect. Calculated effect sizes will be reported as Cohen's d with 95% confidence intervals. Subgroup stratifications will examine differences by gender, baseline motivation, and prior 12th-grade academic marks.

Qualitative data from reflection journals will be evaluated using Braun and Clarke's six-phase thematic analysis framework. Text blocks will be systematically catalogued using TAGUETTE software to draw out primary thematic clusters. The final phase involves data triangulation, where qualitative thematic mechanisms are mapped directly against quantitative score changes to form a cohesive explanatory narrative.

Focus Group Discussion

To explore participants' lived experiences, semi-structured focus group discussions (FGDs) will be conducted at the end of Week 8. A purposive sub-sample of n = 15 intervention participants will be split into 3 separate FGDs (5 students per session), while n = 10 control participants will be assigned across 2 separate sessions.

Discussions will rely on a pre-validated, open-ended interview guide exploring perceived changes in professional confidence, operational barriers to micro-module construction, peer-group relationship dynamics, and structural recommendations for institutional scaling. Every session will be audio-recorded with participant consent, transcribed verbatim, and de-identified. Coding records will be cross-checked by two independent analysts to maintain an inter-rater coding reliability threshold of Cohen's kappa $\geq$ 0.75, with any conceptual discrepancies resolved via third-party academic arbitration.

RESULTS

Expected outcomes and deliverables

Empirical evidence on heutagogy effectiveness

· **Quantified learner metrics:** the study expects to generate clear empirical data on quantified variations in students' self-directed learning readiness (SDLR), basic psychological need satisfaction, and objective academic achievement.

· **Curricular policy insights:** these combined quantitative and qualitative outcomes will provide the necessary evidence base to inform whether heutagogical models merit broader, systematic implementation within indian medical college curricula.

Implementation framework and guidelines

· **Practical scalability guide:** by drawing out qualitative insights regarding real-world implementation barriers, operational facilitators, and faculty perspectives, the study will yield a structured, practical guide for scaling up heutagogy in medical education.

Validated evaluation tools

· **Educational instruments:** the project will deliver a refined, standalone micro-module quality assessment rubric and a dedicated reflection assessment framework.

· **Resource sharing:** these newly compiled metrics and evaluation frameworks will be made openly available for use and adaptation by other medical educators.

Focus areas: the final dissemination outputs will place special emphasis on educational effect sizes, actual implementation feasibility, and long-term implications for the national medical commission's (NMC) competency-based medical education (CBME) frameworks.

Long-term institutional impact

Curricular mapping: the final findings will directly inform localized curricular decisions at the parul institute of medical sciences regarding how to seamlessly integrate heutagogy into the phase 1 MBBS curriculum.

Disciplinary scaling: the framework holds potential for future scaling beyond anatomy to physiology and other foundational preclinical disciplines.

DISCUSSION

Shifting along the pah continuum in indian medical education

Traditional undergraduate medical training in India has historically prioritised *pedagogy*, where the faculty member completely dictates the instructional pathway, leaving students to manage massive cognitive overload through rote memorisation. While the national medical commission's (NMC) competency-based medical education (CBME) framework explicitly calls for a reduction in standard lecture hours and a transition toward student-centric modules, true learner agency is rarely achieved in day-to-day activities [1,9].

This study moves intentionally along the Pedagogy-Andragogy-Heutagogy (PAH) Continuum. Unlike andragogy, which allows self-direction within pre-defined curricular boundaries, heutagogy empowers students to select resources, map conceptual linkages, and actively design learning materials [10,11].

This transition is supported by Bansal et al. (2020) [7], whose work on indian medical undergraduates highlighted that while students are traditionally exposed to pedagogy, they demonstrate clear readiness and a strong preference for transitioning up the PAH continuum toward heutagogical interventions. By positioning first-year students as content creators rather than passive consumers, this protocol directly answers that student preference.

2. Operationalizing self-determination theory (SDT)

A key strength of embedding heutagogy within an anatomy curriculum is its alignment with the psychological framework of self-determination theory (SDT) by Deci And Ryan (2008) [5]. SDT establishes that deep cognitive engagement and intrinsic motivation rely on satisfying three basic psychological needs: autonomy, competence, and relatedness.

The active creation of micro-modules operationalizes these needs:

· **Autonomy:** students exercise meaningful choices regarding media integration, group workflows, and content chunking.

· **Competence:** distilling complex anatomical structures into logical, digestible components provides an optimal cognitive challenge that builds professional confidence.

· **Relatedness:** the collaborative structure of self-selected teams (4–5 students) coupled with peer-review feedback loops builds a supportive learning community.

