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FROM ISOLATED ASSIGNMENTS TO A MANAGED RESEARCH PATHWAY: A CONCEPTUAL MODEL OF PEDAGOGICAL MECHANISMS FOR ORIENTING UNDERGRADUATES TOWARDS RESEARCH ACTIVITY

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Abstract: *Many universities want undergraduates to learn through research, yet students often meet it as a string of unconnected tasks: essays, course papers and a final thesis, each set and graded on its own. This conceptual article argues that the problem is largely one of management. It builds on the author's doctoral research at three Uzbek higher education institutions and reads it through the research–teaching nexus literature, situated learning and cognitive apprenticeship, loose coupling, management theory and realist evaluation. The article makes three contributions. It clarifies three concepts (research activity, orientation towards research activity and pedagogical mechanism) and separates a mechanism from a model and from a pedagogical technology. It describes a three-stage research pathway (adaptive, operational, and research and innovation) linked by six mechanisms and arranged in a six-block management cycle with a feedback loop. Finally, it restates each pedagogical mechanism in realist terms, as resources that should trigger a response and produce an outcome in a given context, and derives six testable propositions. University leaders can use the model to link separate research tasks into one managed pathway, and researchers can test its claims.*

Keywords: *undergraduate research; research–teaching nexus; pedagogical mechanism; higher education management; research competence; conceptual model; realist evaluation; Uzbekistan*

ALOHIDA TOPSHIRIQLAR ORQALI BOSHQARILADIGAN TADQIQOT YO‘LIGA: TALABALARNI ILMIY FAOLIYATGA YO‘NALTIRISHNING PEDAGOGIK MEXANIZMLARI KONSEPTUAL MODELI

Annotatsiya: *Ko‘plab universitetlar bakalavriat talabalari tadqiqot orqali o‘qishini istaydi, biroq talabalar buni o‘zaro bog‘lanmagan topshiriqlar ketma-ketligi sifatida — referat, kurs ishi va bitiruv malakaviy ishi tarzida, har biri alohida topshirilib, alohida baholanadigan shaklda — qabul qiladi. Ushbu konseptual maqolada muammo asosan boshqaruvga taalluqli ekani asoslanadi. Ish muallifning O‘zbekistondagi uchta oliy ta’lim muassasasida olib borgan dissertatsion tadqiqotiga tayanadi va uni tadqiqot-ta’lim bog‘liqligi (research–teaching nexus) adabiyoti, situativ ta’lim va kognitiv shogirdlik, erkin bog‘lanish (loose coupling), boshqaruv nazariyasi hamda realistik baholash nuqtai nazaridan talqin qiladi. Maqola uchta hissa qo‘shadi: uchta tushunchani (ilmiy faoliyat, ilmiy faoliyatga yo‘nalganlik va pedagogik mexanizm) aniqlashtiradi hamda mexanizmni model va pedagogik texnologiyadan ajratadi; olti mexanizm bilan bog‘langan va teskari aloqa halqasiga ega olti blokli boshqaruv siklida joylashtirilgan uch bosqichli (moslashuv, operatsional hamda tadqiqot va innovatsiya) tadqiqot yo‘lini tavsiflaydi; nihoyat, har bir pedagogik mexanizmni realistik atamalarda — muayyan kontekstda javob reaksiyasini keltirib chiqaradigan va natija beradigan resurs sifatida — qayta ifodalab, tekshirish mumkin bo‘lgan oltita qoidani keltirib chiqaradi. Universitet rahbarlari ushbu modeldan alohida tadqiqot topshiriqlarini yagona boshqariladigan yo‘lga bog‘lash uchun, tadqiqotchilar esa uning da’volarini tekshirish uchun foydalanishi mumkin.*

Kalit so‘zlar: *bakalavriat tadqiqoti, tadqiqot-ta’lim bog‘liqligi, pedagogik mexanizm, oliy ta’lim menejmenti, tadqiqot kompetensiyasi, konseptual model, realistik baholash, O‘zbekiston.*

ОТ РАЗРОЗНЕННЫХ ЗАДАНИЙ К УПРАВЛЯЕМОМУ ИССЛЕДОВАТЕЛЬСКОМУ МАРШРУТУ: КОНЦЕПТУАЛЬНАЯ МОДЕЛЬ ПЕДАГОГИЧЕСКИХ МЕХАНИЗМОВ ОРИЕНТАЦИИ СТУДЕНТОВ НА ИССЛЕДОВАТЕЛЬСКУЮ ДЕЯТЕЛЬНОСТЬ

