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Scientific and Pedagogical Schools in New Technological Order: A Community-Service Framework for Knowledge Sharing and Academic Development

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ABSTRACT

Scientific and pedagogical schools can connect research, education, mentoring, and knowledge transfer within universities. This conceptual study examines their changing functions under a new technological order and translates these functions into a community-service framework for academic development. Historical, institutional, systems, comparative, and forecasting approaches were used to analyze scientific-pedagogical schools as collaborative academic communities. The analysis highlights their roles in knowledge generation, tacit-knowledge transfer, mentoring, professional development, research collaboration, and university engagement. A community-service perspective extends these roles toward academic mentoring, interdisciplinary collaboration, knowledge-sharing activities, and university-community interaction. Strengthening scientific and pedagogical schools may therefore support sustainable academic communities while connecting research and educational expertise with broader societal needs.

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1. INTRODUCTION

Universities operate in an environment characterized by rapid technological change, growing interdisciplinarity, accelerated knowledge production, and increasing expectations for societal engagement. These changes affect not only the content of research and education but also the organizational forms through which academic knowledge is generated, transferred, preserved, and applied. Research groups have consequently become important structures within higher education because they can organize collaborative inquiry, researcher development, and specialized academic activity [1]. Within this broader context, scientific and pedagogical schools can be understood as academic communities that combine research, teaching, mentoring, and professional development around a shared intellectual direction.

A scientific and pedagogical school refers to a community involving academic staff, researchers, graduate students, undergraduate students, and other participants who engage jointly in research and educational activities united by a common scientific or pedagogical direction. This definition positions the scientific-pedagogical school not simply as an administrative unit but as a collaborative academic environment for generating, preserving, and transmitting knowledge.

One important function of such academic communities is knowledge sharing. Universities depend not only on explicit knowledge that can be documented in articles, books, databases, or instructional materials but also on tacit knowledge developed through research experience, professional judgment, mentoring, experimentation, and interpersonal interaction. Research on higher-education groups indicates that tacit-knowledge sharing is influenced by relationships, organizational conditions, and collaborative practices [2]. Academic culture also shapes the ways in which new researchers learn how to participate in research, communicate findings, and develop professional identities [3]. Tacit knowledge is therefore particularly important because much research expertise cannot be transferred fully through formal documentation alone [4].

The transfer of such knowledge is closely connected with mentoring. Scientific and pedagogical schools can provide opportunities for experienced academics to support younger researchers, doctoral students, and students through participation in shared research activities. Peer mentoring and collaborative academic groups can facilitate knowledge sharing and researcher development [5]. More broadly, mentoring in higher education can contribute to professional learning, academic socialization, and career development when relationships are structured around meaningful professional interaction [6].

These characteristics are increasingly relevant under conditions of technological and organizational change. Digital technologies expand access to information, facilitate virtual collaboration, and make scientific communication faster, but they do not eliminate the need for interpersonal knowledge exchange. On the contrary, when scientific work becomes more interdisciplinary and specialized, researchers may require stronger communities for interpreting information, transferring tacit expertise, developing professional judgment, and integrating knowledge across fields. Scientific and pedagogical schools may become increasingly important as scientific knowledge becomes more complex and as tacit knowledge gains greater significance in research and education.

Scientific and pedagogical schools can also be considered through the concept of communities of practice. Academic communities can support professional learning when

members interact regularly, share experiences, discuss practical problems, and collectively develop knowledge. Communities of practice have been used to support faculty development and professional learning in higher education [7-9]. This perspective broadens the meaning of scientific-pedagogical schools from groups organized around individual scholars to collaborative environments that support continuous learning and institutional development.

Another important dimension concerns research collaboration and innovation. Internal academic networking can strengthen knowledge-management processes and contribute to university innovation [10]. Universities also perform an important knowledge-transfer function by linking research with broader institutional, economic, and societal environments [11]. Research groups can interact with non-academic actors through knowledge exchange, collaborative activities, consultation, and other forms of engagement [12]. Scientific-pedagogical schools can operate not only internally within universities but also externally as mechanisms connecting academic expertise with professional and community needs.

This external orientation creates a direct connection with community service. Within higher education, community service can involve the translation of academic knowledge into mentoring, professional development, educational support, knowledge-sharing activities, interdisciplinary collaboration, and engagement with external stakeholders. Scientific and pedagogical schools can provide an organizational basis for such activities because they already combine research expertise, teaching capacity, professional networks, and student participation.

Scientific and pedagogical schools perform several interconnected functions, including generating new knowledge, transferring knowledge through pedagogical activity, integrating science and teaching, supporting professional advancement, strengthening professional communication, preserving tacit knowledge, accelerating professional development, and developing specialized academic cultures. These functions can be reinterpreted within a community-service framework without assuming that specific community-service interventions have already been implemented.

