# Strategic Innovation Infrastructure in Scientific Research: A Departmental Model in Progress for Cultivating Research and Entrepreneurship

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***Abstract.*** This case study addresses the need for structured innovation infrastructure at the departmental level to foster research and entrepreneurship in Saudi universities. The Physics Department at King Abdulaziz University established a Scientific Research Committee that developed a departmental model in progress, operationalized through seven coordinated initiatives designed to enhance faculty research productivity, interdisciplinary collaboration, and undergraduate research engagement. Methods included establishing a faculty research activity tracking system (2021–2024), delivering targeted research skills workshops, developing a tailored academic mentorship program, piloting undergraduate research activities, compiling a departmental research funding executive summary, and launching a research resource database. Early outcomes demonstrate improvements in research visibility, faculty development, and student participation, consistent with entrepreneurial-ecosystem and absorptive-capacity perspectives that link human capital, infrastructure, and networks to innovation outcomes. Challenges such as uneven faculty engagement, resource constraints, and limited coordination mechanisms were identified during the development phases. In conclusion, this evolving model has laid a solid foundation for scalable departmental structures that align with institutional priorities and contribute to Saudi Vision 2030 innovation goals. It offers practical insights into how departmental-level structures can progressively build scalable research and entrepreneurship ecosystems to drive long-term academic impact

**Keywords:** Research infrastructure; innovation in higher education; entrepreneurship ecosystem; faculty development; undergraduate research engagement, departmental research strategy; institutional capacity building; patents and funding strategy.

## 1. Introduction

In recent years, higher education institutions have increasingly recognized the need for structured mechanisms that support research productivity, innovation, and alignment with national priorities. Universities are under growing pressure to not only produce high-quality research but also to demonstrate impact, accountability, and sustainability through measurable indicators such as publications,

funding, patents, and collaborations. This has led to the establishment of research committees, centres, and dedicated offices worldwide, yet the effectiveness of such structures at the departmental level remains underexplored.

Research management literature emphasizes that faculty development, mentorship, and research capacity-building are critical for enhancing scholarly output and sustaining long-term academic excellence [1, 2]. Targeted interventions, such as structured mentorship frameworks and research skills workshops, have been shown to address skill gaps and improve faculty engagement [3, 4]. Similarly, the integration of undergraduate students into research has been identified as a high-impact practice that fosters critical thinking, improves retention in STEM fields, and strengthens the research culture of institutions [5–7]. At the same time, debates continue regarding how best to balance centralized versus distributed leadership models in research governance, with some scholars arguing that top-down structures risk disengagement, while distributed leadership fosters collaboration but may suffer from coordination challenges [8, 9].

Within the Saudi context, the strategic vision for higher education emphasizes innovation, entrepreneurship, and knowledge-based economic growth. National initiatives such as Vision 2030 [10] and related higher education strategies explicitly call on universities to build research infrastructure, strengthen innovation pathways, and expand entrepreneurial opportunities for faculty and students. At the same time, universities are expected to cultivate sustainable mechanisms for quality assurance and performance monitoring, ensuring that research outputs contribute not only to academic excellence but also to societal and economic development.

Against this backdrop, the Physics Department at King Abdulaziz University (KAU) established a Scientific Research Committee to operationalize strategic initiatives aimed at strengthening research infrastructure, supporting emerging researchers, promoting collaboration, and aligning departmental activities with institutional and national priorities. This case study documents the committee's structure, mission, and coordinated initiatives, and presents early outcomes from the first cycle of implementation (2024–2025). By examining both achievements and challenges, this work contributes to the literature on departmental research governance and provides practical lessons for institutions seeking to cultivate sustainable, innovation-oriented research environments, particularly within the context of Saudi universities' evolving innovation and entrepreneurship ecosystem.

## 2. Methodology: Committee Model and Strategic Initiatives

This study adopts a structured departmental model to operationalize strategic innovation infrastructure in scientific research. The methodology describes the formation and functioning of the Physics Department's Scientific Research Committee, its mission and objectives, and the framework used to design, implement, and monitor strategic initiatives. The section outlines the committee's composition and roles, the alignment of initiatives with strategic objectives, and the operational framework guiding their execution.

## 1. Committee Structure and Membership

As part of a department-wide effort to advance scientific research and academic innovation, a Scientific Research Committee was established within the Physics Department to design, coordinate, and implement key initiatives that support research excellence, infrastructure, and engagement.

The committee comprises a total of **18 members**, reflecting inclusive representation across academic levels and roles. The composition includes:

- **1 Chairperson**, responsible for strategic oversight, coordination, and official representation of the committee.

- **8 faculty representatives**, consisting of seven academics with doctoral qualifications and one with a master's degree. Faculty members lead or co-lead key strategic initiatives aligned with the committee's objectives.
- **2 laboratory technicians**, who support technical and resource-tracking initiatives.
- **7 student members**, who contribute to initiative support, peer engagement, and internal communication.

This multi-tiered structure ensures distributed leadership, active involvement across career stages, and integration of technical and student perspectives.

## 2. Role of the Committee

The Scientific Research Committee functions as the department's primary body for advancing research excellence and innovation. Its core responsibilities include:

- Designing and implementing research infrastructure initiatives.
- Supporting faculty development through mentorship, workshops, and strategic planning.
- Facilitating interdisciplinary collaboration and knowledge exchange.
- Tracking and reporting research outputs through structured data collection.
- Promoting undergraduate engagement in research.
- Advising departmental leadership on research priorities and funding opportunities.

## 3. Mission and Objectives

The mission of the committee is to foster a sustainable, ethical, and inclusive research environment that supports innovation and scholarly productivity. Its objectives are listed in Table 1.

