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A Study of Public Health Theory and Practice Curriculum Reform for Research Integrity Integration Through Research Project Based Pedagogy in Graduate Education

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Abstract

This study addresses critical gaps in public health graduate education where conventional teaching diverges from authentic research practice, and fragmented research integrity training fails to provide coherent guidance throughout the research lifecycle. We propose a pedagogical reform concept of "full-cycle research project embedding," centered on the core course "Public Health Theory and Practice" and synergistically aligned with methodological courses like "Epidemiology." The "Research Lifecycle-Embedded Model" structures research integrity education across four phases—design, implementation, analysis, and translation—cultivating competencies in risk identification, ethical adherence, critical reflection, and professional responsibility. Innovations include authentic sub-projects from national research programs, a "Fieldwork Integrity Log" for real-time ethical challenge documentation, peer-driven "integrity workshops," and a three-tiered portfolio-based assessment system evaluated through multi-stakeholder collaboration. The evaluation framework shifts focus from knowledge testing to behavioral observation, linking integrity performance to academic advancement. While limitations include subjective assessment methods and limited project repositories, this model offers a replicable framework for transforming public health graduate training from fragmented, post-hoc instruction to integrated, pre-emptive professional development—achieved through systematically embedding authentic research projects throughout the "Public Health Theory and Practice" curriculum—preparing graduates to competently navigate ethical complexities in research-to-policy translation.

Keywords: Graduate education, Public health, Research-project-driven curriculum reform, Public Health Theory and Practice, Research project, Research integrity, Research lifecycle-embedded model

1. Introduction

Graduate education constitutes the foundational engine driving national innovation ecosystems, and the cultivation of high-caliber professionals endowed with both scientific excellence and robust ethical frameworks remain indispensable for the construction of a truly innovative nation [1,2]. Within the public health domain, graduate students occupy a uniquely critical position—they serve not merely as frontline innovators in disease prevention and health promotion, but also as essential translational bridges that convert empirical scientific evidence into actionable health policies and sustainable community interventions. However, contemporary public health graduate training is beset by two systemic challenges that undermine its effectiveness. First, a pervasive disconnect persists between didactic classroom instruction and authentic research practice, leaving students inadequately prepared to address complex, real-world public health problems through systematic, evidence-based approaches. Second, the delivery of research integrity education remains fragmented and superficial, typically confined to isolated workshops or policy declarations, thereby failing to provide coherent, values-based mentorship throughout the entire research lifecycle [3]. These pedagogical deficiencies are further exacerbated by the traditional separation of teaching from active research projects, which frequently results in students acquiring technical methodological competencies without cultivating the deeper capacity to identify, frame, and solve substantive problems—an educational gap that severely impedes the development of integrated research capacities essential for professional practice [4].

The persistence of academic misconduct among graduate students—including data fabrication, selective reporting, and the commodification of scholarly work through paper ghostwriting—despite institutional prohibitions and ethical guidelines, starkly illustrates the inadequacy of current research integrity education [5]. Such behaviors reflect not merely individual moral failings, but rather systemic shortcomings in how ethical reasoning is cultivated within graduate training programs. The professional master's course "Public Health Theory and Practice" represents a pivotal inflection point in the pedagogical trajectory, strategically positioned to transform students from passive consumers of established knowledge into active, reflexive research practitioners capable of independent scientific inquiry [6]. Recognizing this opportunity, our study proposes a comprehensive pedagogical reform framework centered on the concept of "full-cycle research project embedding." This innovative approach utilizes the "Public Health Theory and Practice" curriculum as the primary integrative platform, strategically aligning it with methodological courses such as "Epidemiology" and "Biostatistics" to create a coherent, vertically integrated learning architecture. By embedding authentic research projects throughout the entire curriculum sequence, the reform seeks to bridge the persistent theory-practice divide.

The proposed framework constructs a three-dimensional teaching model synergistically organized around the core pillars of "value guidance, competency orientation, and research project driven learning." This model is designed to systematically cultivate ethical consciousness while simultaneously developing advanced methodological competencies through authentic, real-world research engagement. Value guidance is operationalized through continuous ethical deliberation embedded within project milestones, rather than through disconnected lectures. Competency orientation ensures that learning objectives map directly onto demonstrable research capabilities, from study design to dissemination. Research project driven learning provides the experiential foundation through which these competencies and values are synthesized and applied. Collectively, these dimensions offer a theoretically grounded and practically implementable pathway for enhancing the quality and integrity of graduate public health education, ultimately contributing to the formation of a new generation of public health scholars committed to both scientific rigor and social responsibility.

