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Pre-Incubation in Algerian Schools: A Qualitative Study of Structural Gaps and a Framework for Educational Innovation

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Abstract: The global transition toward knowledge-based economies prompted the Algerian government to institutionalize startup creation in higher education through Ministerial Decision 1275. However, primary, middle, and secondary school learners remain systematically excluded from the national innovation ecosystem, creating a critical developmental discontinuity. This study investigates this structural gap and proposes the Tamkeen Junior Incubator (TJI)—a developmentally grounded conceptual pre-incubation framework designed for learners aged 4–18.

Using conceptual framework analysis within a qualitative case study design, data were collected through document analysis of national curricula, 96 hours of field observations in three purposively selected secondary schools in the Constantine region, and 17 semi-structured interviews with teachers, school directors, regional inspectors, and university incubator managers.

Thematic analysis identified five systemic deficiencies: absence of physical innovation spaces, lack of structured innovation clubs, weak school–university linkages, limited teacher preparedness in innovation pedagogy, and no formal pre-incubation pathways. The TJI model integrates constructivist, experiential, and entrepreneurial learning theories into a three-stage progressive pathway (Exploration, Skill Development, and Pre-Incubation). Strategic policy, institutional, and curriculum recommendations are offered to build a continuous school-to-startup talent pipeline for the national economy.

Introduction

In Algeria, recent national reforms have signaled an ambitious commitment to transitioning from a hydrocarbon-dependent economy to one powered by knowledge and technological innovation. This policy shift is anchored in a robust legislative framework, notably the promulgation of the Startup Law (Executive Decree No. 20-254 of 2020), the creation of a dedicated Ministry of Knowledge Economy, Startups, and Micro-Enterprises, and the implementation of Ministerial Decision No. 1275, which institutionalizes the "Diploma-Startup" and "Diploma-Patent" pathways within higher education. These mechanisms have successfully transformed Algerian universities into vibrant hubs for startup creation, equipping university students with institutional incubators, technological resources, and intellectual property support (Algerian Ministry of Higher Education and Scientific Research, 2020).

Yet, despite these significant advancements, a critical developmental gap remains unaddressed. While university-level innovators benefit from structured incubation pathways, learners in the primary, middle, and secondary education sectors remain entirely isolated from the national innovation ecosystem. The national curriculum, managed under the conservative framework of the National Commission for Curriculum Reform (CNPD), remains dominated by rote learning, high-stakes examinations, and teacher-centric instruction. There are no formal pre-incubation frameworks, no dedicated physical spaces for technological exploration, and no institutional pathways linking school-aged talent to the university incubators or the broader startup ecosystem.

This systemic discontinuity represents a severe vulnerability in Algeria's developmental pipeline. Entrepreneurial mindsets, design-thinking skills, and creative self-efficacy are not sudden cognitive traits that emerge at age eighteen; they are developmental competencies that require long-term cultivation during childhood and adolescence (Fayolle & Gailly, 2015; Lackéus, 2015). By excluding school-aged learners from structured pre-incubation, the Algerian educational system misses the optimal window for cultivating foundational innovation mindsets. This structural disconnect prompts the central research question of this study: What conceptual pre-incubation framework can be designed to bridge the structural gap between

primary, middle, and secondary education and the higher education startup ecosystem in Algeria?

To address this question, this study pursues four interconnected research objectives:
-To document and analyze the specific structural gaps and deficiencies within Algerian schools, those prevent the cultivation of young innovators.
-To synthesize constructivist, experiential, and entrepreneurial learning theories into a cohesive, developmentally appropriate pre-incubation framework.
-To design a structured pre-incubation model (the Tamkeen Junior Incubator) tailored for primary, middle, and secondary learners within the Algerian administrative context.
-To establish actionable policy, institutional, and curriculum recommendations to integrate school-level pre-incubation into the national innovation strategy.