The present study therefore aims to: (i) conceptualize scientific and pedagogical schools within contemporary higher education; (ii) examine their functions in knowledge generation, knowledge transfer, mentoring, and professional development; (iii) analyze their relevance under a new technological order; (iv) identify their potential role in university engagement and community service; and (v) develop a conceptual community-service framework connecting scientific-pedagogical schools with academic development, knowledge sharing, mentoring, and external engagement. The novelty of this study lies in repositioning scientific and pedagogical schools as multidimensional academic communities rather than treating them only as historical or organizational structures. The framework connects their research and pedagogical functions with tacit-knowledge transfer, academic mentoring, communities of practice, university engagement, and community service.

2. LITERATURE REVIEW

2.1. Scientific and pedagogical schools as academic communities

Scientific and pedagogical schools represent a form of organized academic collaboration centered on a shared research and educational direction. Their membership can include experienced academics, early-career researchers, postgraduate students, undergraduate students, and other participants who contribute to scientific and educational activities. Such

groups differ from purely administrative departments because their cohesion is primarily intellectual and professional. Research groups within universities can provide structures for organizing research activity, developing academic specialization, and supporting researcher training [1]. The effectiveness of such groups depends partly on communication, shared goals, leadership, continuity, and opportunities for interaction among members. Scientific-pedagogical schools can therefore be interpreted as academic communities in which research activity and educational development are closely integrated. This interpretation is particularly relevant because scientific-pedagogical schools can function as traditional forms of academic teamwork that contribute to research, education, professional communication, and institutional development.

2.2. Knowledge generation and collaborative research

One of the primary functions of scientific and pedagogical schools is the generation of new knowledge. Collaborative research can enable members to combine specialized expertise, exchange methodological perspectives, develop ideas collectively, and coordinate research activities. Internal networking is particularly important because knowledge-management processes can influence innovation and research performance within university environments [10]. Scientific-pedagogical schools may strengthen this process by providing continuity across projects and generations of researchers. Rather than organizing research exclusively through temporary projects, such schools can preserve methodological traditions and intellectual directions while allowing these traditions to evolve in response to new problems. Collective idea generation, methodological coordination, and integration of scientific activity are therefore important functions of scientific-pedagogical schools.

2.3. Tacit and explicit knowledge transfer

Academic knowledge exists in both explicit and tacit forms. Explicit knowledge can be codified through publications, reports, datasets, instructional materials, and formal procedures. Tacit knowledge is more closely related to professional experience, judgment, methodological intuition, problem-solving strategies, and practical research skills. Tacit-knowledge sharing within higher-education research groups depends on interactions among members and on organizational environments that facilitate communication and trust [2]. Research impact itself may also depend on forms of know-how that cannot be communicated completely through formal academic outputs [4]. Scientific-pedagogical schools therefore provide a potentially important setting for transferring knowledge through observation, collaboration, mentoring, discussion, and participation in research practices. Under rapid technological change, this function becomes especially significant. Digital information systems can distribute explicit knowledge efficiently, but they cannot completely substitute for interpersonal processes through which professional judgment and research experience are developed.

2.4. Mentoring and researcher development

Mentoring represents another central function of scientific-pedagogical schools. Research communities allow less-experienced members to participate in scientific activity alongside more experienced researchers. Such participation can facilitate methodological learning, academic communication, publication practices, professional networking, and the formation of researcher identities. Peer-mentoring groups can support knowledge sharing in doctoral education [5], while broader research on mentoring in higher education demonstrates its importance for professional and academic development [6]. Scientific-pedagogical schools

can therefore function as multi-level mentoring environments in which senior academics, early-career researchers, postgraduate students, and undergraduate students participate in interconnected forms of learning. This function positions scientific-pedagogical schools as mechanisms for professional advancement, social support, and accelerated professional development.

2.5. Communities of practice and academic development

Scientific-pedagogical schools can also be interpreted through the concept of communities of practice. Faculty-development literature indicates that communities of practice can facilitate learning through sustained interaction, knowledge exchange, collaboration, and shared professional activity [7]. Such communities can strengthen professional identity and allow academics to learn from each other's experiences. Communities of practice have also been examined as mechanisms for future faculty development [8] and as collaborative structures supporting professional development in higher education [9]. These findings are relevant because scientific-pedagogical schools similarly depend on regular interaction among participants with different levels of experience and expertise. The community-of-practice perspective also emphasizes that learning occurs through participation rather than solely through formal instruction. This is consistent with the role of scientific-pedagogical schools in transmitting tacit knowledge and developing academic competencies through collaborative activity.