Аннотация: *Многие университеты стремятся к тому, чтобы студенты бакалавриата учились через исследование, однако студенты сталкиваются с ним как с чередой не связанных между собой заданий — рефератов, курсовых работ и выпускной квалификационной работы, каждое из которых задаётся и оценивается отдельно. В настоящей концептуальной статье обосновывается, что проблема носит преимущественно управленческий характер. Работа опирается на диссертационное исследование автора, проведённое в трёх высших образовательных учреждениях Узбекистана, и рассматривает его через призму литературы о взаимосвязи исследования и преподавания, ситуативного обучения и когнитивного ученичества, слабой связанности (loose coupling), теории управления и реалистической оценки. Статья вносит три вклада: уточняет три понятия (исследовательская деятельность, ориентация на*

исследовательскую деятельность и педагогический механизм) и отделяет механизм от модели и от педагогической технологии; описывает трёхэтапный исследовательский маршрут (адаптационный, операциональный, исследовательско-инновационный), связанный шестью механизмами и выстроенный в шестиблочный управленческий цикл с контуром обратной связи; наконец, переформулирует каждый педагогический механизм в реалистических терминах — как ресурс, который в определённом контексте должен вызвать отклик и привести к результату, — и выводит шесть проверяемых положений. Руководители университетов могут использовать модель для связывания отдельных исследовательских заданий в единый управляемый маршрут, а исследователи — для проверки её положений.

Ключевые слова: *исследовательская деятельность студентов, взаимосвязь исследования и преподавания, педагогический механизм, менеджмент высшего образования, исследовательская компетентность, концептуальная модель, реалистическая оценка, Узбекистан.*

1. Introduction

Most universities now expect students to learn through research. The evidence on undergraduate research is broadly encouraging: students who take part in genuine inquiry say they become more skilled and confident as researchers and more drawn to research careers (Hunter et al., 2007; Lopatto, 2007; Seymour et al., 2004). The same literature warns, however, that much of this evidence rests on self-reports from students who chose to take part, and that it is still unclear which features of a research experience produce the benefits (Linn et al., 2015). Even less is known about how an institution guides students across a whole degree.

This organizational side of the problem is easy to see in post-Soviet higher education. A typical Uzbek undergraduate meets research through a series of required tasks. Essays and reports come in the early years, course papers later, and a final qualification paper (the bachelor's thesis) at the end. Some students also join a research circle or speak at a student conference. Each task is set and graded on its own, and none is planned as a step towards the next; my earlier analyses of current practice discuss these shortcomings (Xoshimov, 2024a, 2024b). Borrowing Weick's (1976) term, these tasks form a loosely coupled system: the parts exist side by side, but what happens in one has little effect on the others. National policy asks for tighter links. The Concept for the Development of the Higher Education System of the Republic of Uzbekistan until 2030 calls for closer integration of science, education and production and for the broad involvement of young people, including bachelor's and master's students, in research (President of the Republic of Uzbekistan, 2019).

International work offers detailed advice on building research into the curriculum. Healey and Jenkins (2009) described how students can move from learning about research to doing it. Willison and O'Regan (2007) set out levels of growing student autonomy in research skills, and Brew (2013) offered a framework for deciding what kind of research experience to design. Some of this work looks beyond single courses. Healey and Jenkins (2009) discuss departmental and institutional strategies, the Council on Undergraduate Research describes students entering research at different points along a developmental pathway (Hensel, 2012), and the Connected Curriculum builds a throughline of research activity into each program (Fung, 2017). What these frameworks leave largely open is how management functions are distributed along such a pathway, how students' progress is monitored across courses and years, and how that evidence changes decisions. Post-Soviet pedagogy, for its part, often calls the relevant levers «pedagogical mechanisms», but the term is frequently used without a working definition, which makes claims about mechanisms hard to test.

This article responds to both problems. Its aim is to develop a conceptual model of how a university can plan and manage, stage by stage, the way it orients undergraduates towards research activity. The pathway is designed for the bachelor's degree, and its third stage extends into master's study. The model grew out of my doctoral research, which included fieldwork at three Uzbek higher education institutions. Its empirical evaluation is reported separately, and this article concentrates on the conceptual argument. The article makes three contributions. First, it clarifies three concepts: research activity, orientation towards research activity and pedagogical mechanism. It then uses realist evaluation (Pawson & Tilley, 1997) to give the last of these a testable meaning. Second, it describes a staged research pathway and six mechanisms that link students' separate research tasks into one pathway. Third, it derives propositions that empirical studies can test.

Section 2 reviews the theoretical background, Section 3 explains how the model was developed, Section 4 presents the model, and Section 5 discusses its contribution, implications and limits.

