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Application of Innovative Technologies in Professional Education

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Abstract: The article addresses the important issue of applying modern innovative technologies and open innovations in education. Open innovations can be utilized as a targeted flow of inbound and outbound knowledge to accelerate internal innovation and expand opportunities for external use. This paradigm implies that higher education institutions and educational organizations can and should implement ideas that emerge both internally and externally, using both external and internal pathways to enter the labor market, while simultaneously striving to improve their educational technologies.

Keywords: Personality formation, methods, innovative technologies, open innovations, management system, education system, information, specialists.

Introduction: The great idea of creating "instrumental" pedagogy, based on the spontaneous interests and personal experience of the child, is of particular relevance. According to this concept, learning should primarily consist of play and labor activities, where each action of the learner becomes a tool for their cognition, their own discovery, a way of grasping the truth.

Such a path of learning was considered more aligned with the nature of the child than the traditional transmission of a knowledge system. The ultimate goal of education, according to John Dewey, should be the development of thinking skills, understood primarily as the ability to self-learn. The objectives of education include the ability to solve life problems, mastering creative skills, and enriching experience, which includes both knowledge itself and knowledge of how to act, as well as cultivating a taste for self-education and self-improvement.

According to Dewey, the school (today we would say “educational institution”) must instantly respond to

changes in society and become a kind of miniature society itself. It should provide children with maximum opportunities to develop a social sense of cooperation and mutual assistance. The school—as an educational environment—must fulfill specific tasks: simplifying complex life phenomena and presenting them to children in an accessible form; selecting for study the most common and important elements of human experience; promoting the leveling of social differences by creating unity of thought and coordinated action. The content of education becomes the acquired experience, which is enriched in a learning environment. The method of acquiring such experience lies in solving various practical tasks: building a model, answering a question, etc. The acquisition of the necessary knowledge is linked to the child's interests, which ensures their attention and engagement. Dewey noted, however, that not everything essential in life may be of interest to children, and therefore they need to develop willpower and character. According to Dewey, the contradiction between interest and effort is resolved through the educator's understanding of the child's age-specific traits.

Education, according to Dewey, should begin with activities that have social content and application, and only later lead to the theoretical understanding of material and the nature of things and their production. Thus, learning content is assimilated as a byproduct of exploring a problem-based learning environment, organized as a logical sequence of pedagogical (i.e., problem-based) situations. The sole criterion for the pedagogical value of a subject is its contribution to the "formation of an internal system of personal orientation" in the child.

The "Cone of Experience" by American educator Edgar Dale illustrates the educational outcomes that can be achieved using various media for delivering learning content.

As shown, the data reveal a correlation between teaching methods and the degree of content retention. It becomes evident that the classical lecture (a teacher's monologue without slides or visual aids) is the least effective method—on average, only about 5% of the content is retained. In contrast, "active learning" (involving students in various forms of active engagement) leads to significantly better outcomes. Shall we believe it? Let's believe it... Active learning, problem-based learning, problem-modular learning—all these have been explored to some extent in both general and higher education. However, to be precise and objective: at different stages of educational paradigms, several specific methodological (technological) approaches have been used:

- Practice
- Content transmission
- Case analysis
- Game
- Simulation
- Project work

Practice is the oldest method of learning. The idea is simple: one acquires professional skills and tools through real-life engagement. This approach was used in ancient times for learning hunting and farming, as well as in medieval craft workshops. In modern education, practice is still widely used through internships: industrial, teaching, pre-graduation, etc.

Content transmission — very utilitarian — is the transfer of knowledge about a subject or activity from one person to another. This has been done since ancient times, when knowledgeable teachers told younger learners about how the world works. In the 17th century, the great educator Johann Amos Comenius refined this approach by developing the classic classroom-lesson system to ensure students learned more independently. Today, knowledge transmission takes many forms: lectures, reading, online learning, masterclasses, and more.

Is this classical? Yes. But what are its limitations?

If learning is limited to developing practical skills, students may lack essential theoretical knowledge. If education is based solely on knowledge transmission, it can become overly abstract and disconnected from real life.

The 20th century and new approaches...

At Harvard University, a unique method emerged—the Harvard Case Study Method—originally used to train managers and economists. Its essence lies in identifying typical scenarios from real professional practice. Students analyze these cases, propose solutions, and predict outcomes. This approach fosters professional thinking and decision-making skills.