**Table 1.** Scientific Research Committee Objectives and Corresponding Key Results (OKRs)

| | Objective | Key Results |
|---|---|---|
| 1 | Cultivate research excellence and innovation | 1. Increase the number of peer-reviewed publications by faculty by 20% within one academic year. <br> 2. Facilitate at least two new interdisciplinary or high-impact research collaborations annually. <br> 3. Launch one new departmental innovation initiative or prototype per year (e.g., novel tool, method, or device). |
| 2 | Promote ethical and collaborative research practices | 1. Ensure 100% of faculty and postgraduate researchers complete annual research ethics training. <br> 2. Organize two interdepartmental seminars or workshops focused on collaborative research methods per year. |

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|---|---|---|
| | | 3. Establish a formal code of research conduct and secure written commitment from all committee members. |
| 3 | Support emerging researchers and academic growth | 1. Pair 100% of junior faculty with mentors as part of the departmental mentorship program. 2. Increase junior faculty involvement in graduate research supervision by 30%. 3. Deliver at least three research training sessions or proposal writing workshops annually. |
| 4 | Align departmental research activities with institutional and national priorities | 1. Map 100% of ongoing departmental research projects to national or university strategic themes annually. 2. Submit at least three grant proposals aligned with priority areas per year. 3. Conduct an annual review to revise project focus areas based on updated policy directions. |
| 5 | Build infrastructure for tracking, planning, and reporting | 1. Maintain an up-to-date research activity database with at least 90% faculty participation. 2. Publish an annual departmental research report covering outputs, trends, and funding metrics. 3. Reduce the administrative burden of data entry by 50% through tool/process optimization by the next academic year. |

These objectives were used to guide the design and evaluation of all committee initiatives.

## 4. Strategic Initiatives and Alignment

To translate its mission into measurable action, the Scientific Research Committee operationalized its work through seven coordinated initiatives, each designed to address specific strategic objectives and collectively support the development of a sustainable research and innovation infrastructure within the department.

Table 2 outlines how each initiative aligns with one or more of the committee's strategic objectives, ensuring comprehensive coverage without redundancy and reinforcing a mutually exclusive, collectively exhaustive (MECE) design framework.

**Table 2.** Alignment of Strategic Initiatives with Committee Objectives

|   | Initiative | Aligned Objective(s) |
|---|---|---|
| 1 | Mentorship Program | Support emerging researchers; Promote ethical collaboration |
| 2 | Research Skills Workshops | Cultivate excellence; Support emerging researchers |
| 3 | Build Research Resources Database | Build infrastructure |
| 4 | Seminar & Interdisciplinary Projects | Cultivate excellence; Promote collaboration |
| 5 | Identify Funding Sources | Align with institutional/national priorities |
| 6 | Update Research Activities Database | Build infrastructure; Align with strategic priorities |
| 7 | Undergraduate Research Integration | Support emerging researchers |

## 5. Description of the Seven Initiatives

To operationalize the committee's strategic objectives, seven coordinated initiatives were designed, each addressing a distinct area of research development within the department (Figure 1). These initiatives serve as the functional core of the Scientific Research Committee's efforts, translating broad institutional goals into targeted, action-oriented programs. Together, they aim to enhance mentorship, improve research competencies, expand infrastructure, strengthen collaboration, and promote both faculty and student engagement in research. Detailed task-level descriptions are provided in Table 3.



**Figure 1.** The seven strategic initiatives of the Scientific Research Committee.

| Initiative | Context & Issue | Objective | Key Activities | Timeline | Expected Outputs | Monitoring and Evaluation | Key Performance Indicators | Distinctive Features |
|---|---|---|---|---|---|---|---|---|
| **Initiative 1: Enhance Mentorship and Supervision** | Performance reviews and faculty feedback revealed limited structured support for early-career academics, resulting in inconsistent guidance on research, publication, and postgraduate supervision. | Implement a structured mentorship program to strengthen research capacity, support career progression, and increase faculty participation in graduate supervision. | Design a department-specific mentorship framework, hold orientation sessions, and match junior faculty with experienced mentors based on research alignment. Monitor and refine the program through participant feedback. | Two years — Year 1 for design and planning; Year 2 for implementation and formative evaluation. | • Documented mentorship framework and guidelines • List of active mentor–mentee pairs • Evidence of increased junior faculty co-supervision | Collect structured feedback from participants and track supervision logs and faculty development metrics. | • 100% of junior faculty matched with mentors • 30% increase in postgraduate co-supervision • ≥80% positive feedback rate | Tailored to the department's structure, addressing identified support gaps and aligning with promotion and research expectations. |
| **Initiative 2: Organize Research Skills Workshops** | Faculty research skills vary, particularly in technical tools, grant writing, and publication strategies. Limited targeted training reduces | Enhance research competencies and funding readiness through focused, practical workshops addressing departmental skill gaps. | Deliver at least five workshops annually on topics such as LaTeX, Mendeley, Deanship research services, and nanotechnology (in collaboration with the Center of Nano- | Throughout the academic year, with topics reviewed each term. | • Completed annual workshop series • Workshop materials and feedback reports • Evidence of improved research skills and engagement | Track attendance and assess effectiveness through post-event surveys and follow-up interviews. | • ≥80% faculty participation • ≥85% satisfaction rating • Two new topics added annually based on faculty feedback | Workshop design and content are faculty-driven, ensuring relevance, applicability, and alignment with departmental |