By achieving these objectives, this study contributes to the literature on entrepreneurship and innovation education in developing economies. It offers an empirically grounded, context-specific conceptual model that moves beyond generic international templates to address the concrete institutional realities of Algerian schooling.

1. Theoretical and Conceptual Framework

This study is grounded in the synthesis of three primary theoretical traditions: constructivist learning theory, experiential learning theory, and entrepreneurial learning theory. Rather than acting as isolated paradigms, these three frameworks intersect to provide a developmentally graduated lens for understanding how a primary, middle, and secondary learners transitions from creative play to rigorous, structured startup pre-incubation.

1.1.Constructivist Learning Theory

Constructivism, rooted in the foundational scholarship of Piaget (1972) and Vygotsky (1978), posits that learners are not passive recipients of information but active agents who construct knowledge through interaction with their physical and social environments. In a school-level innovation context, constructivism dictates that creativity and technical skills cannot be taught via traditional lecturing.

Instead, learners must interact directly with physical materials, digital tools, and peer groups. Vygotsky's "Zone of Proximal Development" (ZPD) is highly relevant here: it highlights the critical role of structured scaffolding—provided by teachers, industry mentors, or older peers—in elevating a learner's raw creative potential to structured, viable innovation.

1.2.Experiential Learning Theory

Kolb's (1984) experiential learning cycle conceptualizes learning as a continuous process where knowledge is created through the transformation of experience. The four-stage cycle—concrete experience, reflective observation, abstract conceptualization, and active experimentation—forms the baseline pedagogical engine of pre-incubation.

To transition from passive schooling to active innovation, students must engage in iterative cycles of identifying local community challenges, designing low-fidelity prototypes, testing their ideas in real-world settings, and reflecting systematically on failures and feedback.

1.3.Entrepreneurial Learning Theory

To specialize these constructivist and experiential principles within the economic landscape, we draw upon entrepreneurial learning theory (Fayolle & Gailly, 2015; Lackéus, 2015, 2020). Lackéus (2020) emphasizes "value-creation pedagogy," wherein learning occurs when students engage in activities that create real, external value for other people—whether economic, social, or cultural.

Integrating this perspective ensures that school-level pre-incubation is not reduced to abstract academic exercises. It aligns the learning process with genuine external utility, instilling entrepreneurial self-efficacy and resilience in learners from an early age.

2. Literature Review

2.1. Defining Pre-Incubation in Educational Contexts

While business incubation has been extensively theorized as an infrastructure-rich environment designed to accelerate startup survival (Hackett & Dilts, 2004), the concept of pre-incubation remains less standardized, particularly when applied to pre-university educational systems.

In industrial settings, pre-incubation represents the developmental stage preceding formal business incubation, focusing on market feasibility, team formation, and initial business model development (Carayannis & Von Zedtwitz, 2005).

However, in K-12 educational settings, the objective of pre-incubation is fundamentally pedagogical rather than commercial (Isabelle, 2013). School-level pre-incubation is defined as a structured educational pathway designed to cultivate foundational cognitive, behavioral, and technical competencies, preparing young learners to recognize opportunities, prototype solutions, and navigate risk before they enter formal higher education or professional incubation spaces.

2.2. Entrepreneurship Education in the MENA and Algerian Context

Over the past decade, entrepreneurship education in the Middle East and North Africa (MENA) region has expanded significantly, driven largely by high youth unemployment and the urgent need for economic diversification (Isenberg & Onyemah, 2016). Regional initiatives, such as the INJAZ Al-Arab program, have demonstrated the viability of embedding structured entrepreneurship modules within secondary school curricula, reporting marked improvements in student motivation and career readiness.

Despite these regional advancements, Algeria's implementation of entrepreneurship education has remained structurally unbalanced. While neighboring countries have experimented with secondary school entrepreneurship courses, Algeria has focused almost exclusively on higher education.

Extracurricular activities, such as science and technological clubs, exist in some Algerian secondary schools, but they operate without standardized curriculum frameworks, lack specialized facilities, and maintain no connection to the national startup network. This isolated positioning leaves a major gap at the secondary level, which this study directly addresses.