2.6. Scientific-pedagogical schools under technological change

Technological development has transformed scientific communication, educational delivery, access to information, and collaborative research. Virtual communication allows geographically dispersed researchers to participate in shared projects, while digital databases provide immediate access to large bodies of scientific knowledge. These developments can change the organizational form of scientific-pedagogical schools without necessarily reducing their importance. Scientific-pedagogical schools may develop as both physical and virtual academic communities, while digitalization, smart education, changing university management, and new forms of research organization increasingly shape their development. A new technological order can therefore be understood as requiring greater flexibility in academic collaboration. Scientific-pedagogical schools may increasingly combine face-to-face mentoring with virtual communication, interdisciplinary collaboration, digital research infrastructure, and distributed knowledge-sharing networks.

2.7. University knowledge transfer and external engagement

Universities increasingly operate through relationships extending beyond their institutional boundaries. Knowledge transfer can include interaction with industry, public organizations, professional associations, educational institutions, and community groups. Research on universities shows that knowledge transfer and academic engagement are important elements of institutional research activity [11]. Research groups in the social sciences and humanities also interact with non-academic actors through knowledge-transfer activities [12]. Academic knowledge does not need to remain confined within university departments. Scientific-pedagogical schools can therefore serve as organizational units through which knowledge and expertise are translated into external educational and professional activities. This perspective also strengthens the community-service relevance of

scientific-pedagogical schools. Their internal research and mentoring capabilities can become resources for addressing external educational, professional, technological, or social needs.

2.8. Scientific-pedagogical schools and community service

Community service provides a mechanism through which the intellectual resources of scientific-pedagogical schools can be connected with broader beneficiaries. Potential activities include academic mentoring, methodological workshops, professional-development sessions, collaborative research consultations, knowledge-sharing forums, educational outreach, and support for early-career researchers. The broader conceptual relationship among the academic functions of scientific-pedagogical schools, technological change, and community-service outcomes is illustrated in **Figure 1**. Scientific-pedagogical schools occupy the central position in the framework because they connect Knowledge Generation, Tacit-Knowledge Transfer, Mentoring and Researcher Development, Research-Pedagogy Integration, and External Engagement. These functions operate within a changing environment shaped by digitalization, interdisciplinary collaboration, virtual academic networks, and university-community interaction. Together, they can contribute to Academic Development, Knowledge Sharing, and Community Service.

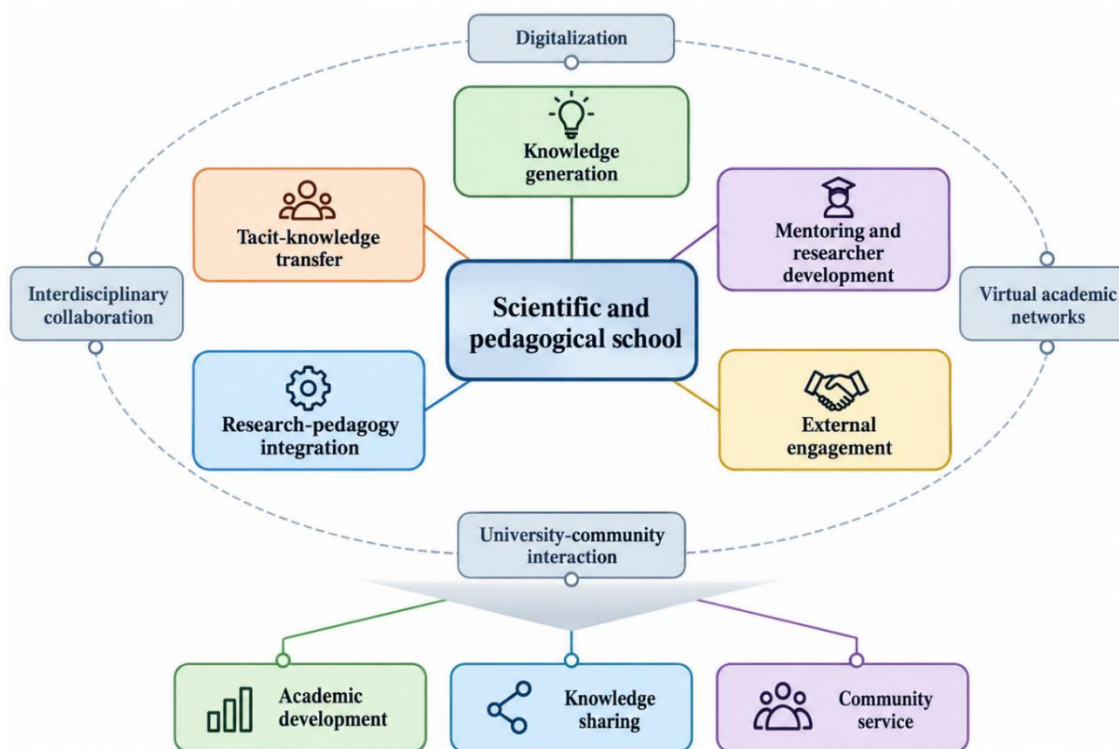


Figure 1. Conceptual framework of scientific and pedagogical schools under a new technological order.