As for games... Despite the fact that humans learn about life primarily through play (remember Marx: "mankind learns through games"), game-based learning only entered professional training in the USSR in the pre-war years. The first business game, "Restructuring Production Due to a Sharp Change in the Program," was conducted by economist M.M. Birshtein in 1932. We also know of G.P. Shchedrovitsky's organizational-activity games and American policy exercises by R. Duke and J. Klabbers. However, these group exercises did not become widespread in Soviet management training programs.

Role-playing games, which model behavior in typical

professional situations—often at specific workplaces—gained some popularity. Today, with the integration of mandatory interactive learning formats into curricula, these methods are likely to attract the serious interest of educators.

Simulation models originated in the military—flight simulators for training pilots. The education sector, especially business education, quickly adopted these ideas, yielding impressive results. In the late 1950s, the U.S. began using simulation-based learning methods, allowing students to practice professional procedures, understand specific fields, and simulate professional roles. In our country, these methods are known as "simulations," "simulators," or "simulation games."

Let us clarify: the primary purpose of the project-based learning method is to provide students with the opportunity to acquire knowledge independently through solving practical problems or tasks that require the integration of knowledge from various subject areas. When we speak of the project method as a pedagogical technology, it is understood as a combination of research, inquiry-based, and problem-solving methods, which are inherently creative. In this context, the teacher assumes the role of developer, coordinator, expert, and consultant. Thus, the core of the project method lies in the development of students' cognitive skills, the ability to construct their own knowledge, navigate the information space, and foster critical and creative thinking.

Originally developed in the first half of the 20th century on the basis of John Dewey's pragmatic pedagogy, the project method has become particularly relevant in today's information society. In light of new standards and the much-discussed concept of competence, it is clear that the main goal of any project is the formation of various key competencies. In modern pedagogy, these competencies are understood as complex personal attributes that encompass interrelated knowledge, skills, values, and the readiness to mobilize them when necessary.

In the process of project-based activity, the following are developed:

- reflective skills;
- research (inquiry) skills;
- teamwork and collaboration abilities;
- managerial and organizational competencies;
- communication skills;
- presentation skills.

So, definitions have been given, key terms mentioned — but what, in essence, is an "innovative educational technology"?

Perhaps it is a complex of three interrelated, interdependent, and mutually defining components:

1. Modern content, which is delivered to students and focuses not so much on mastering subject-specific knowledge as on developing competencies relevant to contemporary life and professional practice. This content must be well-structured and presented through a variety of learning materials, including multimedia, and transmitted using modern means of communication.

2. Modern teaching methods (including interactive methods), which are based on forming competencies through student interaction and engagement in the learning process, rather than passive reception or rote memorization.

3. Modern educational infrastructure (technical tools), including information, technological, organizational, and communication components that enable effective use of, for example, distance learning.

Nowadays, the term "innovative educational technologies" is often narrowly understood as the directive use of information and communication technologies — the Internet, multimedia, webinars, teleconferences — rather than the adoption of new or cutting-edge teaching methods. This limited interpretation of innovation does not help improve the quality of education.

There is also a subtle psychological issue — the attitude toward innovations and change: acceptance, indifference, rejection — a wide scale, often with contradictory reactions coexisting within a single educator.

Psychology identifies several categories of innovation adopters:

- Innovators, always open to new ideas, enthusiastic about novelty, and often adventurous;
- Early adopters, well integrated with others and influential, often leaders;
- Early majority, who take more time to make decisions;
- Late majority, generally skeptical about innovations;
- Laggards, who are guided by traditional values and adopt innovations reluctantly, often slowing the process.

Teachers have become accustomed to living by externally imposed rules and norms — especially in recent years, which have seen a relentless flow of directives, circulars, changes, reforms, and new standards. The standardization of teacher behavior and mindset, along with the adaptation of teaching methods

to fit testing and assessment systems, has resulted in increased reliance on instructional prescriptions. While teachers integrate smoothly into the professional community, their creative capacity often diminishes.

Pedagogical innovation, surprisingly, is still in its formative stage — not only in our country, but globally. The growing demand for it is evident both in science and in educational practice. And what a noble goal it has: to contribute to the foundation of a modern, evolving education system — a mission embraced by those of us who view the future of education with optimism.

Most often, "innovation" is understood as the implementation of any new developments or technologies. Fewer people associate it with the application of scientific and technical achievements, investment in promising industries, social changes, or specific reforms. Many find the concept difficult to define — although, predictably, the higher the respondents' education level, the more confidently they define "innovation." So what should we really understand by this often-used term?