2. Theoretical background

2.1 Undergraduate research and the research–teaching nexus

The belief that research benefits university teaching is long-standing, but there is little evidence that the two support each other automatically. A meta-analysis of studies relating academics' research productivity to the quality of their teaching found the overall relationship to be close to zero (Hattie & Marsh, 1996). For Elton (2001), research

strengthens teaching when students learn in a research-like way; how much their teachers publish matters far less. Later work therefore turned to the student. Griffiths (2004) separated teaching that is led by research, oriented towards it or based on it. Healey and Jenkins (2009) placed such types on two axes: whether students are an audience for research or participants in it, and whether teaching stresses research content or research processes. In the United States, the Boyer Commission on Educating Undergraduates in the Research University (1998) called for inquiry-based learning for every student, and Kuh (2008) later named undergraduate research as one of ten high-impact practices.

Two lessons from this work matter here. Research experience accumulates: students develop as researchers by taking on tasks of growing openness and responsibility (Willison & O'Regan, 2007). And the scope of undergraduate research is a matter of design, so those who design it face a series of choices about what it should include (Brew, 2013). Both lessons imply that someone has to make these choices consistently across a whole degree, which is the management question this article takes up.

2.2 Research competence

Weinert (2001) treats competence as more than knowledge: it also includes the skills and the motivation needed to meet complex demands in real situations. Applied to research, competence means knowing how research is done, being able and willing to do it, and being able to judge the result. Böttcher and Thiel's (2018) instrument breaks research competence down by the steps of the research process, from reviewing the state of research to communicating findings. Willison and O'Regan's (2007) framework grades each research skill by the autonomy the student exercises. The model below works with four components of research competence: motivational, gnoseological (knowledge-related), practical-operational and reflective-evaluative.

Motivation needs separate attention because badly designed incentives can easily damage it. According to self-determination theory, people stay engaged when their setting supports three needs: autonomy, competence and relatedness (Ryan & Deci, 2000). A meta-analysis of 128 experiments found that expected tangible rewards tend to undermine intrinsic motivation for interesting tasks, whereas positive feedback tends to enhance it, at least among college students (Deci et al., 1999). For student research, this means that incentives should recognize effort and quality without turning inquiry into point-scoring.

2.3 Learning to research as guided participation

Situated learning theory describes learning as growing participation in a community of practice: newcomers start with legitimate but peripheral tasks and move towards full membership (Lave & Wenger, 1991). Research is such a practice, with its own tools, genres, standards and community. Cognitive apprenticeship turns this idea into teaching methods. The expert models the work and makes their thinking visible, then coaches the learner and provides scaffolding that is gradually faded. Learners are asked to articulate and reflect on their work and, finally, to explore problems on their own (Collins et al., 1989). The notion of scaffolding comes from a study of tutoring in which the tutor controlled the parts of a task that were beyond the learner, so that the learner could complete the rest (Wood et al., 1976). Withdrawing that help as competence grows is what Collins et al. (1989) call fading.

Read together, these accounts suggest that students should enter research through small, real tasks with strong support, and that the support should be reduced in planned steps. In a loosely organized pathway the opposite often happens. Early tasks stay mostly theoretical, and students first face the full demands of a study in their final thesis.

2.4 Managing a loosely coupled process

Educational organizations are often loosely coupled: their units and activities respond to each other weakly and keep their own identity (Weick, 1976). Loose coupling has advantages, such as local adaptation and room for professional judgment, but it also means that an improvement in one part rarely reaches the others. Orton and Weick (1990) describe three ways in which organizations compensate for loose coupling: enhanced leadership, focused attention and shared values. Management theory supplies further terms for tightening such links. Since Fayol (1916/1949), management has often been described as a set of recurring functions, and a widely used textbook version reduces them to four: planning, organizing, motivating and controlling (Mescon et al., 1985). Fayol's original list also included coordination, which the model treats as a separate function because the pathway crosses departments. Educational management theory, however, treats such function-based models as only one way of understanding schools and universities; ambiguity models, which include loose coupling, are another (Bush, 2020). Within teaching, a related principle is constructive alignment, which asks that intended outcomes, learning activities and assessment be designed as one system (Biggs, 1996). The model in this article extends that logic from a single course to the research pathway of a whole degree.

2.5 What counts as a mechanism

The term pedagogical mechanism is common in Uzbek and Russian-language pedagogy. Because it can cover almost any organized means of reaching a goal, it is easily used loosely, sometimes for a single assignment and sometimes for a whole assessment system. This article therefore uses a narrower definition, taken from my doctoral

research. Here a pedagogical mechanism means a recurring, result-oriented procedure in which organizational forms, teaching methods, tools and management functions are linked so that a set goal is reached. The definition separates three terms that are often merged. A model is the overall picture of a system and the links between its parts. A mechanism is one working part of that system. A pedagogical technology, in the post-Soviet sense of a step-by-step teaching procedure rather than digital technology, is the procedure through which a mechanism is carried out. To improve a mechanism is to add an element, stage or tool that removes a known weakness of current practice; the addition must fit the management functions, and its effect must be shown against measurable criteria.