The relationship among the major functions of scientific-pedagogical schools and possible community-service applications is summarized in **Table 1**. The framework organizes the identified conceptual functions into potential areas for community-oriented academic development. Scientific-pedagogical schools can therefore be conceptualized as an interface among research, teaching, mentoring, professional development, and community engagement. Their effectiveness depends not only on scientific productivity but also on their capacity to preserve expertise, develop new researchers, create collaborative cultures, and make academic knowledge accessible to broader groups.

Table 1. Community-service framework for scientific and pedagogical schools.

SCIENTIFIC-PEDAGOGICAL FUNCTION	COMMUNITY-SERVICE FOCUS	POTENTIAL PARTICIPANTS	EXPECTED CONTRIBUTION
Knowledge generation	Collaborative research and problem-solving activities	Academics, researchers, students, external partners	Strengthening collaborative knowledge production
Tacit-knowledge transfer	Mentoring and experience-sharing sessions	Senior academics, early-career researchers, students	Preserving and transferring professional expertise
Researcher development	Research-methodology and academic-development activities	Postgraduate students and early-career researchers	Strengthening research and professional competencies
Science-pedagogy integration	Teaching-research workshops	Academics and educators	Connecting research findings with educational practice
Professional networking	Academic communities and knowledge-sharing forums	Researchers, educators, professional groups	Expanding professional collaboration
External knowledge transfer	University-community and university-industry engagement	Universities and external stakeholders	Applying academic expertise to broader societal needs
Institutional continuity	Mentoring, succession, and collaborative leadership	Senior and emerging academic leaders	Supporting sustainability of academic communities

3. METHOD

3.1. Research Design

This study employed a conceptual and analytical research design to examine the functions and contemporary relevance of scientific and pedagogical schools in higher education. The analysis examined conceptual arguments and historical perspectives concerning the development and functions of scientific and pedagogical schools.

3.2. Analytical Approach

The study applied historical, institutional, systems, and comparative approaches to examine the development, organization, functions, and changing roles of scientific-pedagogical schools. Heuristic synthesis and forecasting were used to integrate these perspectives and identify potential directions for their development under changing technological and institutional conditions.

3.3. Conceptual Analysis

The conceptual analysis focused on major functions including knowledge generation, knowledge transfer, integration of research and pedagogy, professional advancement, social support, tacit-knowledge preservation, professional development, and academic culture. These functions were interpreted in relation to contemporary literature on research groups, mentoring, knowledge sharing, communities of practice, and university engagement.

3.4. Community-Service Interpretation

The identified functions were subsequently translated into a conceptual community-service framework. The framework connects scientific and pedagogical schools with academic mentoring, knowledge-sharing activities, researcher development, professional collaboration, and external knowledge transfer. The analysis treats these activities as proposed applications of the conceptual findings rather than as interventions already implemented or empirically evaluated.

4. RESULTS AND DISCUSSION

4.1. Changing Role of Scientific and Pedagogical Schools

Scientific and pedagogical schools should be understood as dynamic academic communities whose roles change in response to technological, institutional, and organizational developments in higher education. Their importance is not limited to preserving established scientific traditions. They can also provide continuity between generations of researchers, facilitate collaborative knowledge production, and integrate research with educational activities. Direct interaction between experienced scholars and learners represented an important mechanism for transmitting scientific and professional knowledge before modern institutionalized forms of higher education became dominant. Over time, universities developed increasingly formal structures for research and teaching, but scientific and pedagogical schools continued to provide environments in which knowledge could be generated and transferred through sustained collaboration. Contemporary technological change modifies rather than eliminates this function. Digitalization, virtual communication, automated learning systems, and expanded access to information can strengthen the dissemination of explicit knowledge, while interpersonal academic communities remain important for professional judgment, methodological experience, and tacit knowledge. This distinction supports the continued relevance of scientific and pedagogical schools under changing technological conditions. Formal research groups can strengthen collaborative research and researcher development [1], while research culture also depends on communication and interaction among academics at different stages of professional development [3]. Scientific-pedagogical schools can therefore serve as organizational environments combining continuity with adaptation to technological and institutional change.

4.2. Knowledge Generation and Research Collaboration

A central function identified in the analysis is the generation of new knowledge through coordinated research. Scientific-pedagogical schools can bring together academics and students working within related scientific directions, thereby providing opportunities for collective idea generation, methodological coordination, and continuing research development. The source study identifies common methodological perspectives, collective generation of ideas, and increased coordination of research activities as mechanisms through which scientific schools may strengthen research effectiveness. This collaborative function is consistent with research showing that internal networking and knowledge-management processes can contribute to innovation within university research environments [10]. Collaboration allows researchers to combine expertise, exchange methodological knowledge, identify emerging problems, and respond to scientific questions that may exceed the capacity of individual researchers. A supportive research culture is also associated with stronger scientific output, reinforcing the importance of sustained research communities within

universities [13]. However, scientific-pedagogical schools should not be interpreted as closed academic structures. Excessive dependence on a single research tradition may restrict intellectual diversity. Their effectiveness therefore depends on maintaining continuity while remaining open to interdisciplinary interaction, external collaboration, and methodological renewal. Under a new technological order, this adaptability becomes especially important because emerging research problems increasingly intersect across disciplinary boundaries.