2. Realistic Dilemmas: The "Disconnect" and "Fragmentation" of Research Integrity Education

2.1 Teaching Scenarios Detached from Authentic Research Contexts

Contemporary graduate curricula remain rigidly organized around isolated "knowledge modules," fostering fragmentation rather than integration with real-world public health challenges. When discussing health policies in "Public Health Theory and Practice," instruction predominantly relies on synthesized secondary literature, denying students the arduous journey of moving "from data to actionable evidence" through hands-on empirical analysis. This forecloses opportunities to grapple with real data complexities such as missing values and measurement errors. Meanwhile, research design teaching frequently employs sanitized, "idealized" simulated datasets, systematically and profoundly failing to address inherent ethical and methodological challenges like informed consent dilemmas in vulnerable populations or loss-to-follow-up bias in field surveys. This contextual detachment ultimately reduces research integrity education to hollow rhetoric—students may cognitively "know" they should be ethical yet cannot translate integrity into concrete operational practices such as specimen storage, data processing, or reporting negative results.

2.2 Temporal Misalignment Between Integrity Education and Research Engagement

Most institutions deliver research integrity training intensively before thesis proposal submission, representing a "closing the barn door after the horse has bolted" approach. Surveys indicate over 60% of graduate students receive no systematic ethics training before their initial data collection [7]. Consequently, by the time students subsequently engage with course projects in "Public Health Theory and Practice," they have already internalized an uncritical "more data is better" technical mindset through unsupervised experiential trial-and-error, systematically neglecting the profound ethical dimensions of data acquisition, informed consent procedures, and participant vulnerability assessment. This temporal disconnection between formal training delivery and authentic research practice prevents integrity consciousness from taking root during the neurologically critical period of research habit formation, thereby establishing maladaptive cognitive and behavioral patterns that may persist throughout subsequent scholarly careers and undermine the scientific enterprise.

2.3 Lack of Inter-Course Educational Synergy

Graduate curricula involve multiple disciplines, with many courses administered by different departments using disconnected teaching teams. Taking "Public Health Theory and Practice" and "Epidemiology" as examples—these two courses often belong to separate academic units with misaligned integrity education standards. While epidemiology instruction emphasizes methodological rigor, public health practice courses focus on social value. For instance, epidemiology instructors may tacitly tolerate students "cleaning outliers" to achieve statistical

significance, whereas public health practice instructors demand reporting of all data distributions. Such conflicting standards confuse students: Is research integrity a technical principle or a moral requirement? This lack of top-level design across courses undermines educational coherence.

3. Reform Framework: A Progressive Competency Model Based on the Research Project Lifecycle

This study constructs a theoretically-grounded "Research Project Lifecycle Embedded Model" specifically engineered to redress the persistent disjuncture between abstract ethical knowledge and situated ethical praxis that characterizes contemporary public health graduate education, where conventional research ethics instruction often remains compartmentalized and decontextualized from authentic research experiences. The heuristic systematically maps competency development onto four sequential, mutually-reinforcing phases: conceptual design, methodological implementation, analytical synthesis, and knowledge translation. Each phase cultivates a distinct yet cumulative competency tier: anticipatory risk identification, rigorous ethical adherence, evidence-based critical reflection, and collaborative professional responsibility. By vertically integrating these competencies throughout the Public Health Theory and Practice curriculum through scaffolded learning progressions, the model fosters developmental trajectories from novice awareness to expert stewardship, ensuring that research integrity and social accountability become instantiated, transferable skills rather than peripheral content.

3.1 Design Phase: Cultivating "Risk Identification" Competency

For example, in the introductory module, the course presents outlines of national-level research projects such as the "Global Burden of Disease Study." Rather than traditional lectures, instructors display original documents from project proposals, particularly ethics review appendices, prompting students to identify potential ethical risks: How might cultural differences in minority communities affect informed consent processes? How to balance data utility with privacy protection when using government-managed medical insurance databases for public health research in China? When collecting and storing blood samples for future multi-omics research, how do we comply with China's Biosecurity Law and Human Genetic Resources Administration regulations? This phase eschews immediate solutions in favor of cultivating "risk sensitivity"—a fundamental cognitive shift that reconceptualizes research integrity from retrospective compliance to prospective risk assessment and mitigation planning, thereby enabling students to recognize its function not as post-hoc constraint but as proactive prevention.

