Adult and Higher Education (2026)
Clausius Scientific Press, Canada

DOI: 10.23977/aduhe.2026.080210
ISSN 2523-5826 Vol. 8 Num. 2

Research on the Pathways for Integrating Liaoning's Industrial Cultural Heritage into the Higher Education System

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Keywords: Industrial cultural heritage; Liaoning; higher education; Educational transformation

Abstract: Industrial cultural heritage stands as a historical testament to the process of industrialization, embodying a wealth of technical knowledge, craft wisdom, and spiritual connotations, thereby holding distinctive educational value. As a nationally significant old industrial base, Liaoning Province possesses an extensive, diverse, and broadly distributed array of industrial heritage resources, offering invaluable materials for university education. On the basis of reviewing the general profile and characteristics of Liaoning's industrial cultural heritage, this paper analyzes its educational values across three dimensions: knowledge transmission, competency development, and value cultivation. It further examines current practices and existing challenges in utilizing such heritage for educational purposes within Liaoning's higher education institutions. The study reveals that the integration faces practical obstacles, including insufficient educational transformation of heritage resources, overly simplistic curriculum incorporation, underdeveloped practical teaching systems, and inadequate faculty and support conditions. In response, this paper proposes systematic advancement strategies from four dimensions: curriculum integration, practical platform construction, digital technology empowerment, and collaborative mechanism development. These proposals aim to provide theoretical references and practical pathways for effectively converting industrial cultural heritage into educational resources for higher education.

1. Introduction

Cultural heritage serves as a repository of a region's historical memory and constitutes an indispensable resource foundation for education. As a significant category of cultural heritage, industrial cultural heritage records technological changes, production mode transformations, and socio-economic transitions throughout a nation or region's industrialization, encapsulating substantial technical knowledge, craft experience, and spiritual traditions. Introducing these resources into the higher education domain not only broadens students' intellectual horizons and enhances their practical competencies but also nurtures their professional qualities and cultural

identity[1].

Liaoning Province has occupied a pivotal position in China's national industrialization process, accumulating exceptionally rich industrial cultural heritage. These heritages encompass both tangible elements such as factory buildings, workshops, and machinery, and intangible aspects including production techniques, technical standards, corporate institutions, and industrial traditions. According to statistics, Liaoning has currently inventoried and screened 76 industrial heritage sites and 19 industrial museums, with 16 national-level industrial heritage designations, ranking among the top provinces nationwide in quantity[2]. These industrial cultural heritages not only bear witness to Liaoning's industrial development but also provide uniquely advantageous conditions for universities to conduct culture-based education.

In recent years, the preservation and utilization of industrial cultural heritage have received increasing attention at both national and local levels, with explicit requirements articulated for strengthening industrial heritage protection and industrial cultural transmission. Against this backdrop, how to effectively integrate Liaoning's abundant industrial cultural heritage resources into the higher education system—transforming them from "static exhibits" into "dynamic educational assets"—constitutes a topic of both theoretical significance and practical value.

Taking Liaoning's industrial cultural heritage as its research subject, this paper reviews the resource profile and characteristics, analyzes its educational values, investigates current problems and dilemmas in integration practices, and subsequently proposes systematic advancement strategies, with the aim of offering references for the educational transformation of local industrial cultural heritage in higher education.

2. General Profile and Characteristics of Liaoning's Industrial Cultural Heritage

2.1 Resource Overview

Liaoning's industrial cultural heritage resources are characterized by large quantity, wide distribution, and high value. In the Third National Census of Immovable Cultural Relics, Liaoning Province registered 269 industrial heritage relics. In terms of national-level industrial heritage, Liaoning currently has 16 sites included in the national list. The first batch includes Anshan Iron and Steel Plant, Lushun Dockyard, and Benxihu Coal and Iron Company; the second batch includes Shenyang Foundry and State-owned Qingyang Chemical Plant; the third batch includes Fushun West Open-pit Mine, Yingkou Paper Mill, and Dalian Refrigerator Factory Foundry; the fourth batch includes Laolongkou Distillery, Dalian Shipyard Repair South Dock, and Fuxin Coal Industry Heritage Group; and the fifth batch is Shenyang Mint. Additionally, Liaoning has announced two groups of provincial-level industrial heritage, with 15 in the first group and 7 in the second. All 14 prefecture-level cities in the province are industrial cities, forming numerous renowned industrial districts and towns.