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| | productivity and participation in strategic programs. | | technology). Include hands-on elements, collect feedback, and issue participation certificates. | | | | | research goals. |
| **Initiative 3: Build Research Resources Database** | The department lacks a centralized, accessible record of research equipment and facilities. This limits visibility, planning, and collaborative use, with unclear custodianship creating further barriers to maintenance and funding alignment. | Develop and implement a departmental database to consolidate and manage research resource information. | Define database structure, collect equipment data from departmental labs, and work with laboratory technicians to verify and input records. | Phased implementation over the academic year, starting with accessible sections (e.g., female section). | • Operational internal database with verified entries<br>• Documented custodianship for each resource<br>• User access guidelines | Track progress via audits, periodic verification with lab staff, and faculty usability feedback. | • ≥80% of departmental equipment catalogued in first version<br>• Custodians identified for 90% of entries<br>• 50% of faculty researchers accessing the database in year one | Internally developed to match departmental structure, with potential for future integration into institutional lab management systems. |
| **Initiative 4: Promote Seminar Participation and Interdisciplinary Projects** | Departmental research has often been siloed, with limited communication about relevant academic | Increase faculty participation in seminars and conferences while fostering cross-disciplinary research | Maintain and distribute a monthly updated list of relevant events, and facilitate networking among faculty | Throughout the academic year, with monthly event list updates. | • Updated seminar and event registry<br>• Increased faculty participation<br>• Initiation of interdisciplinary | Track awareness and participation via surveys and the Faculty Research | • 70% of faculty report benefiting from the event list<br>• At least two interdisciplinary proposals or | Leverages student participation for coordination and prioritizes events aligned with institu- |

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| | events and few opportunities for interdisciplinary collaboration. This reduces exposure to emerging ideas and partnerships. | engagement. | with shared research interests. Student members will assist with dissemination. | | meetings or proposals | Activities Database. | collaborations initiated annually • Seminar participation logged in 50% of annual reports | tional research priorities. |
| Initiative 5: Identify Funding Sources | Funding efforts have been fragmented, with faculty pursuing opportunities individually, leading to missed opportunities and underfunding in priority areas. A centralized, strategic approach is needed to align departmental research priorities with available funding. | Assess departmental funding needs and establish a structured process for identifying and securing internal and external funding aligned with institutional and national priorities. | Conduct a department-wide needs assessment, prepare a Research Funding Executive Summary, develop modular proposal templates, and circulate relevant funding calls. | One academic year — needs assessment in semester one, proposal development and submission support in semester two. | • Funding needs assessment report • Research Funding Executive Summary • Draft or submitted proposals aligned with priorities | Track faculty participation, proposal development activity, and grant submission outcomes. | • ≥75% faculty participation in needs assessment • ≥3 modular proposals prepared annually • 30% increase in grant submissions compared to previous year | Tailors funding strategies to the department's research strengths, providing coordinated support for faculty grant-seeking efforts. |
| Initiative 6: Update Faculty Scientific Research | Research output has been recorded inconsistently, | Maintain an accurate, accessible, and up-to- | Audit existing records, conduct annual data collection | Annual cycle — survey design and distribution | • Updated research activity database | Track faculty response rates, data | • ≥90% faculty submission rate | Employs flexible survey formats and |

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| **Activities Database** | making internal evaluation and external reporting inefficient and error-prone. A centralized, regularly updated system is required for accurate tracking. | date database of faculty research activities to support evaluation, planning, and reporting. | using standardized surveys, validate entries, and integrate into a structured database. | in semester one; validation, analysis, and database update in semester two. | • Internal and external reporting datasets <br> • Streamlined annual data collection process | completeness, and consistency with external records. | • ≥95% data accuracy <br> • Annual database update completed before year-end reporting | standardized data categories to ensure comprehensive, high-quality reporting aligned with university KPIs. |
| **Initiative 7: Include Undergraduates in Scientific Research** | Undergraduate students have limited structured exposure to research, resulting in missed opportunities for skill development and faculty–student collaboration. | Introduce undergraduates to research through guided participation in faculty-led projects, literature engagement, and departmental activities. | Hold research literacy sessions, facilitate paper discussion meetings, survey faculty on mentoring interest, and pilot an undergraduate integration plan. | One academic year — planning and engagement in semester one; implementation in semester two. | • Two or more research literacy sessions <br> • Faculty engagement report and integration plan <br> • Pilot student–faculty research activities | Track participation rates and collect feedback from students and faculty to assess pilot success. | • ≥20 undergraduate participants in initial sessions <br> • ≥5 faculty hosting student research activities <br> • ≥80% positive participant feedback | First formal departmental program for undergraduate research engagement, designed for scalability and sustainability. |

**Table 3.** Overview of the Seven Strategic Initiatives of the Scientific Research Committee

## 6. Operational Framework

The operational framework outlines how the Scientific Research Committee functioned during the reporting period to implement its approved initiatives. It is based on the *Scientific Research Committee Operational Plan*, formally approved at a department chair meeting, which specified the seven initiatives, their subtasks, expected outcomes, and milestone timelines.

a)   **Meeting Operations and Schedule**

The committee operated on an initiative-based structure, with each initiative led by a designated faculty member or staff representative. Coordination was maintained primarily through individual

consultations between the chairperson and initiative leads, with progress tracked against the milestones set out in the operational plan. Monthly follow-ups were conducted via a dedicated WhatsApp group, which enabled rapid updates, document sharing, and issue resolution. During this period, no full-committee meetings were convened; instead, activities were managed through one-to-one and digital communications.

b)  **Confidentiality and Data Handling**

All members are required to maintain strict confidentiality regarding committee discussions, unpublished data, and strategic planning materials. Sensitive information, particularly related to funding, faculty evaluations, or student participation, is shared only with relevant subgroups.

c)  **Reporting Protocol**

- **Frequency:** A comprehensive annual report is submitted to the department chair at the end of each academic year.
- **Components:** Initiative summaries, progress metrics, challenges, engagement levels, and strategic recommendations.
- **Interim Updates:** Provided semi-annually or upon request.

d)  **Ethics and Code of Conduct**

Members are expected to:
- Uphold academic integrity and research ethics.
- Participate constructively and respectfully.
- Avoid conflicts of interest.
- Ensure equitable participation across roles and genders.
- Maintain professional conduct in all official capacities.

e)  **Data and Documentation Availability**

All non-confidential committee documentation, operational plans, and datasets referenced in this study are available from the corresponding author upon reasonable request. This study did not involve human or animal subjects and therefore did not require institutional ethics approval.