Realist evaluation helps to make such claims testable, but it uses the word mechanism differently. Pawson and Tilley (1997) argued that programs do not work by themselves. They offer resources, and outcomes follow only when those resources change how the people involved reason and act in a given context. Dalkin et al. (2015) proposed separating the two parts of a realist mechanism: the resources a program introduces and the reasoning they trigger. A pedagogical mechanism in the post-Soviet sense corresponds to the resource part. To avoid confusion, this article keeps «pedagogical mechanism» for the organized means and calls the reasoning part the intended response. Each pedagogical mechanism can then be described by four elements: the resources it offers, the response it should trigger in students and staff, the outcome it should produce, and the context it depends on. Described this way, a claim about a mechanism can be tested.

3. Approach

This is a conceptual article of the model type (Jaakkola, 2020). It brings together concepts from several bodies of theory and proposes testable relationships between them. Its domain is the management of undergraduate research within the research–teaching nexus. The model was developed in three steps during my doctoral research (2023–2026), and a fourth step was added for this article.

1. Literature analysis. The doctoral study drew mainly on Uzbek and Russian-language work on research activity, research competence and educational management, where the term pedagogical mechanism is common. It also used the research–teaching nexus literature (Elton, 2001; Griffiths, 2004; Healey & Jenkins, 2009).

2. Analysis of policy and practice. National documents on higher education and science were reviewed, and existing practice was examined at three public higher education institutions: Namangan State University, Bukhara State University and Samarkand State Pedagogical Institute. The diagnostic work combined a structured student questionnaire, conversations with students, systematic pedagogical observation and in-depth interviews, semi-structured in form, with 15 experienced subject teachers and research supervisors. These data were used to locate the points at which the existing pathway breaks down, not to estimate effects.

3. Modeling. The doctoral study named four methodological approaches as the basis of its experimental work, and they also explain the logic of the model. The systemic approach treats the pathway as a whole with interacting parts. The competence-based approach defines outcomes as components of research competence. The activity-based approach holds that students learn research by doing research tasks. The managerial approach treats the pathway as a process to be planned, organized, motivated and controlled.

4. Specification. For this article, I restated each mechanism in realist terms (Section 2.5) and linked the model to the theories reviewed in Section 2. This step turns the model into a set of propositions (Section 4.5).

Most of the theory reviewed in Section 2, namely loose coupling, self-determination theory, situated learning and cognitive apprenticeship, constructive alignment and realist evaluation, was not used in the doctoral study. It is brought in here to specify how the mechanisms are expected to work and to derive propositions; Table 3 in Section 4.5 shows where each body of theory enters the model. Two further points concern independence. The module program and the matrix of teaching combinations described in Section 4.3 were designed for the experimental stage, so the model is not fully independent of its later evaluation. That evaluation, a quasi-experimental study at the same three institutions, is reported separately, and the present article does not rely on its results.

4. The model

The model has four parts: core concepts, a staged pathway, six mechanisms that hold the pathway together and a six-block management cycle. Each part is presented below, followed by the propositions that the model implies.

4.1 Core concepts

Research activity. Research activity is goal-directed creative work that generates new knowledge, systematizes it and puts it to use; it is judged by its novelty and by whether its claims are demonstrated. The individual study is its core: the direct process of obtaining new knowledge about a defined problem. Research activity is broader than any single study, continuous, and open to management. Besides research itself, it covers mastering, systematizing, disseminating and applying new knowledge, scholarly communication and building a research environment.

Student research. Most student research is applied research carried out for learning. It addresses a problem that is new to the student rather than to the field and serves the student's own learning needs. This is narrower than the definition used by the Council on Undergraduate Research, for which undergraduate research makes an original intellectual or creative contribution to the discipline (Hensel, 2012). The narrower view fits the early stages of the pathway, where originality for the field is rarely a realistic aim; the broader definition describes where the pathway should lead. Student research follows the same stages as professional research, from problem and hypothesis to testing, conclusions and presentation, but differs in scope and in the degree of novelty expected. Because the stages are shared, the same standards can be applied, at different levels of demand, from a first-year essay to the final thesis.

Orientation towards research activity. Orientation towards research activity is a purposeful system that combines pedagogical and managerial approaches to bring students into research step by step. Its aim is to build their research competence as teaching and research are integrated. The phrase refers to research activity rather than to research because the aim is to bring students into all of that activity, not into a single study.

Research competence. Research competence is a student's readiness to plan, organize, carry out and evaluate research activity independently. It has four components: motivational (stable interest and initiative), gnoseological or knowledge-related (methodology and the literature), practical-operational (posing a problem, selecting methods, gathering and analyzing data) and reflective-evaluative (judging and correcting one's own work). Competence without motivation is not used, and motivation without competence achieves little, so the model treats the four components as parts of one whole.