4.3. Integration of Research and Pedagogy

Another major function is the integration of scientific research with educational activity. The source study identifies scientific-pedagogical schools as structures capable of connecting research and pedagogy and increasing the scientific content of university education. This integration can operate in several ways. Students may participate in research projects, postgraduate researchers may contribute to teaching and mentoring, and academics may translate current scientific developments into educational content. Such interaction reduces the separation between knowledge production and knowledge transmission. Scientific-pedagogical schools can therefore provide a setting in which students encounter research as an active process rather than only as completed knowledge. Participation in research communities can expose learners to problem formulation, methodological reasoning, scholarly communication, and collaborative problem solving. This role is particularly relevant when rapid technological development causes disciplinary knowledge to change quickly. From a community-service perspective, the same integration can be extended beyond the university. Research expertise can support workshops, professional consultation, methodological training, educational outreach, and collaborative projects involving external educational or professional communities.

4.4. Tacit-Knowledge Preservation and Transfer

One of the most important findings of the conceptual analysis concerns the role of scientific-pedagogical schools in preserving and transferring tacit knowledge. The source study explicitly identifies the acquisition, preservation, and transmission of implicit knowledge as a major function of scientific and pedagogical schools. Tacit knowledge includes professional judgment, research intuition, methodological experience, problem-solving strategies, and practical knowledge that cannot always be fully codified in publications or instructional materials. Research groups provide social environments in which this knowledge can be shared through participation, observation, discussion, mentoring, and collaborative work [2]. Research impact can also depend on forms of practical know-how that extend beyond formal academic outputs [4]. The importance of tacit knowledge may increase when scientific activity becomes more complex and interdisciplinary. Emerging scientific directions can generate forms of knowledge that are initially difficult to formalize and therefore depend heavily on direct interaction among researchers. Scientific-pedagogical schools can consequently complement digital knowledge systems. Databases, artificial intelligence, online repositories, and digital educational resources can distribute explicit knowledge efficiently, whereas professional communities remain important for interpreting that knowledge and developing the judgment required for its application.

4.5. Mentoring, Professional Development, and Academic Continuity

Scientific-pedagogical schools can also function as environments for mentoring and accelerated professional development. The source study identifies professional

advancement, social support, professional communication, and additional professionalization among their major functions. Mentoring allows experienced researchers to transfer methodological knowledge, academic practices, and professional norms to less-experienced participants. Researcher development also extends beyond immediate academic training because advanced research experience can generate transferable professional and organizational value [14]. Peer-mentoring groups can support knowledge sharing in doctoral education [5], while mentoring in higher education more broadly contributes to professional development and academic socialization [6].

Table 2 summarizes the relationship between mentoring, tacit knowledge, and academic development. The table shows how different functions of scientific-pedagogical schools can support the development of academics and researchers at different career stages. The mentoring role is also important for institutional continuity. Scientific schools may become vulnerable when their identity and functioning depend excessively on a single founder. The effectiveness of a school may decline following the departure or death of its founder. Sustainable scientific-pedagogical schools therefore require succession, distributed leadership, mentoring of emerging academic leaders, and preservation of institutional knowledge. The conceptual development and sustainability pathway is illustrated in **Figure 2**. The framework distinguishes four progressive stages, namely Formation, Development, Maturity, and Renewal or Sustainability. Formation involves a shared research direction, academic leadership, and initial collaboration. Development expands these foundations through mentoring, research collaboration, and knowledge sharing, while Maturity is characterized by a stable research culture, academic reputation, and external engagement. Sustainability subsequently depends on leadership succession, mentoring of emerging scholars, digital and virtual collaboration, and interdisciplinary expansion. In contrast, excessive dependence on the founder, weak knowledge transfer, and reduced collaboration may contribute to decline.

Table 2. Academic-development functions of scientific and pedagogical schools.