This multi-dimensional support is reflected in medical education literature. Feri et al. (2016) [4] demonstrated that autonomous motivation significantly and directly predicts higher academic achievement among medical students (beta = 15.2, p = 0.004). Interestingly, their findings also highlighted that *relatedness* emerged as the most powerful predictor of clinical decision-making performance. This underscores why collaborative group projects are pedagogically superior to isolated self-study. Furthermore, as noted by babenko and lee (2022) [9], content competence alone is insufficient; medical training must explicitly nurture the psychological well-being and autonomous drive of the learner to prevent early burnout.

Microlearning as a tool for managing cognitive overload

Medical students in their first semester often face cognitive fatigue when trying to process extensive anatomical data. This protocol utilizes microlearning—the practice of breaking down broad, complex subjects into narrow, bite-sized units of 10–15 minutes—as a cognitive scaffolding tool.

According to scoping reviews by De Gagne et al. (2019) [6] and conceptual work by thillainadesan et al. (2022) [11], microlearning in health professions education is highly effective because it respects the boundaries of working memory. It relies on principles of simplicity, immediate clinical relevance, and accessibility.

By incorporating Bersin's four key efficiencies of microlearning, this protocol ensures that student-designed modules achieve [12]:

1. Compactness
2. Discrete topic design
3. Strategic interactive activities
4. Built-in opportunities for repeated practice

When students are tasked with *authoring* these micro-units, they move into the highest tier of bloom's revised taxonomy (creation), forcing them to anticipate peer learning gaps and logically organise clinical relationships.

Cultivating lifelong learning via double-loop learning

A core objective of this research is measuring changes in self-directed learning readiness (SDLR) Using Guglielmino's [13] refined 30-item scale. Globally, tracking SDLR is vital; research indicates that between 32.9% and 64% of first-year medical undergraduates score below average in self-directed readiness, leaving them poorly prepared for an evolving clinical landscape. This gap has been further validated by Lim and Willey (2024) [14] in their recent structural refinement of the scale for medical cohorts.

Heutagogy addresses this readiness gap by driving double-loop learning. As articulated by Blaschke and Hase (2015) [3], single-loop learning centres on solving an immediate problem or mastering a fact to pass a test. Double-loop learning occurs when students use reflective journals to question their own underlying learning assumptions, identify personal cognitive biases, and actively alter their study habits.

This protocol's use of weekly reflection logs provides a mechanism to capture this metacognitive growth, steering students toward long-term capability rather than short-term competency.

Overcoming systemic and implementation barriers

Despite its theoretical advantages, implementing a heutagogical model within a traditional institutional environment introduces certain practical challenges. A comprehensive global review by Panta et al. (2025)[2] synthesizing 22 peer-reviewed studies identified consistent systemic friction points:

"implementation challenges include educator resistance to changing roles, student unpreparedness for self-direction, and tension between flexible approaches and traditional curriculum structures."

This protocol explicitly builds in mitigation strategies to handle these hurdles:

· **Role shift:** the faculty member's role shifts from an authoritative lecturer to a non-controlling coach, which is safeguarded through clear training and fidelity checklists.

· **Scaffolding:** to support students accustomed to rigid instruction, the protocol provides structured orientations and exemplar micro-modules.

· Measurement:to bridge the gap between educational innovation and strict assessment requirements, the study employs validated instruments specifically tailored to the local environment, similar to the comparative heutagogical questionnaire validation work published by Poorvi Kulshreshtha et al. (2025) [8,14].

By systematically managing these tensions, the study provides a realistic model for integrating self-determined learning into the everyday realities of Indian medical colleges.

Methodological strengths and limitations

The study protocol features several clear structural strengths alongside notable limitations that influence how the final results can be interpreted:

Strengths

· **Mixed-methods strategy:** the explanatory sequential design allows researchers to validate quantitative findings (via SDLRs and ACR scales) using qualitative themes from reflection logs and focus group discussions.

· **High curricular relevance:** embedding the study within the host institution's phase 1 anatomy curriculum ensures the findings remain relevant to current NMC policy.

· **Fidelity safeguards:**the study uses structured evaluator rubrics, double qualitative coding, and facilitator checklist reviews to minimize internal bias.

Limitations

· **Quasi-experimental constraints:** because direct randomization is often impractical in medical school cohorts, the study utilizes a non-equivalent control group design. While stratification by academic performance quartiles helps balance baseline characteris-

tics, unmeasured confounding variables like individual student motivation may persist.

· **Single-site and sample size limitations:** the relatively small sample size (n = 150) drawn exclusively from the Parul Institute of Medical Sciences & Research limits the direct generalizability of the findings to medical colleges with different resources or cultures.

· **Short intervention horizon:** an 8-week timeline may capture short-term improvements in self-directed readiness, but it may not fully demonstrate whether these habits endure as long-term lifelong learning capabilities.

· **The Hawthorne effect:** students' awareness that they are participating in an innovative educational trial may temporarily increase their engagement, potentially overstating the intervention's real-world effect size.

Conflicts of Interests: None

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