4.2 The research pathway

The model uses the three-stage division of students' development as researchers adopted in my doctoral research (Table 1). In what follows the stages are called adaptive, operational, and research and innovation. They are defined by what students can do rather than by fixed years, and the support students receive is reduced as they move along. Each stage should end with outputs that the next stage builds on: an essay prepares the ground for a course paper, a course paper for a first article, and both for the final thesis.

Table 1. Stages of the research pathway

Stage	Typical period	What students do	Typical outputs	Management focus
1. Theoretical-initial (adaptive)	First years of the bachelor's program	Move from listening to inquiring; read core literature; look for a problem or gap; learn the basics of methodology and how experiments, tests, interviews and surveys differ	Essays and reports	Direct students to the right information sources
2. Practical-developmental (operational)	Middle years of the bachelor's program	Plan a course paper or small project with a supervisor; choose a method; collect and analyze primary data; write a first article or conference abstract; discuss results in the department or a research circle	Course papers, mini-projects, first articles and abstracts	Guidance by supervisors, advisers and academic managers; monitoring so that early failures do not push students away from research
3. Consolidating (research and innovation)	Graduating years and master's study	Work independently; publish in international peer-reviewed journals; present at international conferences; enter grant and startup competitions; make practical recommendations to their field of practice	Final thesis, journal articles, grant and startup applications	Support for independent work: access to databases, recognition, staff–student co-authorship, links with research centers and industry

Note. The doctoral study gives no fixed period for Stage 2 and no management focus for Stage 3; the Stage 3 entries are drawn from its general recommendations and assigned to this stage here.

Stage 3 extends into master's study. The doctoral study places the whole pathway within a wider vertical integration of bachelor's, master's and doctoral education, in which the same logic of growing independence applies.

4.3 Six mechanisms

Six mechanisms hold the pathway together. For this article, each is linked to the management function it serves most directly; the doctoral study treats every function as present in every mechanism. Table 2 restates each mechanism in the realist form introduced in Section 2.5. The last column draws on the five pedagogical conditions identified in the doctoral study: an organizational-methodical environment with targeted management, material and information resources, open dialogue and collaboration, fair reward and assessment, and continuous reflection with psychological support.

Table 2. The six mechanisms in realist terms

Mechanism (main function)	Resources it offers	Intended response	Expected outcome	Context it depends on
1. Design and planning (planning)	Design at the levels of the institution, the department and the individual student; SMART goals; a four-step project plan (preparation, methodology, analysis, synthesis), each step with its own management method (supervisor consultation, practical diagnostics, digital monitoring, plagiarism check); a project passport; a Gantt chart of deadlines	Students treat research as a project with a goal, a hypothesis and deadlines; supervisors plan ahead instead of reacting	Research becomes a managed project instead of an episodic event	Targeted management: supervisors' time and a shared calendar across departments
2. Staged involvement (organizing)	Introductory courses in years 1–2 (research methodology, academic writing, project work); a year-3 core module and a year-4 advanced module; a matrix that pairs 25 research ideas with a teaching form, method and tool; mini-projects and case studies; a step-by-step guide to IMRaD writing	Students take on tasks of growing openness and see each task as a step towards the next	Continuity between essay, course paper, final thesis and publication; progress through the three stages	Targeted management: space in the curriculum and agreement between departments
3. Monitoring and diagnostics (control)	Three-level indicators for each of the four competence components; evidence from e-portfolios, workbooks, written reviews, online tests and expert ratings; results reported to supervisors, departments and the research office	Students and staff use evidence of progress to adjust plans; assessment is formative, not punitive	Timely correction for individuals; changes to courses and resources when weaknesses are widespread	Continuous reflection with psychological support: trust between students and supervisors
4. Motivation and incentives (motivating)	A rating system with published criteria; competitions and mock conferences; certificates and public recognition; nomination for grant and startup contests; bonuses for supervisors; regular reflection on progress	Students experience autonomy, growing competence and recognition;	Students' motivation rises and is tracked as one of the four components	Fair reward and assessment: public criteria; rewards that do not displace interest in the work itself

Mechanism (main function)	Resources it offers	Intended response	Expected outcome	Context it depends on
		supervisors see their effort valued		
5. Collaboration and supervision (coordinating)	Small project teams in which each student has a defined role; research circles and debating clubs; joint planning by senior management, the research office, deans and departments; mentoring that continues across years	Students learn from peers and mentors as members of a research community	A working three-way link between students, staff and the research community	Open dialogue and collaboration; supervisors' capacity and recognition of supervision in workload
6. Digital support and academic integrity (organizing resources)	Subscriptions to international databases and e-libraries; statistics software (SPSS, Excel); online forums and webinars; plagiarism screening; an institutional code of research ethics and integrity; teaching students to use AI ethically and only as an auxiliary analytical tool	Students use sources and tools responsibly and know where the limits lie	Access to research beyond the campus library, with safeguards for integrity	Material and information resources: funding for database access; an institutional integrity policy

Table 2 shows two things. First, the mechanisms depend on each other. Monitoring supplies the evidence that planning and incentives need, and without the transparent criteria that monitoring produces, incentives would look arbitrary. Staged tasks work only if supervisors plan them and have time to guide students through them. This interdependence is why the model arranges the mechanisms in a cycle rather than treating them as separate measures. Second, one condition, supervisors' capacity, underlies all six mechanisms even where the table does not list it, and it is the first thing a university should check before introducing the model. The table also illustrates the difference between a mechanism and a technology: the four-step project plan and the Gantt chart, for example, are the technology through which mechanism 1 is carried out.