In 1912, the term "innovation" was first used by Austrian-American economist Joseph Schumpeter (1883–1950) in his book The Theory of Economic Development. He defined innovation as the application of a novelty in production or management within an economic unit. Schumpeter was the first to suggest that innovation is a key driver of profit. But what is a novelty in this context? It is a formalized result of fundamental or applied research and development in any field aimed at improving its efficiency. Such novelties may include discoveries, patents, inventions, trademarks, technologies, production or management processes, or know-how.

Today, "innovation" is understood as the result of creative activity aimed at designing, creating, and disseminating new types of products, technologies, and organizational forms. According to the Frascati Manual, an innovation is the final result of innovation activity that manifests as a new or improved product introduced to the market, a new or improved process used in practical activity, or a new approach in the provision of social services.

The Frascati Manual is the proposed standard for surveys of research and experimental development. It is an official set of recommendations by the OECD (Organisation for Economic Co-operation and Development) for collecting statistics on R&D. The first version of the manual was adopted in 1963 at a meeting in Frascati, Italy, and has since become a unified methodology for OECD member countries.

The American scholar Peter Drucker (1909–2005) understood innovation as "the means by which the entrepreneur either creates new resources that generate wealth or endows existing resources with enhanced potential for generating profit."

Notably, both scholars and practitioners emphasize the importance of bringing innovation to the market. In the 21st century, the competitiveness of many organizations now genuinely depends on the degree of innovation adoption.

And now — something relevant for us, educators!

There are two major types of innovations: closed and open:

- Closed innovations refer to an approach that relies solely on the internal resources of an organization — its own research, discoveries, inventions, patents. This implies the existence of a dedicated department within the company focused exclusively on innovation development. Larger organizations can afford to fund complex research, resulting in cutting-edge technologies.
- Open innovations, on the other hand, allow for the use of both internal and external sources. The core idea is that not all smart minds work for the same company. The theory of open innovation conceptualizes research and development as an open system. In such an environment, there are numerous ideas — both inside and outside the organization. These ideas are accessible, and the experts behind them may be hired by other organizations. Many individuals have unique, sometimes revolutionary and breakthrough ideas.

Today, the state — including its educational system — is increasingly interested in applying the open innovation paradigm to its activities. The goals? To promote the development, production, and even export of educational technologies by supporting educational institutions as developers and producers (through contracts or other legal frameworks), influencing decision-making, and attracting investment.

Based on this goal, specific tasks emerge:

- the creation of innovative/integrated infrastructures, including business incubators, consulting, training, and coaching centers at universities, as well as systems for managing intellectual property rights and integrating them into the economy;
- expanding cooperation with leading universities, research organizations, and innovative companies using existing platforms for innovation testing;
- integration into international projects;
- the formation and implementation of technological platforms.

One of the most famous quotes by English philosopher and statesman Francis Bacon is: “He who does not apply new remedies must expect new evils.”

The topic of innovation is gaining popularity year after year. It is one of the key challenges of the 21st century — but it is also a challenge for management systems, especially in education, which significantly influences strategy, goals, and operational methods.

A new interpretation of the term "open innovation" was introduced (and formalized) by Henry Chesbrough in his 2003 book “Open Innovation: The New Imperative for Creating and Profiting from Technology.” In this context, open innovation refers to the use of targeted knowledge flows to accelerate internal innovation processes and to expand markets for more effective utilization of innovations.

Of course, we should not forget our core mission — to teach and educate. Thus, new ideas and the theory of open innovation are interpreted as a process of research and development, attracting external ideas and launching new products not only through internal efforts but also in collaboration with other educational institutions. This opens the door to identifying the principles on which open innovation in education may be based:

- shifting from relying solely on internal closed developments to using external knowledge;
- acknowledging the vast pool of ideas in the world that can be beneficial;
- recognizing that one does not need to be the originator to benefit from innovation.

Today, education is clearly entering a new phase of innovation, where the sources of innovative potential often lie outside the university or even the country. The center of innovation is shifting from centralized research institutes and government ministries to higher education institutions, favoring collaboration and joint development.

It may be necessary to adopt new strategies, such as:

- organizing R&D by pooling shared resources;
- allowing individual universities to develop specific components of an innovative product or educational technology;
- freely distributing broadly applicable developments that can serve as a foundation for various innovative methods and tools;
- reducing bureaucracy in innovation-related decision-making.