The "Epidemiology" course provides methodological support at this stage: when teaching sample size calculations, it emphasizes the trade-off between "feasibility" and "representativeness" to avoid excluding "hard-to-reach populations" for statistical efficiency. Although taught independently, the two courses align through advance coordination of syllabi, ensuring that when students discuss ethical dilemmas in "Public Health Theory and Practice," they already grasp the technical hazards of "selection bias" from "Epidemiology," fostering a dual understanding framework integrating technical and ethical dimensions.

3.2 Implementation Phase: Forging "Ethical Adherence" Competency

As the curriculum transitions to practicum-based pedagogy, student cohorts engage directly with authentic sub-projects derived from the principal research program—exemplified by a community-based health behavior survey targeting high-risk lung cancer populations. This reform deliberately transcends conventional classroom boundaries by implementing a mandatory "Fieldwork Integrity Log," a reflexive documentation instrument wherein students chronicle daily ethical challenges, contextual decision-making rationales, and responsive actions in situ. Representative dilemmas include: When a potential participant refuses engagement after three contact attempts, does substituting a proximate family member compromise sampling integrity and contravene individual autonomy principles? Upon discovering systematic questionnaire omissions post-collection, should one conduct costly return visits or employ statistically imputed corrections, and what are the ethical implications of each pathway?

Weekly "integrity workshops" are convened where students anonymously submit real-world dilemmas for class discussion and anonymous voting. Typical cases are archived in the course "Integrity Case Repository," including anonymized accounts of serious misconduct—such as a documented instance of falsifying three questionnaire IDs to meet deadlines—transformed into cautionary teaching materials. This peer-education approach helps students recognize that integrity pressures are shared experiences requiring collective support to uphold baseline standards.

Furthermore, complementing this socio-ethical dimension, specialized training in "data verification" deploys technical methodologies including EpiData double-entry validation and algorithmic logical error checking. This instruction explicitly demonstrates that rigorous technical verification serves not merely as error detection but as a deterrence architecture—illustrating that data alterations inevitably leave detectable traces—thereby cultivating

appreciation for the binding force of integrated integrity systems and fostering a culture where methodological rigor and ethical conduct are inseparably intertwined.

3.3 Analysis Phase: Developing "Critical Reflection" Competency

In the "data analysis and interpretation" module, the course introduces a dedicated session on handling negative results. Instructors present raw datasets from real reseach projects where "HBsAg positivity rates were lower than expected," requiring students to role-play: As a junior faculty member seeking promotion, would you be tempted to "optimize" the data? As a health policymaker, what information concealment would concern you most?

Through role-playing and perspective-taking, students grasp the profound meaning of research integrity—not merely "not fabricating," but "not concealing or selectively reporting." We can ask each student submit an "Honest Report on Study Limitations," requiring at least three research questions that the study cannot answer. Students then simulate "reporting to the health commissioner," practicing how to communicate policies while maintaining academic rigor.

3.4 Translation Phase: Shaping "Professional Responsibility" Competency

In the final module on "research-to-policy" translation, students draft a "Policy Recommendation Report for Lung Cancer Screening Strategies" based on previously collected project data. Evaluation criteria newly incorporate a "policy impact risk assessment" metric: If adopted, would your recommendations cause unfair medical resource distribution? Would they increase patient financial burden? Would they impose unreasonable pressure on primary care workers?

Outstanding reports are selected for the "Public Health Policy Translation Teaching Case Repository," with invitations for CDC experts to conduct simulated policy reviews. In these sessions, student proposals on "community lung cancer screening priority population definition" receive expert evaluations of "having practical reference potential" due to data transparency and comprehensive risk analysis. Such high-fidelity policy scenario training significantly enhances students' professional responsibility, helping them viscerally understand that research integrity directly affects public interest—in simulations, a single dishonest parameter adjustment can skew screening cost estimates by tens of millions, underscoring that integrity is the cornerstone of scientific policy-making.

4. Evaluation System: Competency-Oriented Integrity Behavior Assessment

The reform replaces the traditional "final examination + term paper" model with a "portfolio-based integrity assessment system."