4.4 The six-block cycle

The mechanisms are arranged in a six-block management cycle (Figure 1). The target block states what student research is for and which values, such as integrity and curiosity, should guide it. The organizational-managerial block coordinates the people and units involved. The content-methodological block organizes the staged tasks, and the technological-informational block provides digital resources and protects academic integrity. The diagnostic-reflective block tracks the four components of research competence and turns the results into decisions. The outcome block defines what the cycle should produce: graduates with research competence and a working link between students, staff and the research community.

The doctoral study names the six blocks and places three mechanisms in them: monitoring and diagnostics in the diagnostic-reflective block, collaboration and supervision in the organizational-managerial block, and digital support and academic integrity in the technological-informational block. The placement of the other three mechanisms and the feedback loop between blocks are specified here for the first time. Staged involvement belongs to the content-methodological block. Design and planning, and motivation and incentives, work in two places: in the target block, where goals are set, and in the organizational-managerial block, where plans and incentives are run. The outcome block holds no mechanism, because it defines the results the others serve. The blocks add what Table 2 cannot show: the order in which the mechanisms act within a cycle and the loop that links results to goals.

The cycle is open. Outcomes, as measured in the diagnostic-reflective block, return to the target block, where they inform the goals and plans of the following cycle; the model itself is meant to be revised in the same way. Students have a voice at two points. They shape their own research trajectory and topic with their supervisor, which is the individual level of design, and they reflect on and comment on their progress in the diagnostic-reflective block.

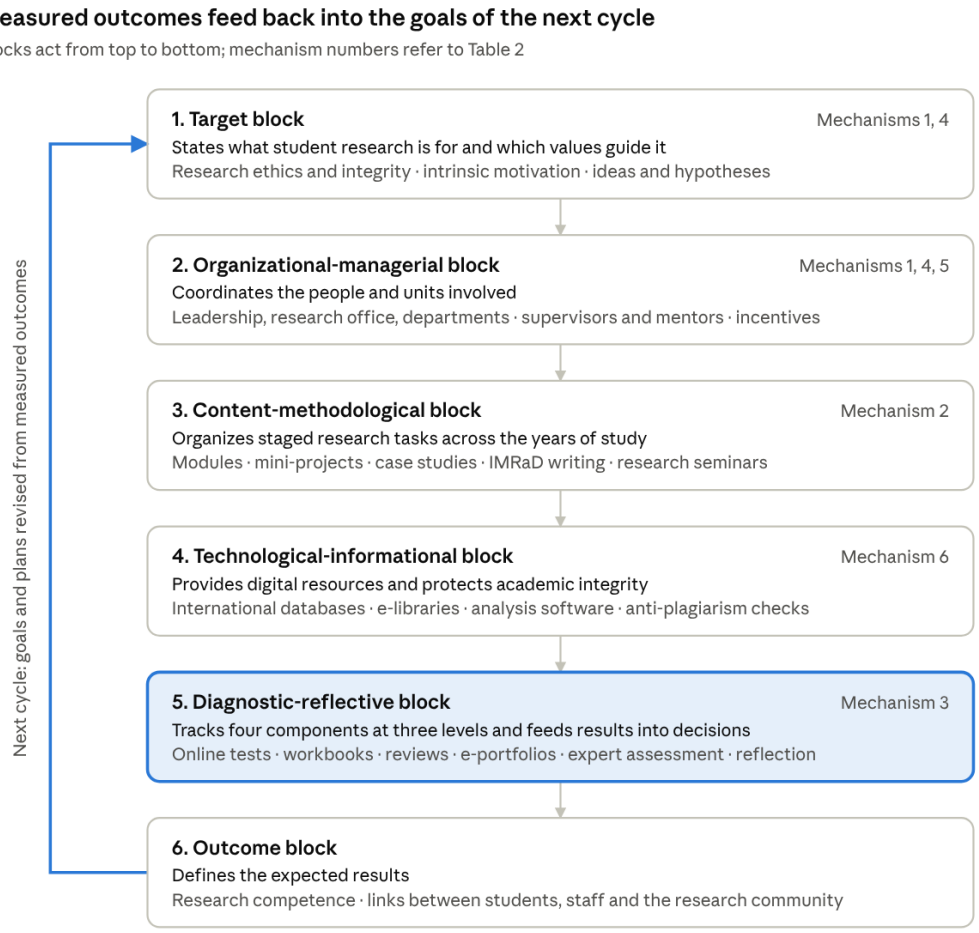

Figure 1 · the six-block model as a management cycle

Figure 1. The six-block model as a management cycle. Blocks act from top to bottom; outcomes, as measured in the diagnostic-reflective block, feed back into the target block at the start of the next cycle.