## 3. Results / Current Progress

This section presents the progress, achievements, and measurable outputs of the Scientific Research Committee's seven strategic initiatives during the reporting period, highlighting both quantitative indicators and qualitative outcomes.

### 3.1 Initiative Progress Overview

As of May 2025, the Scientific Research Committee has advanced all seven coordinated initiatives, with two fully completed, three in active progress, and two in early implementation stages (Figure 2). Table 4 summarizes the key achievements and quantitative indicators of each Initiative.
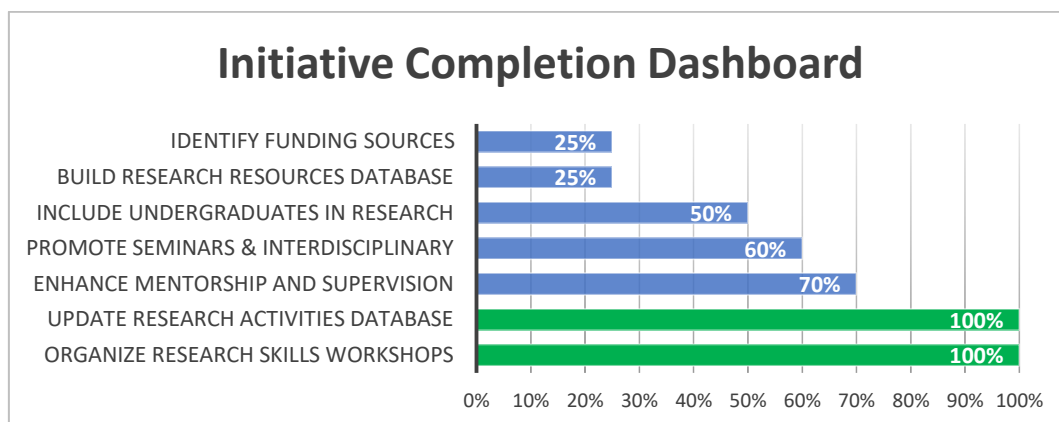
**Figure 2.** Completion status of the seven strategic initiatives of the Scientific Research Committee during the reporting period.

**Table 4.** Summary of Early Outcomes of the Scientific Research Committee (Sep 2024 – May 2025)

| Area | Key Achievements | Quantitative Indicators |
|---|---|---|
| **Mentorship & Supervision** | Developed and approved a structured mentorship framework; initiated pilot mentor–mentee pairings for junior faculty. | Initial pilot launched; mentor–mentee list prepared. |
| **Research Skills Development** | Delivered targeted workshops on LaTeX, Mendeley, Deanship research services, and nanotechnology in collaboration with the Centre of Nanotechnology. | 5 workshops delivered; ≥80% participant satisfaction in post-workshop surveys. |
| **Research Infrastructure** | Updated and validated the Faculty Scientific Research Activities Database; improved data accuracy and accessibility for reporting. | 2 survey rounds completed; database update finalized. |
| **Funding Strategy** | Conducted funding needs assessment; prepared and presented the 2025 Research Funding Executive Summary to the department chair. | 1 funding summary report; priority proposals identified. |
| **Undergraduate Engagement** | Delivered introductory sessions on research literature; surveyed faculty for undergraduate research hosting; developed integration plan. | 2 undergraduate sessions; ≥20 student participants. |
| **Interdisciplinary Collaboration** | Facilitated faculty connections for cross-departmental research opportunities; promoted participation in external seminars and events. | 2 interdisciplinary events; monthly event list circulated. |

### 3.2 Early Outcomes

Despite operating through a decentralized, initiative-based structure, the Scientific Research Committee delivered measurable early outcomes between September 2024 and May 2025 (Table 4). A structured mentorship framework was designed and piloted, a series of targeted research workshops was completed, and key infrastructure was strengthened through an updated faculty database and a Research Funding Executive Summary. Undergraduate engagement also advanced through initial

research literacy sessions and faculty surveys, laying the groundwork for sustained student participation. Collectively, these achievements illustrate the committee's capacity to translate strategic objectives into action and to establish a foundation for long-term research and innovation capacity building (Figure 3).
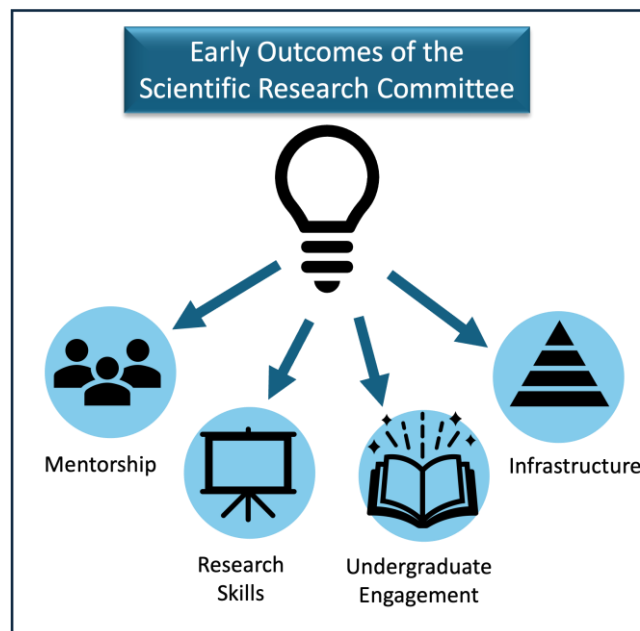


**Figure 3.** Early outcomes of the Scientific Research Committee.

### 3.3 Quantitative Indicators

Table 4 highlights the committee's tangible outputs, including workshops, undergraduate sessions, interdisciplinary events, surveys, and database updates. While participation and activity levels confirm early progress toward objectives, they also reveal areas for improvement—particularly in faculty survey response rates, which averaged only 50%. The establishment of a validated research database, pilot mentorship pairs, and a funding executive summary indicates that the committee has begun to institutionalize systems for long-term monitoring and resource mobilization. These quantitative gains, though modest, provide a measurable baseline against which future cycles can be evaluated.