Advocates for open technologies have created an interesting comparative table, which, when adapted to education, reveals a significant transformation in thinking.

As we can see, the concept is often heavily profit-driven, which raises debate. However, we know of many outstanding student and faculty discoveries, and numerous universities benefit from contract-based projects that generate consistent income. So perhaps the real change should be in how people perceive your university? Might involving third parties in the development and implementation of new technologies significantly enhance its value? Perhaps collaboration with other universities and, of course, companies and organizations seeking graduates is worth exploring?

Building a model of open innovation is largely a matter of communication with the external environment. The key? Effective idea management — the ability to collect, discuss, and analyze a flow of proposals and signal interest. But does academia always have the foresight to explore all aspects of a problem? Might it not sometimes approach a challenge head-on, when dozens of alternative paths may exist?

After all, the most important advances in education, science, and technology often arise at the intersection of fields. For example, today there is much talk about full personalization of learning and the creation of individual learning paths — which require data management and information systems.

A well-structured search for fresh ideas can save significant human resources and time — someone nearby may already have a ready-made solution. It is therefore entirely reasonable to complement internal university innovations with external contributions.

The value of the Open Innovation Model lies in its ability to synchronize efforts across internal and external research and methodological dimensions, thereby amplifying their impact in the educational process. But we must remember: this model should not be idealized. Its implementation and maintenance are themselves complex managerial tasks requiring special competencies from university administration, vice-rectors, deans, and department heads. Tasks related to testing and implementation, project coordination, and team management across faculties and departments will arise.

It seems that the most sensitive areas are governance and forecasting — these new challenges demand new approaches. Should we look toward appointing a Vice-Rector for Innovation or perhaps a Vice-Rector for Research and Development — someone responsible for intellectual property management, development strategy, and engagement with the scientific community?

Additionally, such leaders may face resistance from

internal institutional lobbies that champion stability and view any change as a needless risk, showing a degree of mental inertia — surprisingly, even in academic circles.

He will have to facilitate internal discussions and engage in strategic balancing... Can we use the term venture here? We collaborate with leading universities and research centers, seeking ideas and laboratory developments that may be of interest to us. The technological risks are high, yet the required investment amounts are often relatively low. With a competent selection process, some of these ideas and projects may eventually evolve into solid innovative phenomena — or even yield breakthrough innovations that can significantly enhance a university's competitiveness, including in comparison with Western institutions.

Corporate venturing in education — but aren't we witnessing a form of discrimination? In developed countries, education often seems excluded from the global exchange of even mid-level educational technologies. Access is delayed, if not denied outright, while some of us try to break in by force. Perhaps that caution is partially justified. When entering through the main door proves difficult, maybe it's worth slipping quietly through the back — it's still unlocked. The likely reason: a lack of experience and specialists in organizing such initiatives. In this case, several recommendations could be made — for instance, establishing partnerships with already successful universities or leveraging the vast potential of the Russian academic diaspora abroad. This could help acquire valuable experience, avoid common mistakes, and, crucially, open many doors.

That said, we must remember that openness to innovation is not always universal. In many cases, systems remain highly closed, relying entirely on internal R&D — partly to prevent leaks of intellectual property or educational technologies. And yet, when catching up is needed, the doors suddenly swing wide open... So perhaps open innovation is especially effective as a catch-up model? Following in others' footsteps can allow institutions to "cut corners" and "avoid the rakes" — by immediately embedding an open model into their operations.

Indeed, this gives us a lot to think about — especially under growing administrative pressure to innovate. This raises a new question: Are we ready to take action to increase innovation performance indicators? Perhaps the first step should be to establish a dedicated interdisciplinary unit within the university that sits at the intersection of research, methodology, pedagogy, and administration. And let's not forget: innovation requires resources and support before it begins to generate returns.

This is where we encounter "innovation within innovation." Consider the idea of "innovation scouting" — searching for complementary educational technologies, sometimes even in fields far removed from traditional disciplines. The earlier these discoveries are made, the better. It contributes to the creation of a productive, innovation-oriented teaching staff. And critically, we must establish new infrastructure that sustains the open innovation model — a "soft" infrastructure composed of communication methods, networks, and channels that facilitate interaction between the university and the external world.

Perhaps we should borrow another term from economics — crowdsourcing. It refers to delegating tasks to a broader group (not the university administration), often involving volunteers or members of the academic community. Crowdsourcing can, in certain cases, be the fastest and most cost-effective way to address institutional challenges. However, not every issue can be resolved this way. Tasks must be well-defined, and both the university and those involved must be mutually invested in the outcome.