In terms of industry coverage, Liaoning's industrial cultural heritage spans a broad spectrum. Categorized by industrial sectors, it includes mining, manufacturing, electricity/heat/gas/water production and supply, transportation/storage/postal services, and culture/sports/entertainment, among which manufacturing industrial heritage is the most numerous. Spatially, Liaoning's industrial heritage forms a regional branching distribution pattern along three major railway lines, including the core industrial axis along the Shenyang–Harbin–Dalian railway linking Shenyang, Tieling, Anshan, and Liaoyang, as well as the Central–Southern Liaoning heritage area concentrated along the Shenyang–Jilin and Shenyang–Dandong railway lines. This regional distribution endows different cities with distinctive industrial features—Shenyang's equipment manufacturing, Dalian's port and shipbuilding industries, Anshan's iron and steel sector, Fushun's coal industry, and so forth.

2.2 Main Characteristics

Liaoning's industrial cultural heritage exhibits several notable features.

First, large scale and massive volume. Given that equipment manufacturing and metallurgy are pillar industries of Liaoning, the production spaces required are enormous, resulting in numerous large factories and mines. A significant proportion of industrial heritage comprises large workshops, large equipment, and large open-pit mines—such as Anshan Steel's blast furnaces, Fushun West Open-pit Mine, and Fuxin Haizhou Mine's pit. This "large-scale" industrial landscape provides students with visually striking experiences and expansive learning spaces.

Second, comprehensive system and complete typology. Liaoning's industrial heritage comprehensively reflects the different stages of China's modern industrial development, from the nascent modern industry in the late Qing and early Republican periods, to large-scale industrial construction after the founding of the People's Republic, and to industrial transformation since reform and opening-up—all with corresponding industrial remains as testimony. This temporal continuity and typological completeness offer rich materials for systematic industrial culture education.

Third, diverse explorations in adaptive reuse. In recent years, various localities in Liaoning have actively explored adaptive reuse pathways for industrial heritage. Production workshops at Anshan Iron and Steel Plant have been converted into the Anshan Steel Industrial Museum; old factory buildings in Shenyang's Tiexi District have been transformed into cultural and creative spaces such as 1905 Cultural and Creative Park and Hongmei Cultural and Creative Park; Dalian Iceberg Foundry has been repurposed as the Iceberg Huigu Cultural and Creative Park; and Chaoyang Water Pump Factory Historical and Cultural District has been renovated into a complex integrating science education, study tours, leisure, and entertainment. These adaptive reuse practices not only preserve the physical carriers of industrial heritage but also create conditions for universities to conduct on-site instruction and experiential learning.

3. Analysis of the Educational Value of Industrial Cultural Heritage

The educational value of industrial cultural heritage in higher education lies in its multi-dimensional and multi-layered educational potential.

3.1 Knowledge Transmission Value: Living Textbooks of Industrial History and Technology

Industrial cultural heritage serves as "living fossils" of the industrialization process, carrying abundant historical information and technical knowledge. The production layout of an old workshop, the mechanical structure of an antique machine, and the process parameters in technical archives all embody the production technology levels and industrial civilization achievements of specific historical periods. For students in engineering, design, and management disciplines, industrial cultural heritage provides intuitive learning materials—students can understand technological evolution, analyze production organization modes, and perceive industrial design changes in authentic industrial settings[3]. The China Industrial Museum, located in Shenyang's Tiexi District, is the nation's first comprehensive industrial-themed museum, housing 13,000 cultural relics and over 5,000 precious documents, systematically displaying the complete developmental trajectory of Chinese industry from ancient handicrafts to modern intelligent manufacturing. Such systematic displays of industrial history offer irreplaceable real-scene classrooms for professional knowledge instruction in higher education.

3.2 Competency Development Value: Training Grounds for Practice and Innovation

Industrial cultural heritage provides unique venues for cultivating students' practical abilities. On the one hand, the authenticity and situationality of industrial heritage free practical teaching from the limitations of classroom simulation. Through field investigations of industrial sites, students can exercise their observational, analytical, and research capabilities. The School of Architecture and Art Design at University of Science and Technology Liaoning has co-established a collaborative innovation practice base with the Anshan Steel Museum, conducting research cooperation and talent cultivation in areas such as industrial heritage preservation and cultural digitalization. This university-museum cooperation model offers students opportunities to engage in real projects[4].

On the other hand, the adaptive reuse of industrial heritage is itself an innovative process. How to transform abandoned industrial buildings into cultural spaces? How to convert industrial heritage resources into cultural and creative products? How to "revitalize" industrial heritage through digital means? Addressing these questions requires interdisciplinary knowledge integration and innovative thinking. Universities can guide students to participate in the preservation and utilization practices of industrial heritage, honing their innovation capabilities through real-world problem-solving.