3. Methodology

3.1. Research Design and Conceptual Framework Analysis

This study adopts a qualitative, empirical case study design combined with Jabareen's (2009) Conceptual Framework Analysis (CFA) methodology. CFA is uniquely suited for designing a new educational framework in an under-researched area because it provides a highly structured process for identifying, deconstructing, and mapping multidisciplinary concepts. Following Jabareen's (2009) multi-phase protocol, the research design progressed through three distinct phases:

PHASE 1: Conceptual Deconstruction (Jabareen, 2009)
- Systematic policy document analysis (national curricula, startup laws)
- Academic literature review on school-level pre-incubation.
PHASE 2: Field-Grounded Qualitative Case Study
- 96 Hours of direct ethnographic observations across 3 Constantine secondary schools
- 17 Semi-structured interviews with key educational stakeholders
PHASE 3: Conceptual Synthesis
- Integrating empirical field codes into the "Tamkeen Junior Incubator" Framework

3.2. Sampling Rationale and Context

To ground the conceptual framework in the empirical reality of Algerian schooling, fieldwork was conducted in the Constantine Wilaya (province) during the 2025–2026 academic year. Three secondary schools were selected through purposive sampling to capture a representative range of socio-economic and structural conditions:

Abdrezzak Bouhara Secondary School (Massinissa): A newly established suburban school characterized by modern standard infrastructure but limited extracurricular links.

Massinissa Secondary School (El-Khroub): An urban school with high student density and nominal extracurricular science clubs, but no technological tools.

Elhoria Secondary School (Constantine City): A historic, highly populated inner-city female-only school with active student participation but severely outdated science facilities.

3.3. Data Collection Methods

- Document Analysis: A systematic review was conducted of the Algerian Ministry of National Education's secondary curriculum frameworks (2022 edition), Executive Decree No. 20-254 (Startup Law), and Ministerial Decision 1275 to identify points of alignment and divergence.

- Field Observations: Structured ethnographic observations were carried out over a 12-week period (October 2025 – January 2026), totaling 96 hours of field observation. Observations focused on classroom pedagogical dynamics, technology use, and extracurricular science club operations, recorded using a standardized observation protocol.

- Semi-Structured Interviews: Seventeen formal interviews were conducted to gather perspectives on systemic barriers and opportunities for innovation education. The participant sample consisted of:

-8 secondary school teachers (science, technology, and informatics)
-3 school directors
-2 regional education inspectors
-4 university incubator managers within the Constantine region

Interviews lasted between 35 and 55 minutes, were conducted in Algerian Arabic or French, audio-recorded with written consent, and transcribed verbatim.

3.4. Analytical Approach

The research data were analyzed using the six-phase thematic analysis framework proposed by Braun and Clarke (2006). Transcripts and observation notes were uploaded to NVivo 12 software. Open coding was applied to capture barriers to innovation, pedagogical constraints, infrastructural limitations, and institutional attitudes. These codes were iteratively grouped into broader sub-themes and ultimately refined into five overarching thematic deficiencies that define the current Algerian educational gap.

4. Findings and Analysis

The qualitative analysis revealed five major structural deficiencies within the Algerian secondary school system. These findings demonstrate that while individual students and teachers possess high creative potential, the institutional environment actively prevents this potential from translating into viable innovation.

4.1. Deficiency 1: Absence of Innovation Laboratories and Makerspaces

Field observations across all three schools revealed that school spaces are strictly segmented into traditional classrooms and highly rigid science laboratories. The existing "computer rooms" are kept locked under key, with access permitted only during scheduled informatics classes.