All of this prompts a valid question: Is it too cumbersome to follow the principles of open innovation? Or do we actually need innovation in how we create innovation itself? After all, a university's capacity for innovation depends on the intellectual assets and knowledge it possesses, and on its ability to use them — especially within the framework of knowledge management. Many researchers currently focus on the external factors of the innovation process, often neglecting the internal complexities of innovation dynamics.

These are not simple questions — particularly in today's knowledge-based economy, where notions such as intellectual capital, human capital, innovation, and innovation activity are tightly interwoven.

In the modern global educational landscape, leading positions are held by countries that view professional education as a branch of the economy, and universities as active participants in international competition. Integration into the Bologna Process demands a reinterpretation of the university's role within this competition — primarily in terms of quality assurance and governance models.

We have already defined open innovation as a multifaceted approach to solving innovation challenges. The phenomenon of organizational boundary dissolution and the transition to network-based knowledge acquisition is well-known and widely used in

transnational corporate practice. However, it is typically discussed in relation to non-traditional business models, rather than as a defining feature of innovation itself.

In the final decades of the 20th century, several converging factors began to seriously undermine the foundation of closed innovation models. One of these factors was the increased mobility of professionally trained individuals. Another was the erosion of knowledge silos, resulting from the growing number of individuals receiving higher education and continuing their learning beyond formal schooling. This trend has helped knowledge escape the confines of traditional "vertical" systems.

Within the process of open innovation, ideas initially deemed weak or impractical may prove valuable over time. Their potential may become apparent only after integration with other projects. In traditional closed innovation systems, such opportunities were often lost forever.

New approaches to higher education development are now aligned with the transformation of traditional universities into innovation-driven institutions. Their development strategies are based on the university as an integrated educational-research-innovation complex. Such institutions prepare a new generation of specialists for the intellectual labor market, and position themselves as full-fledged market actors — developers and suppliers of intellectual property, products, and services with qualities demanded by the market.

However, progress is currently hindered by several limiting factors:

- The process of accumulating experience and information about innovation universities is still ongoing, often with references to foreign models. The next step should be a theoretical analysis of this data to generate well-grounded legislative proposals on the status of innovation-based organizations in higher education. The creation of a legal framework should be considered an essential part of the evolution of the traditional education system.
- A university of a new type requires integration of research, education, and innovation, but the concept of "innovation activity" still lacks clarity. Although innovation policy has been broadly discussed in academic literature, the theoretical and legal foundations for developing and managing innovation strategies in emerging market contexts remain underdeveloped. This results in subjectivity and inconsistency, including a wide variety of interpretations of what constitutes innovation activity.

When considering the quality of education as an innovative component of the reform process in the education system, it should be emphasized that this is no longer merely a national issue but a global challenge. The question faced by all is: how to ensure the quality of education under the conditions of expanding access to educational services and rapidly changing dynamics in the labor and education markets. In one of UNESCO's documents, the quality of higher education is identified as the "common denominator" of higher education reform.

Since the quality of professional education can be improved, among other things, through the integration of educational and research activities, an initial step toward achieving this goal may be simply to restore science to all higher education institutions. This would lead to the development of academic, innovation-driven universities, and the introduction of innovative technologies into professional education. Within a system focused on generating, disseminating, and utilizing knowledge competitively, this integration transforms university education into a process that is not only instructional but also research-oriented and exploratory. It implies educating students not only in scientific knowledge itself but also in the methodology of acquiring and applying that knowledge, thus fostering their capacity for lifelong learning and professional growth in a transforming society.

Only by following this path can we begin to speak of the self-sufficiency of education as a social institution and of its quality. Research activity, therefore, must now be seen as a key element of an open innovation system, without which a transition to truly high-quality education is inconceivable. Comparing the principles of closed and open innovation, one may view this as a shift from a model focused on gains from generating good ideas to a model that emphasizes gains from utilizing both internal and external ideas.

To ensure the high-quality training of specialists, perhaps it is time for modern universities to adopt methods from innovation management, such as benchmarking? Yes, benchmarking in a university — understood as the process of identifying and implementing new practices and projects, and a continuous strategy for improving educational quality and generating academic output.