FUNCTION	DEVELOPMENT MECHANISM	MAIN PARTICIPANTS	POTENTIAL ACADEMIC CONTRIBUTION
Research mentoring	Participation in collaborative research and methodological discussion	Senior academics, early-career researchers, postgraduate students	Development of research competence
Tacit-knowledge transfer	Observation, discussion, joint problem solving, and experience sharing	Experienced and emerging researchers	Preservation of professional know-how
Academic socialization	Participation in scholarly communication and professional networks	Students and early-career researchers	Development of academic identity and professional norms
Professional communication	Seminars, research meetings, peer feedback, and collaborative writing	Academic community members	Stronger scholarly communication
Career development	Mentoring, networking, and participation in research activities	Early-career academics and postgraduate researchers	Broader professional opportunities
Leadership continuity	Progressive transfer of coordination and mentoring responsibilities	Senior and emerging academic leaders	Greater continuity of the academic community

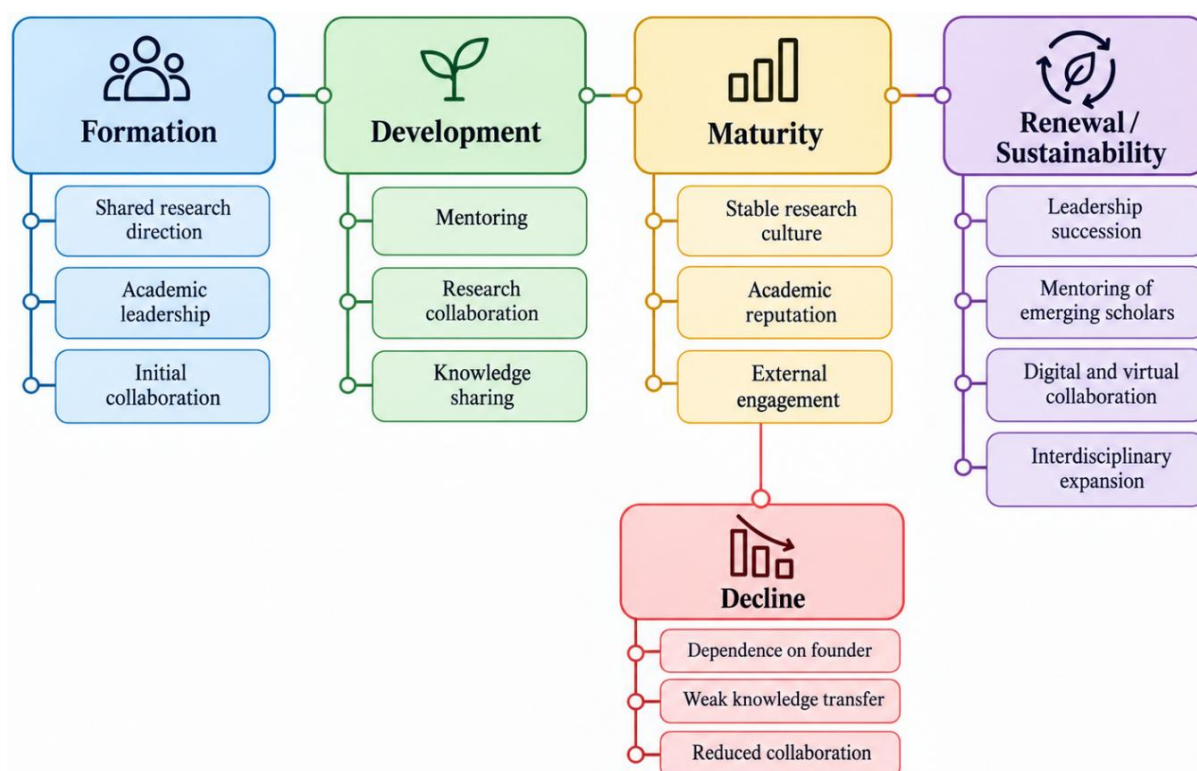


Figure 2. Conceptual development and sustainability pathway of scientific and pedagogical schools.

4.6. Scientific-Pedagogical Schools as Communities of Practice

The identified functions closely resemble characteristics of communities of practice. Scientific-pedagogical schools bring together individuals with shared professional interests who develop knowledge through sustained participation, interaction, and collaborative work. Communities of practice have been associated with faculty development, knowledge exchange, and professional learning in higher education [7-9]. This perspective is useful because it shifts attention from formal organizational structure toward actual participation. A scientific-pedagogical school is unlikely to function effectively merely because it is formally recognized. Its effectiveness depends on whether members regularly interact, collaborate, exchange expertise, mentor one another, and develop shared intellectual practices. Community participation can also strengthen professional identity and belonging. Recent evidence indicates that communities of practice can support peer exchange, professional identity, belonging, and career development among academics. Younger researchers may benefit not only from methodological instruction but also from opportunities to observe how experienced academics formulate problems, respond to criticism, communicate results, and develop research programs. These processes reinforce the importance of scientific-pedagogical schools as social as well as intellectual institutions.