### 3.4 Comparative Trends Analysis

To evaluate the department's research performance over time and provide context for the 2024 outcomes, multi-year data from the Scientific Research Activities Database were analyzed, covering the period 2021–2024. This comparative analysis highlights key trends in publications, projects, patents, and citations, providing a baseline for assessing the potential long-term impact of the Scientific Research Committee's initiatives.

3.4.1. Publication Trends (ISI and non-ISI)
From 2021 to 2024, the number of ISI-indexed publications in the Physics Department followed an overall upward trajectory, starting at 237 in 2021, dipping slightly to 230 in 2022, then rising to 291

in 2023 and reaching a peak of 298 in 2024 (Figure 4). Non-ISI publications, although fewer, increased steadily from 10 in 2021 to 18 in 2024. This trend reflects a sustained high level of indexed research output alongside gradual growth in non-indexed contributions.

The peak in ISI publications in 2024, albeit a modest increase from 2023, coincided with the rollout of structured mentorship and targeted research skills workshops. These initiatives likely supported the maintenance of high-quality output while enhancing faculty engagement in scholarly publishing.
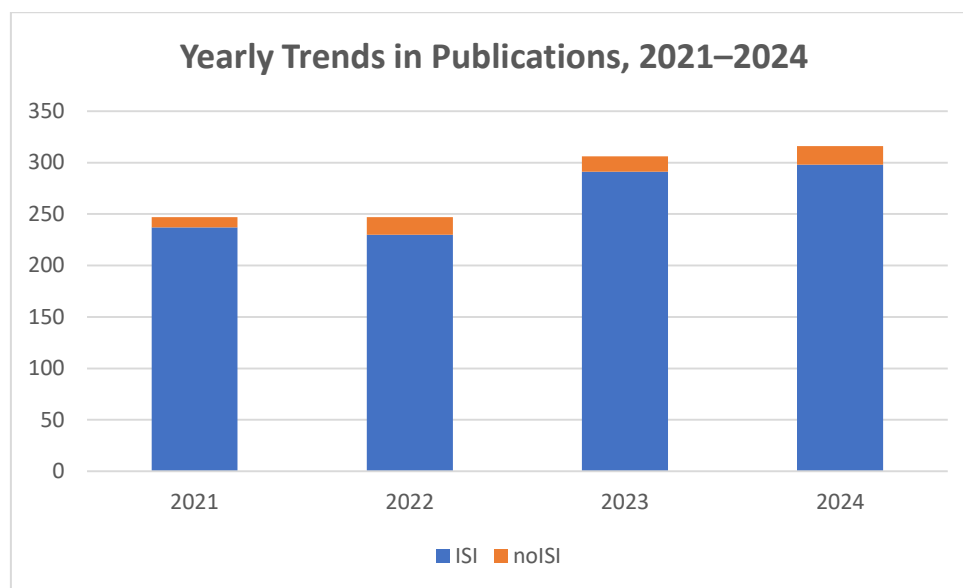


**Figure 4**. Annual trends in ISI and non-ISI publications for the Physics Department from 2021 to 2024.

3.4.2. Research Projects (Funded vs. Non-Funded)

Between 2021 and 2024, the number of KAU-funded projects fluctuated, rising from 8 in 2021 to 13 in 2022, then dipping to 9 in 2023 before recovering to 11 in 2024 (Figure 5). Non-KAU-funded projects remained comparatively limited, ranging from zero to three per year, with the highest number recorded in 2024.

The slight recovery in both KAU and non-KAU funding in 2024 aligns with the early implementation of the Identify Funding Sources initiative, which introduced a structured funding needs assessment and prepared the department's first Research Funding Executive Summary. Although still in its initial stages, this initiative appears to have supported greater visibility of funding opportunities and diversification of funding sources.
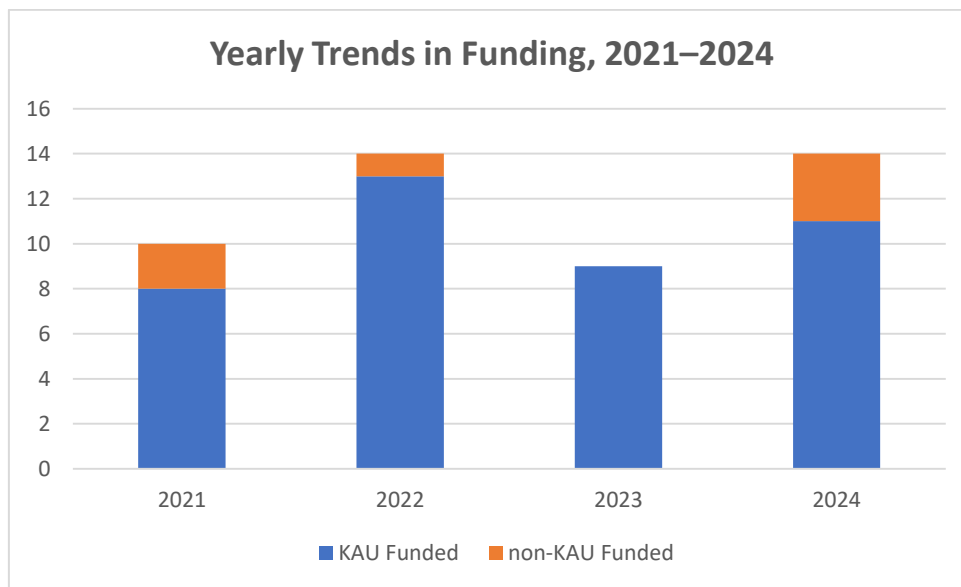
**Figure 5**. Annual trends in KAU- and non-KAU-funded projects in the Physics Department, 2021–2024.