4.5 Propositions

The model implies six propositions that empirical studies can test. Each is tied to the mechanisms it concerns, and Table 3 shows the theory behind it.

1. P1 (coupling; mechanisms 1 and 2). With the number of research tasks held constant, students' research competence at graduation is higher where more of their tasks build on an earlier output, such as the same topic, data or supervisor, and are planned as one sequence.

2. P2 (fading support; mechanisms 2 and 5). Support withdrawn in planned steps across the three stages produces larger gains in practical-operational competence than an unstaged pathway, in which students meet the full demands of research only in their final thesis.

3. P3 (use of evidence; mechanism 3). Monitoring raises research competence more when its results lead to changes in individual plans, courses or resources than when they are used only for grading.

4. P4 (motivation; mechanism 4). Incentives that recognize the quality of work and progress under public criteria strengthen the motivational component more than incentives tied only to grades or output counts, which may weaken intrinsic motivation.

5. P5 (supervision; mechanism 5). The benefits of staged involvement and collaboration are larger where supervisors have time in their workload and recognition for supervising student research.

6. P6 (digital access and integrity; mechanism 6). Access to databases and analysis software raises practical-operational competence more when students are also taught source evaluation, plagiarism rules and the permitted uses of generative AI than when access is provided alone.

Table 3. Theories behind the model

Body of theory	What it contributes	Where it enters the model	Propositions
Research–teaching nexus (Griffiths, 2004; Healey &	Types of research-linked teaching; growing student	Content of the stages;	P1, P2

Body of theory	What it contributes	Where it enters the model	Propositions
Jenkins, 2009; Willison & O'Regan, 2007)	autonomy	mechanism 2	
Loose coupling (Orton & Weick, 1990; Weick, 1976)	Diagnosis of the problem; leadership, focused attention and shared values as compensations	Ownership of the pathway; diagnostic loop; target block	P1, P3
Situated learning and cognitive apprenticeship (Collins et al., 1989; Lave & Wenger, 1991; Wood et al., 1976)	Participation that grows from peripheral to full; scaffolding and fading	Staged pathway; mechanisms 2 and 5	P2, P5
Management functions (Fayol, 1916/1949; Mescon et al., 1985)	Planning, organizing, motivating, coordinating and control as recurring functions	Allocation of mechanisms to functions (Table 2)	None directly
Constructive alignment (Biggs, 1996)	Goals, activities and assessment designed as one system	Links between the target, content-methodological and diagnostic-reflective blocks	P1, P3
Formative assessment and feedback (Black & Wiliam, 1998; Hattie & Timperley, 2007)	Evidence counts only when it is used to adapt teaching	Mechanism 3; diagnostic-reflective block	P3
Self-determination theory and rewards (Deci et al., 1999; Ryan & Deci, 2000)	Autonomy, competence and relatedness; effects of rewards and feedback	Mechanism 4	P4
Mentoring in undergraduate research (Crisp & Cruz, 2009; Shanahan et al., 2015)	Practices of effective mentors; uneven definitions of mentoring	Mechanism 5	P5
Realist evaluation (Dalkin et al., 2015; Pawson & Tilley, 1997)	Resources, reasoning, context and outcome	Specification of all mechanisms (Table 2)	All
Guidance on generative AI (Miao & Holmes, 2023)	Institutional rules for the use of AI	Mechanism 6	P6

P1 restates the loose-coupling argument in testable form: if separate tasks are the problem, the degree of linkage between them, not their number, should predict competence. P2 follows from the accounts of participation and apprenticeship, in which newcomers move towards full participation as scaffolding is faded. P3 follows from the formative assessment literature, which counts assessment as formative only when its evidence is used to adapt teaching (Black & Wiliam, 1998). P4 rests on the evidence that expected tangible rewards tend to undermine intrinsic motivation while positive feedback tends to support it (Deci et al., 1999). P5 draws on work on the practices of undergraduate research mentors (Shanahan et al., 2015) and on reviews that show how unevenly mentoring is defined and delivered (Crisp & Cruz, 2009). P6 combines the doctoral study's observation that easy access to online sources invites copy-and-paste writing with UNESCO's call for institutional rules on generative AI (Miao & Holmes, 2023).