There are no fabrication labs (FabLabs), maker spaces, or communal areas where students can build prototypes or experiment with physical materials. A technology teacher captured this limitation:

"We have computers, yes, but they are locked in a room and only used for basic informatics lessons. If a student wants to build a prototype, design an interactive model, or write code for an Arduino, there is literally no physical space or equipment to do so. The system is designed to consume information, not to build." (Teacher 3)

This physical limitation prevents students from engaging in active prototyping, reducing technology education to abstract textbook diagrams.

4.2. Deficiency 2: Lack of Structured Extracurricular Innovation Clubs

While secondary schools had "science clubs" registered on paper, field observations showed these clubs were highly inactive, meeting sporadically and lacking any structured curriculum or clear objectives. School directors reported that no operational budget is allocated for extracurricular student projects. As a school director explained:

"We have a science club on paper, but it has no budget, no set curriculum, and meets only when a teacher volunteers free time. The

teacher in charge does it voluntarily, without any material support or guidance on how to foster innovation. It is basically a hobby club with no direction." (Director 1)

4.3. Deficiency 3: Absence of School-University Linkages

An absolute structural divide exists between the secondary education sector and higher education. Despite the rapid growth of university incubators under Ministerial Decision 1275, there are no institutional pathways, joint projects, or mentorship networks connecting secondary schools to nearby universities. A university incubator manager in Constantine described this dynamic:

"We receive brilliant university students, but they arrive at our incubator with zero entrepreneurial mindset. They have spent twelve or thirteen years in a school system that demands obedience and memorization. We would love to collaborate with local secondary schools to mentor young talents, but there is no legal or administrative framework allowing us to do so. Our operations are strictly bounded by Ministerial Decision 1275 within the university walls." (Incubator Manager 2, Constantine)

This isolation prevents younger learners from gaining early exposure to university resources, professional mentorship, or real-world technological applications.

4.4. Deficiency 4: Limited Teacher Preparedness in Active Innovation Pedagogy

Interviews with teachers and regional inspectors confirmed that pre-service and in-service training programs in Algeria do not include entrepreneurship pedagogy, design thinking, or project-based learning. Teachers are evaluated almost exclusively on their ability to finish the national curriculum and prepare students for the baccalaureate examination. A regional inspector noted:

"Our pedagogical training focuses exclusively on rote curriculum delivery and preparing students for the Baccalaureate. Entrepreneurship pedagogy, design thinking, and project-based learning are entirely absent from the teacher training models in Algeria. If a teacher wants to try something creative, they must do it intuitively, and often they are

discouraged because it takes time away from the official exam curriculum." (Inspector 1)

This rigid evaluation system deters teachers from adopting student-centric, experiential teaching methods.

4.5. Deficiency 5: Absence of Structured Pre-Incubation Pathways

When school-aged students develop an innovative idea or software application, they have no formal path to register, protect, or develop their concept. There is no intermediate administrative structure to validate their innovation or connect them to legal and developmental support. An informatics teacher recounted:

"A student of mine developed a brilliant smart agricultural drone that provides information on crop growth stages, health, and soil variations. He wanted to know how to develop it further, maybe protect the code he used. I didn't know what to tell him. There is no path for them. He has to wait until he finishes school, enters university, and hopes he still has the motivation. By then, the spark is usually gone." (Teacher 1)

This lack of structural continuity leads to a significant loss of creative talent, as promising student projects are abandoned or stolen due to a lack of institutional support.

5. Proposed Conceptual Framework: The Tamkeen Junior Incubator

The Tamkeen Junior Incubator (TJI) model is designed to resolve these five structural deficiencies. It establishes a developmentally appropriate, school-level pre-incubation framework specifically tailored for the Algerian public educational system.

5.1. Model Overview and Architecture

The TJI model does not seek to push children into early commercialization. Rather, it focuses on building cognitive, technical, and collaborative competencies across three progressive developmental stages.

Stage 1: Exploration (Ages 4–10): Located in primary schools, this stage focuses on cultivating curiosity, divergent thinking, and basic

problem-solving. Learning activities are designed around play, simple block construction, storytelling, and observational science. The objective is to build foundational cognitive flexibility and collaborative social skills without introducing complex technical terms.