4.7. Adaptation to a New Technological Order

The analysis suggests that scientific-pedagogical schools need organizational adaptation rather than simple preservation of traditional structures. The source study identifies digitalization, smart education, changing university management, and the transformation of research organization as important influences on their development. Traditional scientific schools have often depended on physical proximity, stable institutional membership, and

long-term interaction around a recognized academic leader. Contemporary technologies allow these characteristics to be supplemented by virtual collaboration, digital research infrastructure, online mentoring, and geographically distributed academic networks. Virtual scientific-pedagogical schools are therefore a plausible development pathway. They can connect researchers from different universities, support interdisciplinary teams, expand access to mentoring, and facilitate continuous knowledge sharing. The source study explicitly identifies the creation of virtual scientific and pedagogical schools as a promising direction. Nevertheless, digitalization should not be interpreted as a substitute for academic relationships. Technological tools can facilitate interaction, but knowledge sharing still depends on trust, professional commitment, communication quality, and shared intellectual goals. The development of virtual scientific-pedagogical schools should therefore combine technological infrastructure with purposeful academic community building.

4.8. University Knowledge Transfer and External Engagement

Scientific-pedagogical schools also have potential roles beyond internal university development. Research universities increasingly engage with external organizations through knowledge transfer, professional collaboration, consultation, and applied research [11]. Research groups can interact with non-academic actors and translate academic knowledge into forms useful to wider social and professional communities [12]. The source study similarly proposes stronger integration among science, practice, pedagogy, universities, business, and professional associations. It identifies long-term university-industry cooperation, improved scientific infrastructure, participatory management, and greater involvement of public and business associations as potential directions for strengthening scientific-pedagogical schools. These proposals provide a direct basis for community service. Scientific-pedagogical schools can organize activities such as methodological consultations, research-capacity workshops, professional seminars, educational outreach, collaborative problem solving, and knowledge-sharing forums. Their contribution to community service can therefore emerge from their existing academic strengths rather than from activities disconnected from their research identity.

4.9. Community-Service Priorities

Community service can extend the internal functions of scientific-pedagogical schools toward external academic and societal engagement. The main priorities derived from the analysis are summarized in **Table 3**. Unlike the general framework presented earlier, this table connects specific findings of the conceptual analysis with corresponding community-service priorities. Community service does not need to be separated from research and teaching. Instead, scientific-pedagogical schools can use their accumulated knowledge, mentoring capabilities, professional networks, and research expertise to support broader educational and societal development.

This process is illustrated in **Figure 3**, which organizes the proposed model into four interconnected components. Internal Academic Resources comprise Research Expertise, Mentoring Capacity, Tacit Knowledge, and Professional Networks. These resources can support Community-Service Activities, including Mentoring, Workshops, Methodological Consultation, Collaborative Research, and Knowledge-Sharing Forums. The potential beneficiaries include Students, Early-Career Researchers, Educators, Professional Groups, and Industry and Community Organizations. Through these activities, scientific-pedagogical schools can contribute to Knowledge Transfer, Professional Development, Research Capacity,

Collaboration, and Societal Relevance. The model therefore shows how internal university capabilities can be extended toward broader academic and community beneficiaries. The specific community-service priorities derived from the conceptual findings are further summarized in **Table 3**. The table connects each major finding with an appropriate community-service priority, potential beneficiaries, and its intended contribution.

Table 3. Community-service priorities derived from the functions of scientific and pedagogical schools.

CONCEPTUAL FINDING	COMMUNITY-SERVICE PRIORITY	POTENTIAL BENEFICIARIES	INTENDED CONTRIBUTION
Scientific schools support collaborative knowledge generation	Collaborative research and problem-solving workshops	Researchers, educators, external organizations	Broader application of academic expertise
Tacit knowledge requires interpersonal transfer	Academic mentoring and experience-sharing activities	Early-career researchers and students	Preservation and dissemination of research expertise
Research and pedagogy are mutually reinforcing	Research-informed teaching and methodological workshops	Teachers, lecturers, and students	Stronger integration of scientific knowledge and educational practice
Professional development occurs through participation	Peer mentoring and communities of practice	Academics and postgraduate researchers	Continuous professional development
Technological change enables distributed collaboration	Virtual scientific-pedagogical networks	Researchers across institutions	Expanded access to expertise and collaboration
Research groups can interact with non-academic actors	University-community and university-industry knowledge exchange	Professional groups, organizations, and communities	Application of research to practical needs
Academic communities require continuity	Leadership mentoring and succession activities	Emerging academic leaders	Sustainability of scientific-pedagogical schools

4.10. Integrated Community-Service Perspective

The analysis supports an integrated interpretation of scientific-pedagogical schools as structures connecting knowledge generation, knowledge preservation, mentoring, professional development, academic collaboration, and external engagement. Their contribution is therefore broader than research productivity alone. A sustainable scientific-pedagogical school requires continuing interaction among experienced and emerging researchers, mechanisms for transferring tacit knowledge, opportunities for interdisciplinary and external collaboration, and organizational arrangements that reduce dependence on individual founders. Technological development can strengthen these processes by expanding communication and creating virtual communities, but technology alone cannot replace the interpersonal foundations of academic development. Within a community-service perspective, the accumulated intellectual and professional resources of scientific-pedagogical schools can be extended to wider groups through mentoring, training, methodological consultation, knowledge-sharing forums, collaborative research, and university-community partnerships. Such activities provide a pathway for connecting university research with educational practice and broader societal needs while preserving the scientific identity of the academic community.