However, for these methods to be effective, universities need an infrastructure based on information and analytical activities that enable the search for, implementation, dissemination, and management of educational innovations. This infrastructure may include:

- active participation in innovation processes;

- the creation of an innovation database;
- decision-making support through the analysis of innovation effectiveness, requiring the processing of large volumes of data;
- information exchange with various institutions, including the use of external best practices in innovation management for the purpose of discovery, implementation, and promotion.

Since educational innovation is inherently linked to the operation of a higher education institution, the key indicators of such a support system will include information on innovations, educational goals and content, methods and tools, quality assurance, diagnostic systems, and the evaluation of learning outcomes. A bank of educational innovations, quality monitoring, foresight and recommendations, and the identification of viable innovations for implementation — all form the core of this internal innovation circuit.

Several key drivers underline the need to adopt open innovation approaches in education:

- With the advent of ICT, monopolies on knowledge have largely disappeared due to the global availability of databases, open-access journals, and internet resources;
- Under the new educational paradigm, universities benefit by embracing external ideas, avoiding redundant internal research;
- The dominant logic is “not invented here” (NIH), where relying on external sources proves more efficient;
- Distributed knowledge is greater than that held by any one university; combining knowledge from other institutions and stakeholders presents a new model;
- Many innovation-capable professionals work outside one's institution, across countries and institutions — requiring international collaboration;
- The value of innovation may only emerge after merging ideas from multiple sources;
- Hoarding unused ideas is no longer viable, especially given the increased turnover of researchers and their mobility.

Thus, the implementation of the open innovation concept in education could follow these paths:

- Establishing inter-university and cross-sector networks, sharing knowledge and ideas;
- Conducting external monitoring and benchmarking, employing staff with skills in external innovation management;
- Integrating internal and external knowledge to produce complex new solutions;
- Commercializing innovations by entering external markets and licensing IP from or to other universities, when aligned with institutional innovation strategies.

The modernization of higher education unfolds amid the structural transformation of the national economy. Drawing on global experience, the chosen path — innovation-based development — is essential for avoiding lagging behind in global economic trends. Given its intellectual and scientific potential, the national higher education system must support an innovative economy, ensuring continued leadership among technologically advanced nations.

In a knowledge-driven economy, a modern quality management system for education must be based on cutting-edge approaches that ensure competitive advantages on the international labor market. The principle of open innovation should be embedded in quality management, with innovation in education viewed as a mandatory and strategic element for progress and sustainable growth.

And yet, a resistant culture often opposes such progress. The current legal and regulatory frameworks do not always support, and sometimes even hinder, innovation in the economy.

Systemic reforms must therefore become a core agenda item at all levels of government. Not only must the economy be restructured, but — difficult as it may seem — the mindset of society must also evolve, or innovation will remain isolated and sporadic. Some positive developments can be observed, such as youth involvement in innovation projects, though these are still modest.

In summary, we are opening a two-way street... Open innovations — will they become an essential condition for the very existence of the education system? They can emerge from within or outside the university, and their implementation — including commercial — can take various forms. This is only possible if the university is not isolated from the broader innovation ecosystem.

Given the shortage of talent and their high mobility, institutions must seek ways to attract the best minds. This requires a clear strategy, defined funding policies, and an entrepreneurial university culture that values experimentation and creativity. That is precisely what open innovation is: the use of targeted inbound and outbound flows of knowledge to accelerate internal innovation and expand external opportunities. This paradigm implies that higher education institutions must implement ideas from both inside and outside and pursue both internal and external paths to market,

while continuously improving their educational technologies.

We now understand that open innovation intersects with the four pillars of the knowledge economy (as defined by the World Bank):

1. Education and training in science and technology;
2. Information and communication infrastructure;
3. Economic incentives and policies;
4. Innovation systems of research and development.

Open innovation supports both engineering and humanities disciplines in the realm of advanced technologies — a field with ongoing global demand. Innovation programs involving faculty and students allow participants to gain real-world professional experience, transforming theories into products and services. This, in turn, informs how educational curricula should evolve and which skills future professionals must acquire.

Considering the complex engineering, social, and economic challenges faced by the modern world, the need to apply scientific and technological advances to global transformation is not just apparent — it is urgent. Engineers, scientists, and educators must identify new domains for discovery, and universities should consider creating dedicated departments or units for advanced technology development. Governments and private investors must invest in intellectual capital to ensure collective success. The most effective way to meet these multifaceted needs is to invest in partnerships that generate the next generation of breakthroughs in educational technology.

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