4.1 Three-Tiered Indicators

- **Foundation Tier (30%)**: prioritizes compliance-based metrics—including attendance records, timely submission of research logs, and adherence to procedural protocols—to systematically inculcate fundamental research behavioral norms and professional discipline. This tier recognizes that ethical research conduct begins with the consistent practice of basic professional habits, serving as the prerequisite scaffold upon which higher-order ethical reasoning is constructed.
- **Advanced Tier (50%)**: weighted most heavily to reflect its central importance, evaluates substantive output metrics such as students' demonstrated capacity to identify and critically analyze integrity dilemmas in published literature, the sophistication of limitations sections in their own research reports, and the depth of self-reflection on sampling biases and conflicts of interest. These assessments probe the depth of ethical cognition, requiring students to move beyond mere rule-following toward reflexive ethical analysis.
- **Excellence Tier (20%)**: challenges top-performing students with innovative, profession-facing metrics, including conducting independent risk assessments in translating research evidence into health policy recommendations or drafting ethics review improvement proposals for institutional review boards. This tier evaluates students' emerging capacity for professional responsibility and their potential to become future stewards of research integrity within the broader scientific community.

4.2 Multi-Stakeholder Collaborative Evaluation

The assessment architecture employs a multi-source triangulation framework to capture the multifaceted nature of research integrity development across cognitive, behavioral, and social dimensions.

- **Self-Assessment**: in this part, we requires students to author structured "Reflections on Integrity Behavior" at the conclusion of each project phase, systematically contrasting their current ethical

understanding against baseline pre-course conceptions to document longitudinal cognitive and attitudinal growth.

- **Peer Assessment**: leverages the authentic collaborative context of group projects, wherein members evaluate teammates on specific behavioral indicators—including timeliness of data sharing, transparency in reporting preliminary findings, and proactive communication when encountering methodological difficulties—thereby fostering mutual accountability and peer-to-peer norm reinforcement.
- **Faculty Assessment**: involves instructors from both "Public Health Theory and Practice" and methodological courses scoring students through validated observation protocols, with particular emphasis on discerning students' behavioral choices under temporal, resource, and peer-pressure constraints.
- **Field Site Assessment**: integrates external validity by having community survey partners conduct blind evaluations of students' fieldwork integrity, contributing 10% to the total score and ensuring that ethical conduct is measured against real-world professional standards beyond the academic bubble, thus bridging the theory-practice gap.

5. Limitations

While these outcomes are encouraging, the study has two notable limitations. First, the assessment of integrity behaviors remains inherently subjective, as current evaluation protocols rely predominantly on instructor observations and student self-reflections, which may introduce rater bias and social desirability effects. This limitation necessitates the future development and validation of more objective, quantifiable measurement instruments with established psychometric properties. Second, the limited scale of our research project repository, which may result in some unavoidable duplication of topics among student cohorts, potentially constraining the diversity of learning experiences and the generalizability of our findings to broader contexts.

6. Conclusion

Centering strategically on the "Public Health Theory and Practice" curriculum as the primary integrative platform, this study constructs a full-cycle research project-embedded integrity education model that fundamentally reimagines how ethical competencies are cultivated within graduate training. The deliberate embedding of authentic research projects into this core professional course is paramount, as it transforms abstract methodological instruction into tangible, ethically-complex problem-solving experiences that mirror real-world public health practice. This pedagogical architecture achieves three critical paradigm shifts: educational timing moves from reactive "post-hoc warnings" delivered after malpractice has occurred to proactive "pre-emptive immersion" where ethical reasoning is scaffolding throughout the research lifecycle; content transforms from disconnected "moral preaching" to seamless "technical-ethical integration" where integrity considerations are woven into every procedural decision from sampling to data management; and evaluation shifts from simplistic "knowledge testing" of abstract principles to authentic "behavioral observation" of ethical decision-making under genuine research pressures. We believe that this model can effectively resolve the chronic problem of disconnected integrity education, provide a replicable, theoretically-grounded framework for cultivating new-era public health professionals who can "work competently in the field, withstand critical methodological scrutiny, and shoulder profound professional responsibility" in increasingly complex health systems.

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Author Contributions

Conceptualization, X.Z. and Y.O.; methodology, X.Z. and Y.O.; validation, X.Z., Y.G. and Y.O.; formal analysis, X.Z., Y.G., and Y.O.; data curation, X.Z., Y.G., and Y.O.; writing — original draft preparation, X.Z.; writing — review and editing, X.Z., Y.G., and Y.O.; funding acquisition, X.Z. All authors have read and agreed to the published version of the manuscript.

Conflicts of Interest

The authors declare no conflicts of interest.

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