Stage 2: Skill Development (Ages 11–14): Situated in middle schools, this stage introduces structured, project-based design. Students learn block-based coding (e.g., Scratch), basic robotics, and user-centered design principles. Learning is organized around collaborative team projects where students identify a school-level challenge and construct simple, physical prototypes to address it.

Stage 3: Pre-Incubation (Ages 15–18): Positioned within secondary schools, this stage serves as the formal gateway to the national startup ecosystem. Students participate in structured design-thinking sprints, build high-fidelity digital and physical prototypes using dedicated maker spaces, and receive direct mentorship from university incubator networks. Projects are pitched to panels of educators, university incubation officers, and local entrepreneurs.

5.2. Stakeholder Roles and Operational Matrix

To ensure effective implementation, the TJI model integrates multiple stakeholders across the educational and entrepreneurial sectors, as outlined in Table 1.

Table 1: Stakeholder Roles and Implementation Responsibilities

Stakeholder	Key Strategic Responsibility	Core Operational Tasks
Ministry of National Education	Policy Integration & Systemic Standardization	Formulate national pre-incubation guidelines, align the national curriculum with the TJI stages, and allocate funding for school-level innovation spaces.

Ministry of Knowledge Economy & Startups	Ecosystem Integration & Resource Allocation	Connect schools to the national venture registry, fund school maker spaces, and provide technological resources.
University Incubators (Decision 1275)	Mentorship, Scaffolding & Pathing	Provide secondary school students with laboratory access, mentor student teams, and run joint innovation events.
Secondary School Administration	Local Resource Management & Scheduling	Set aside dedicated physical rooms for maker spaces, integrate innovation clubs into the school week, and support teacher-led projects.
Teachers and Facilitators	Experiential Facilitation & Coaching	Pivot from teacher-centric lecturing to guiding and mentoring student teams through experiential design cycles.
Local Enterprises & Startups	Contextual Challenges & Mentorship	Sponsor school innovation challenges, share real-world business problems, and host study visits.

5.3. Comparative Analysis with International Models

To contextualize the proposed framework, Table 2 compares the Tamkeen Junior Incubator with established regional and international entrepreneurship education models.

Table 2: Comparative Analysis of Global and Regional Models

Program/ Model	Target Context	Age Group	Primary Pedagogical Focus	Core Structural Limitations in Algeria

Junior Achievement (JA) / INJAZ	Global / MENA Region	K-12 (5–18)	Financial literacy, business simulation, work readiness.	Operates as an external extracurricular add-on with limited integration into formal school curricula and weak ties to university tech incubators.
Young Enterprise	United Kingdom	15–18	Practical business startup creation and school-level company operations.	Highly dependent on mature local corporate financial ecosystems, which are not currently available in Algerian public schools.
Stanford d.school K12 Lab	United States	K-12 (5–18)	Human-centered design thinking, creative self-efficacy, and empathy mapping.	Requires high institutional flexibility, intensive teacher training, and modern technology resources, making it difficult to scale in Algeria.
Tamkeen Junior Incubator (TJI)	Algeria	4–18	Developmental pre-incubation, hands-on prototyping, and direct university incubator pathways.	Specifically designed for public schooling, providing a clear pathway to higher education startups under Ministerial Decision 1275.

The TJI model distinguishes itself by focusing specifically on the Algerian context. It aligns directly with the nation's public administrative structures and provides a clear developmental pathway connecting early childhood play to university-level tech startup incubation.

6. Discussion

The findings of this study confirm that while Algeria has made significant progress in establishing university-level startup incubators, the lack of school-level pre-incubation infrastructure creates a major bottleneck in the national innovation pipeline. This gap is consistent with Isenberg and Onyemah's (2016) observation that emerging innovation ecosystems often focus too heavily on later-stage business incubation while neglecting the early-stage educational pathways that build entrepreneurial talent. The proposed Tamkeen Junior Incubator addresses this structural gap by synthesizing constructivist, experiential, and entrepreneurial learning theories into a coherent, practical framework. By organizing pre-incubation into three developmentally appropriate stages, the model moves beyond generic entrepreneurship programs to align with established cognitive development milestones (Piaget, 1972; Vygotsky, 1978).