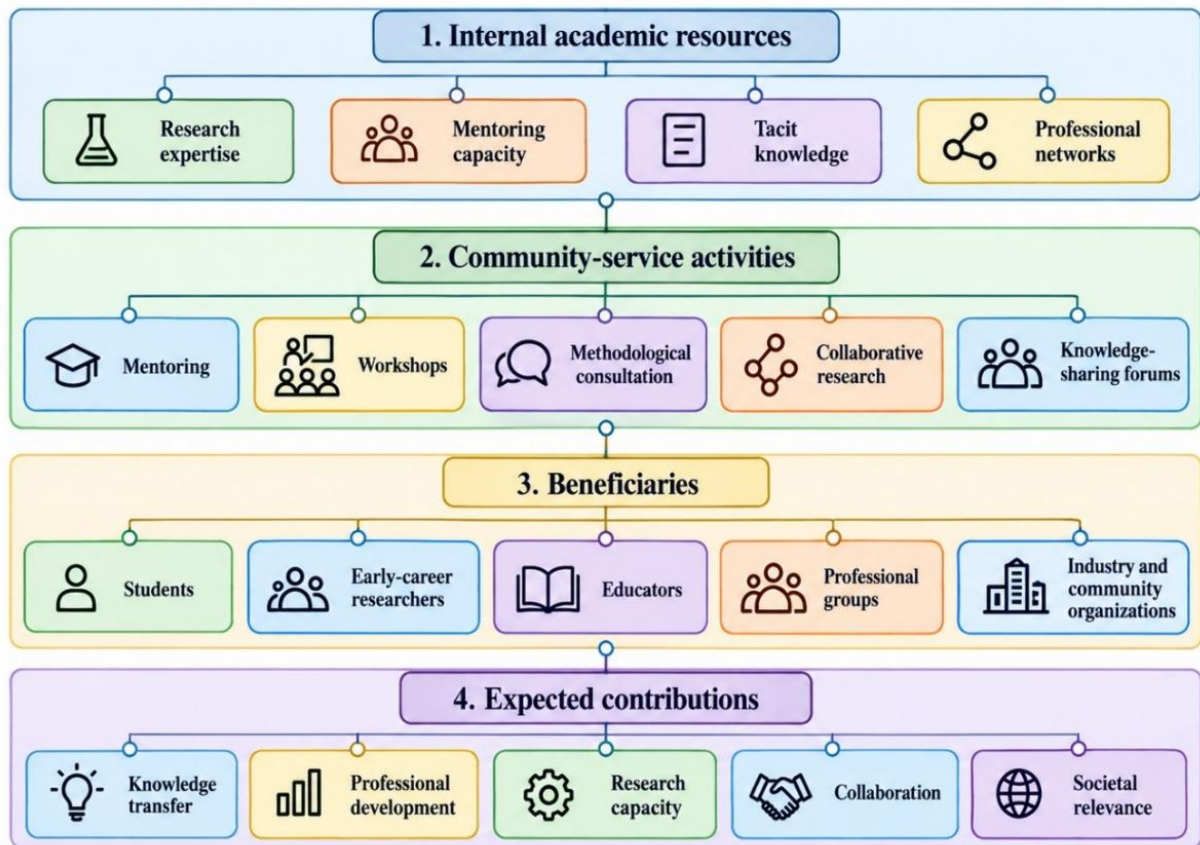


Figure 3. Community-service model for extending the academic functions of scientific and pedagogical schools to broader stakeholders.

5. CONCLUSION

Scientific and pedagogical schools remain important academic structures for integrating research, education, mentoring, knowledge sharing, and professional development under changing technological and institutional conditions. Their significance extends beyond the generation of new knowledge because they also support tacit-knowledge preservation, researcher development, academic socialization, collaborative culture, professional communication, and continuity across generations of scholars. The analysis further indicates that these schools can adapt to a new technological order through digital and virtual collaboration, interdisciplinary interaction, distributed leadership, and stronger engagement with external stakeholders. Their sustainability depends on effective mentoring, leadership succession, knowledge transfer, and reduced dependence on individual founders. From a community-service perspective, scientific and pedagogical schools can extend their internal academic resources to wider beneficiaries through methodological support, professional-development activities, collaborative research, mentoring, knowledge-sharing forums, and university-community partnerships. Such activities can strengthen research capacity, professional competence, academic collaboration, and the practical relevance of university expertise. Scientific and pedagogical schools can therefore function not only as internal academic communities but also as platforms connecting universities with broader educational, professional, and societal needs while supporting sustainable academic development.

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7. AUTHORS' NOTE

The authors declare that there is no conflict of interest regarding the publication of this article. The authors confirmed that the paper is free from plagiarism.

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