5. Discussion

5.1 Contribution

For the literature, the model matters in three ways. First, it treats the research pathway of a whole degree as an object of management. The idea of a degree-long pathway is not new (Fung, 2017; Healey & Jenkins, 2009; Hensel, 2012). What the model adds is an account of who plans the pathway, how its tasks are linked and how evidence of progress feeds back into decisions. Most frameworks in the research–teaching nexus literature describe what students do with research in a course or program (Griffiths, 2004; Healey & Jenkins, 2009), or how much autonomy they have in a given task (Willison & O'Regan, 2007). The present model uses these frameworks to fill its stages.

Second, it suggests how a university can tighten a loosely coupled system without losing the advantages of loose coupling. Orton and Weick (1990) describe leadership, focused attention and shared values as ways of compensating for loose coupling. The model supplies all three, in the form of an owner for the pathway, a diagnostic loop and shared goals, while leaving the content of tasks to departments and supervisors. It also turns several institutional characteristics described by the Council on Undergraduate Research, such as administrative support, research infrastructure, recognition, assessment and strategic planning (Hensel, 2012), into mechanisms with stated responses, outcomes and contexts.

Third, it gives the post-Soviet notion of a pedagogical mechanism a form that other researchers can use. Read through realist evaluation, a pedagogical mechanism becomes the resource side of a context–mechanism–outcome configuration, and its effect depends on the reasoning it triggers in students and staff and on the context (Dalkin et al., 2015; Pawson & Tilley, 1997). This should make findings from Uzbek and other post-Soviet universities easier to compare with the international literature. It also changes the question from whether a mechanism works to for whom and under what conditions it works.

5.2 Implications for practice

Because the main addition of this article is the realist specification, its practical implications concern how the model should be introduced rather than what it contains. Three follow. First, a university should check the context before it introduces any mechanism, above all supervisors' capacity and the resources listed in the last column of Table 2; a mechanism introduced without its context is unlikely to trigger the intended response. Second, the mechanisms should be introduced as a set, because each depends on the evidence or the conditions produced by the others. Third, a university should monitor implementation as well as outcomes, asking which responses the mechanisms actually trigger and among whom.

A caution is needed. A managerial vocabulary can easily turn into paperwork and control. Deem and Brehony (2005) argue that «new managerialism» in higher education works as an ideology that serves managers' interests and strengthens their position. Authoritarian, bureaucratic management also tends to stifle the creativity that research needs. The model is meant to work in the opposite direction, through collaboration, delegation and formative feedback rather than reporting for its own sake. Whether it does so in practice is itself a question for evaluation.

5.3 Limitations

The model was developed in one national system, and its practical material comes from three public higher education institutions, so its fit with other institutional cultures is uncertain. The realist restatement of the mechanisms, especially the intended responses and the contexts, is my own interpretation and has not yet been tested directly. The boundaries between mechanisms are analytical rather than real: incentives also work through monitoring, and supervision runs through every block. The stages are not tied to fixed years and will be timed differently in different programs. The model has also not yet been examined from students' own point of view. Finally, some elements, such as teaching the responsible use of AI, rest on a young evidence base and will need revision as practice develops.

5.4 Directions for research

The propositions in Section 4.5 suggest several lines of research. P1 could be tested by comparing programs that link students' research tasks tightly with programs that do not, while holding the number of tasks constant. P2 and P3 call for longitudinal designs that follow individual students across years, with multilevel models that allow for students being nested in study groups and universities. Realist evaluations could test the configurations in Table 2 by asking which responses the mechanisms actually trigger, for whom and in which contexts (Pawson & Tilley, 1997). Using a validated measure of research competence, for example Böttcher and Thiel's (2018) questionnaire, would allow comparison across countries. Comparative work in Central Asia, where universities share much of the post-Soviet tradition, would show how well the model transfers.

6. Conclusion

In many universities, student research is a collection of tasks rather than a pathway. This article has argued that the problem is largely one of management, and it has proposed a conceptual model for addressing it. The model treats the orientation of students towards research activity as something a university can plan and manage, and it divides the pathway into three stages. Six mechanisms link the stages into one management cycle: design and planning, staged involvement, monitoring and diagnostics, motivation and incentives, collaboration and supervision, and digital support and academic integrity. Each mechanism is restated in realist terms, as resources that should trigger a response and produce an outcome in a given context, and the model yields six propositions for empirical testing.

The main message for universities is that adding more research tasks is not enough. Students develop as researchers when their tasks build on each other and support is withdrawn in planned steps. They also need staff who act

on evidence of their progress, and supervisors with the time and recognition to guide them. University leaders can use the model to link separate research tasks into one managed pathway; researchers can test its claims.

Declarations

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Data availability. This conceptual article reports no quantitative data. Materials from the diagnostic stage of the doctoral research are available from the author on reasonable request.

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