3.4.3. Patent Activity

From 2021 to 2024, the department's patent output remained modest but steady, with one patent filed in 2021, two in 2022, none in 2023, and two again in 2024 (Figure 6). The absence of new patents in 2023 reflects a temporary lull, but the recovery in 2024 suggests renewed engagement with innovation pathways.

This modest upward trend coincided with broader efforts under the Mentorship and Research Skills Workshops initiatives, which emphasized grant writing, research design, and translational impact. While patents are not a direct outcome of these initiatives, the strengthened support for research competencies and structured mentorship likely created an enabling environment that facilitated patent activity. This also signals convergence with international patterns in which departmental mentorship, project design support, and early IP activity operate as proximate levers for research commercialization pathways [11–13].
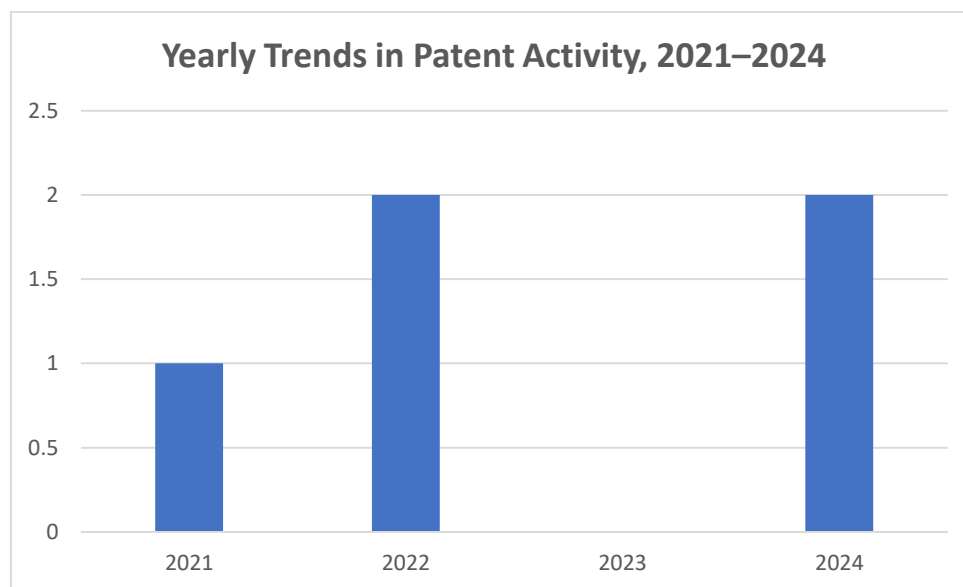
**Figure 6**. Patent filings in the Physics Department, 2021–2024.


### 3.4.4. Citation Trends

From 2021 to 2024, faculty citation averages in the Physics Department demonstrated variability across both Web of Science and Google Scholar (Figure 7). Web of Science citations rose from 220 in 2021 to a peak of 257.57 in 2022, dipped to 196.94 in 2023, and then recovered to 231.94 in 2024. By contrast, Google Scholar consistently showed higher citation averages, increasing from 234.18 in 2021 to 313.66 in 2024, despite a minor dip in 2023. The consistent upward trend in Google Scholar indicates growing visibility and impact of departmental research across wider academic and professional audiences, while Web of Science reflects more selective citation dynamics.

These citation patterns align with Initiative 6 (Update Faculty Scientific Research Activities Database), which emphasized systematic tracking of faculty research outputs and ensured more accurate reporting. The recovery in 2024 also coincides with Initiative 2 (Research Skills Workshops), which strengthened publication practices and visibility strategies, potentially contributing to improved citation performance across platforms.
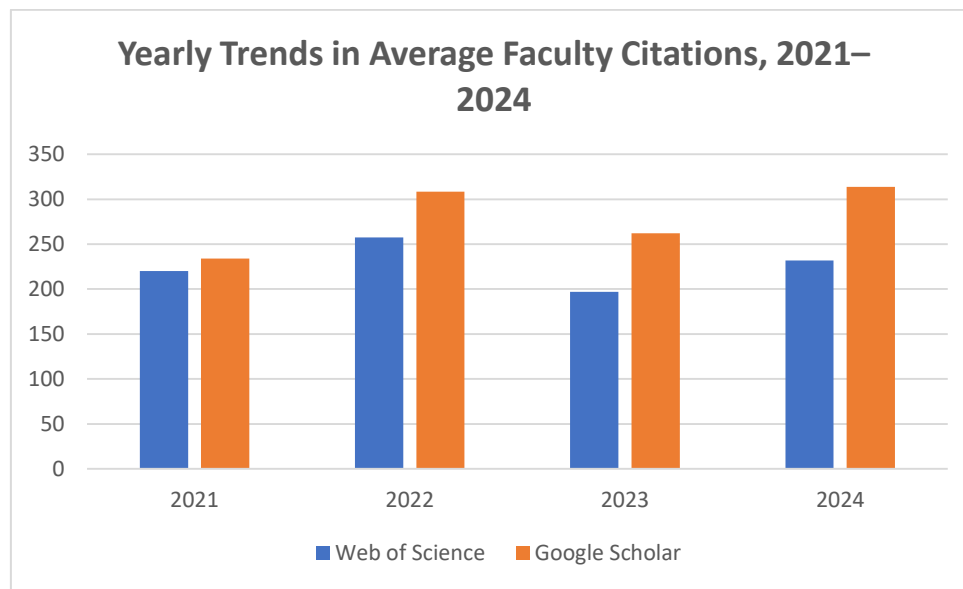
**Figure 7**. Average faculty citations in the Physics Department from 2021 to 2024, based on Web of Science and Google Scholar data.