At Stage 1, the model focuses on simple, constructivist play, helping primary-school learners build basic creative confidence. By Stage 3, the model transitions to advanced design thinking and physical prototyping, preparing secondary-school learners to participate in formal higher-education incubators.

Furthermore, this study highlights that fostering youth innovation requires more than simply adding new entrepreneurship courses to the curriculum. It demands a fundamental shift in pedagogical design and physical learning spaces. Fostering creative self-efficacy requires transforming classrooms into active learning environments where students can experiment, prototype, and learn from constructive failure (Lackéus, 2020).

By establishing dedicated maker spaces and formalizing school-university partnerships, the TJI model bridges the physical and administrative divide between public schooling and the higher-education startup ecosystem. This structural alignment ensures that young, talented innovators receive the early encouragement, resources, and mentorship necessary to succeed in a modern, knowledge-based economy.

Conclusion

This study has investigated the structural gap between the Algerian secondary school system and the rapidly expanding higher-education startup ecosystem. While national reforms have successfully institutionalized startup creation in universities under Ministerial Decision 1275, primary, middle, and secondary school learners remain largely isolated from this innovation network.

The qualitative analysis identified five major structural barriers in public schools: a lack of physical maker spaces, unstructured extracurricular science clubs, an absence of school-university linkages, limited teacher preparedness in active pedagogies, and no formal pathways for young innovators.

To address these gaps, this study proposed the Tamkeen Junior Incubator (TJI)—a developmentally appropriate pre-incubation framework that integrates constructivist, experiential, and entrepreneurial learning theories to guide primary, middle, and secondary school learners through three progressive stages of creative development.

To operationalize this pre-incubation framework, three coordinated sets of strategic recommendations are proposed for national policy, institutional structures, and school curricula:

- Inter-Ministerial Policy Alignment: Establish a formal coordinating committee linking the Ministry of National Education, the Ministry of Higher Education and Scientific Research, and the Ministry of Knowledge Economy and Startups. This committee should formulate a joint regulatory framework to formally integrate school-level pre-incubation into the national innovation strategy.

- National Funding and Regulatory Frameworks: Draft a ministerial decree authorizing public schools to receive technological equipment and development funding from the national startup fund, providing the resources necessary to build and maintain school-level maker spaces.

- Infrastructural Investment: Repurpose underutilized spaces in public schools into dedicated maker spaces and fabrication laboratories (FabLabs). These spaces should be equipped with accessible

prototyping tools, such as basic electronics kits, mechatronics sets, and open-source computing platforms.

- School-University Mentorship Networks: Mandate university incubators (operating under Decision 1275) to establish outreach programs for secondary schools. These programs should include joint innovation events, laboratory visits, and mentorship structures where university startups support young student inventors.

- Teacher Training Reform: Revise the curriculum of teacher training institutions (the Écoles Normales Supérieures - ENS) to integrate modules on design thinking, project-based learning, and entrepreneurial facilitation, preparing teachers to guide experiential student projects.

- Curriculum Modernization: Transition the computer science and technology curriculum away from passive computer literacy toward active programming, robotics, and user-centered design.

- Evaluation Frameworks: Adopt standardized competency evaluation models, such as the European Entrepreneurship Competence Framework (EntreComp), to systematically assess student progress in creativity, teamwork, and problem-solving.

Ultimately, building a strong national innovation culture depends not only on the strength of university incubators but also on how effectively early childhood curiosity is cultivated. By investing in school-level pre-incubation and bridging the gap between public education and the startup ecosystem, Algeria can establish a continuous talent pipeline, driving long-term economic development and empowering the next generation of innovators.

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