### 3.5 Challenges Encountered

While the committee achieved measurable progress across its seven initiatives, several operational and structural challenges emerged during implementation. These challenges varied in scope from participation and resource constraints to procedural inefficiencies and coordination gaps, and had direct implications for timelines, data quality, and overall impact. Table 5 summarizes each challenge alongside its observed impact and proposed mitigation strategies to inform future cycles of committee work.

**Table 5.** Challenges Encountered, Their Impact, and Mitigation Strategies

| Challenge | Impact | Mitigation Strategy |
|---|---|---|
| **Low engagement from some committee members** | Slowed progress in initiatives requiring broad input (e.g., surveys, mentorship program participation, seminar attendance); uneven workload | Introduce clear role definitions, assign deliverables, and monitor participation through scheduled progress check-ins |
| **Manpower shortages and overreliance on individual leads** | Delays in initiative timelines; reduced capacity to address emerging issues; risk of burnout for key contributors | Recruit additional committee members; engage postgraduate or undergraduate assistants; distribute sub-tasks among multiple members |
| **Inefficiencies in data design, collection, and cleaning** | Prolonged analysis time; inconsistent or incomplete datasets; delayed reporting | Standardize data collection tools; run pilot surveys; provide clear instructions and examples to respondents |

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|---|---|---|
| **Overlap with other university initiatives** | Confusion over initiative scope and ownership; duplication of work | Establish early coordination with other units; formally document project boundaries in the operational plan; assign liaison roles |
| **Absence of full-committee meetings** | Reduced cross-initiative coordination; limited collective problem-solving and shared accountability | Introduce quarterly full-committee meetings in addition to one-to-one updates; share initiative updates in a centralized progress log to improve communication and alignment |
| **Limited faculty response to surveys** | Incomplete datasets; reduced accuracy of research activity tracking | Simplify survey formats, set clear deadlines, and integrate completion into annual performance expectations |
| **Role ambiguity and lack of administrative support** | Slower decision-making; inconsistent documentation | Define roles in the operational plan and assign administrative support for minutes, documentation, and follow-ups |
| **Logistical constraints in accessing and verifying equipment data** | Delayed progress on research resource database; incomplete records | Prioritize accessible facilities first; identify official points of contact for verification; phase the project |
| **Difficulty securing external speakers for workshops due to procedural delays** | Missed opportunities for certain training topics | Build a pre-approved pool of speakers; start outreach earlier in the term; explore internal expertise where possible |
| **Limited faculty availability for undergraduate-focused initiatives** | Slower integration of undergraduates into research activities | Develop flexible, low-time-commitment mentoring formats; align undergraduate involvement with ongoing faculty projects |

### 3.6 Recommendations

Drawing on the findings and challenges identified during the 2024–2025 implementation cycle, a set of targeted recommendations is proposed to enhance the Scientific Research Committee's operations in the upcoming year. These recommendations are designed to address existing limitations, reinforce successful practices, and improve overall coordination, efficiency, and impact across all strategic initiatives. Table 6 presents the recommendations, their rationale, and the intended outcomes.

**Table 6**: Recommendations Summary Table

| Recommendation | Purpose | Expected Impact |
|---|---|---|
| **Clarify Roles and Strengthen Support** | Assign clear responsibilities and provide adequate resources to initiative leads | Improved accountability and faster progress toward milestones |
| **Institutionalize Full-Committee Meetings** | Establish regular meeting schedule | Enhanced coordination, shared accountability, and timely decision-making |
| **Streamline Data Collection** | Consolidate into a single annual survey | Reduced administrative burden and improved data quality |
| **Enhance Inter-Unit Coordination** | Align with departmental and university initiatives | Minimized duplication and better resource utilization |
| **Expand and Structure Student Engagement** | Formalize undergraduate participation frameworks | Increased student contribution and skill development |
| **Secure Administrative and Technical Support** | Allocate dedicated personnel for documentation and logistics | Frees academic leads for strategic and technical work |

Implementing these recommendations in the 2025 cycle will strengthen the committee's capacity to deliver on its strategic objectives and ensure that its initiatives remain aligned with departmental, institutional, and national research priorities. By addressing structural and operational gaps, the committee will be better positioned to foster a collaborative, data-driven, and innovation-oriented research culture, with sustained engagement from faculty, students, and technical staff.

## 4. Discussion

The establishment of the Scientific Research Committee within the Physics Department has yielded measurable early outcomes in mentorship, research training, infrastructure development, and undergraduate engagement. Within less than one academic cycle, the committee introduced a structured mentorship framework, piloted faculty pairings, and delivered a series of targeted research skills workshops. These efforts are consistent with higher education capacity-building models, which highlight structured mentorship and didactic training as essential components of academic development [14]. Inclusive mentorship is particularly valuable, as evidence shows that underrepresented and first-generation undergraduates who engage in mentored research achieve higher academic outcomes and greater research independence[15]. Furthermore, periodic opportunities for faculty to refresh and expand their skills are recognized as critical to sustaining long-term research productivity and innovation [16]. These initiatives directly address departmental priorities by closing skill gaps, enhancing scholarly productivity, and offering systematic guidance to early-career academics [17]. This model aligns with broader capacity-building strategies in higher education, where effective faculty development integrates structured didactic training, mentorship, and hands-on research opportunities [18].

Ongoing exposure to advanced knowledge through complementary learning modalities is also essential to ensure that academic competencies remain current and aligned with institutional goals [19].

Infrastructure improvements, particularly the update and validation of the Faculty Scientific Research Activities Database, strengthened the department's capacity for evidence-based planning and transparent reporting. A reliable database not only ensures accurate tracking of publications, projects, and funding but also provides the foundation for calculating departmental KPIs and for alignment with institutional systems such as the Evaluation and Quality Assurance of University Performance (EQUAP). Key performance indicators are widely recognized as essential for accountability in higher education, and research information systems play a pivotal role in aggregating outputs to inform decision-making and benchmarking [18]. By consolidating this information, the committee has created a tool that supports evaluation, resource allocation, and strategic alignment with university and national research priorities.

Complementing these structural developments, the introduction of undergraduate-focused sessions represents a parallel investment in human capital. Evidence from higher education confirms that undergraduate research experiences (UREs) are high-impact practices that extend learning beyond memorization, foster critical thinking, and connect coursework to scientific inquiry and innovation [20, 21]. Importantly, UREs are not limited to laboratory-based work; they include activities such as engaging with scientific literature, contributing to project design, and producing oral or written outputs [22]. By adopting this broader understanding of research engagement, the committee's initial steps in undergraduate integration lay a strong foundation for sustained student participation in future research cycles.

Beyond supporting traditional research outputs, several initiatives also create pathways toward entrepreneurial outcomes. The mentorship program fosters translational thinking by guiding early-career faculty in project design and proposal development, the funding strategy enhances the department's readiness to pursue external grants and innovation-linked funding calls, and the modest recovery in patent activity indicates the potential for applied research translation. Collectively, these elements position the committee model as both a research support structure and a foundation for entrepreneurship within the university context.

From an entrepreneurial-ecosystem perspective, the committee's initiatives activate several core components: human capital (mentorship and workshops), knowledge & support infrastructure (research activity and resources databases), networks (seminars and interdisciplinary projects), and finance & incentives (funding strategy). By reinforcing these interdependent elements, the model functions as a departmental micro-ecosystem that connects to broader institutional and regional entrepreneurship architectures, thereby increasing the likelihood that research capacity translates into innovation, intellectual property, and venture-oriented collaboration [11–13].

The results also reflect gains in absorptive capacity, the ability to acquire, assimilate, transform, and exploit knowledge. Workshops and seminars strengthen acquisition and assimilation; mentorship and student integration foster transformation; and the funding strategy together with emerging patent activity enable exploitation toward applied and entrepreneurial outcomes [25].

Strategic lessons emerging from these findings include: (i) local micro-ecosystems accelerate coordination and learning; (ii) absorptive-capacity building requires paired investments in human capital and data infrastructure; and (iii) diffusion levers such as visibility, social proof, and low-friction communication channels are essential for scaling participation.

Variability in participation and survey response can be interpreted through diffusion of innovations. Early adopters (initiative leads and engaged faculty) drove initial progress, while broader uptake will require clearer communication channels, visible relative advantage (e.g., KPI/EQUAP reporting benefits), and periodic full-committee forums to strengthen social proof and reduce perceived complexity [26].

At the same time, several operational challenges limited the efficiency. Low faculty response rates to surveys, reliance on a small number of initiative leads, and the absence of full-committee meetings highlighted the need for stronger coordination mechanisms and clearer role definitions. These challenges mirror broader trends in higher education, where traditional leadership approaches often fall short of supporting collaborative implementation. As noted in recent research, the lack of structures that promote shared leadership, such as authentic role distribution, interdependence, and team empowerment, can limit an institution's ability to adapt and sustain new initiatives [9, 23]. These issues are consistent with early-stage committee models in higher education, where enthusiasm for new initiatives may outpace available resources and administrative support [27]. Importantly, these challenges generated practical lessons, including the value of phased database development, early alignment with existing university initiatives, and the institutionalization of regular committee meetings to ensure accountability and shared problem-solving.

Comparatively, the departmental model aligns with international practices that emphasize structured research management and performance-informed planning (e.g., CRIS-enabled tracking, KPI-linked reporting, and targeted capacity building). OECD Higher Education Innovate (HEI) reviews similarly recommend linking university initiatives to regional smart-specialisation priorities and entrepreneurial learning [24]. Within Saudi Arabia, the committee's mapping of projects to institutional priorities and to Vision 2030 mirrors national expectations for innovation-oriented performance and knowledge-economy outcomes [10]. While many universities centralize these functions, our results suggest that a department-level micro-infrastructure can accelerate implementation by localizing ownership and shortening feedback loops, thereby complementing university-wide offices and policies [11–13, 28]. Emerging trends in Saudi universities, particularly in engineering and medical faculties, point to piolet internal research councils that aim to accelerate grant submissions and student participation, though these efforts remain uneven across departments. Internationally, comparable departmental-level structures in UK and Australian universities have demonstrated that distributed mentorship and localized accountability can reinforce central strategies while increasing agility [19, 24]. By situating the KAU Physics Department model within this spectrum, we highlight how a localized, initiative-based framework can deliver early impact and offer transferable lessons for institutions seeking to balance central oversight with departmental autonomy.

Taken together, these findings illustrate both the promise and limitations of committee-driven models for advancing research and innovation infrastructure. While the 2024–2025 cycle demonstrates fea-

sibility and early impact, longer-term evaluation will be essential to determine sustainability, scalability, and alignment with broader institutional and national priorities. The committee's approach of mapping projects to university and national strategic themes reflects broader international trends in which research capacity is treated as a strategic driver of competitiveness and policy-making. Governments increasingly view investment in research and management processes as essential to sustaining national knowledge economies [28]. Future directions include strengthening undergraduate research integration, expanding mentorship capacity, and benchmarking outcomes against comparable departments. By addressing these areas, the committee model may provide a scalable template for fostering ethical, collaborative, and innovation-oriented research environments.

In summary, the early outcomes of the Scientific Research Committee demonstrate the feasibility of a departmental model for strengthening research infrastructure, faculty development, and student engagement. Through the lenses of entrepreneurial ecosystems, absorptive capacity, and innovation diffusion, the model also contributes to the development of entrepreneurship pathways aligned with Saudi Vision 2030. While challenges remain, the initiative-based approach provides a promising foundation for a sustainable, innovation-oriented research culture that can be adapted within Saudi universities and beyond.

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