3.3 Value Cultivation Value: Vehicles for Professional Ethics and Cultural Identity

Industrial cultural heritage carries the spiritual traditions of specific industries and eras. The professional virtues forged throughout Liaoning's industrial development—such as perseverance, craftsmanship excellence, and innovation—constitute invaluable spiritual wealth. For university students about to enter society, understanding these traditions helps shape sound professional values and ethics. The Anshan Steel Museum presents the development history of China's iron and steel industry through rich exhibitions; the China Industrial Museum systematically portrays China's industrial journey from humble beginnings to growth and strength through themed halls including the Tiexi Hall, Machine Tool Hall, General History Hall, and Foundry Hall. These venues integrate historical narratives of industrial development with spiritual connotations, providing immersive learning experiences for students.

Furthermore, industrial cultural heritage is also an important vehicle for fostering regional cultural identity. Liaoning's industrial heritage vividly epitomizes the historical struggles of the Liaoning people, carrying collective memories of urban development. For university students studying in Liaoning, understanding the province's industrial cultural heritage deepens their cognitive and emotional connections to this land, fostering a sense of belonging and responsibility for serving the local community[5].

4. Practical Examination of Integrating Industrial Cultural Heritage into the Higher Education System

4.1 Existing Practical Explorations

In recent years, some universities in Liaoning have actively explored the use of industrial cultural heritage for educational purposes. In practical teaching, certain institutions have organized students to visit industrial museums and heritage parks for on-site instruction. Shenyang Normal University has conducted "walking classroom" practical teaching activities at the China Industrial Museum. University of Science and Technology Liaoning has established industry-university-research cooperation with the Anshan Steel Museum, inviting corporate mentors to deliver lectures on industrial culture and heritage knowledge on campus[6]. In campus culture construction, Liaoning Institute of Science and Technology has themed its cultural education around

"steel culture," integrating industrial cultural elements into talent cultivation. These practical explorations have accumulated some experience for the educational transformation of industrial cultural heritage in higher education.

4.2 Main Existing Problems

Despite the above efforts, overall, the integration of Liaoning's industrial cultural heritage into the higher education system still faces numerous challenges.

First, insufficient educational transformation of resources. At present, the preservation and utilization of Liaoning's industrial cultural heritage remain largely confined to cultural relic protection and tourism development, with inadequate systematic exploration of its educational value and curricular conversion. A considerable amount of industrial heritage remains in a "dormant" state, yet to enter the educational purview of universities. Which heritage sites are suitable for which disciplines and courses? How can the historical information and technical knowledge of industrial heritage be transformed into systematically designed teaching content? These critical questions lack clear understanding and systematic planning.

Second, overly simplistic curriculum integration. In terms of integration methods, current educational uses of industrial heritage by universities predominantly take the form of one-off activities such as visits and on-site tours, lacking systematic curriculum design and sustained educational arrangements. The deep integration of industrial heritage with disciplinary course instruction remains insufficient, and fragmented, token activities fail to yield lasting educational effects. How to transform industrial heritage from "objects of visitation" to "curricular content" represents a bottleneck demanding urgent resolution.

Third, inadequate practical teaching systems. Although some universities have established cooperative relations with industrial museums and heritage parks, these collaborations often remain at the level of memoranda of understanding, lacking institutionalized operational mechanisms. Normative institutional designs concerning class hours, credit recognition, safety guarantees, and other aspects of practical teaching have not yet been fully developed. Curriculum co-construction, faculty sharing, and joint project research between universities and museums are still in nascent stages.

Fourth, weak faculty and support conditions. University teachers' levels of awareness and capacity to utilize industrial cultural heritage vary considerably, with most lacking systematic training in incorporating such heritage into teaching. Meanwhile, insufficiencies in funding and policy support also constrain the in-depth advancement of heritage-based educational work.

5. Advancement Strategies for Integrating Liaoning's Industrial Cultural Heritage into the Higher Education System

In response to the above issues, systematic advancement should be pursued from four dimensions: curriculum teaching, practical platforms, digital technology, and collaborative mechanisms.

5.1 Curriculum Integration: Establishing a Systematic "Resource-to-Course" Transformation Mechanism

Curriculum is the primary channel for education, and the integration of industrial cultural heritage into higher education must first achieve systematic transformation at the curricular level.

First, develop specialized courses. Universities should be encouraged to develop distinctive courses themed around industrial cultural heritage, leveraging their disciplinary strengths and

professional characteristics. Engineering-oriented institutions may offer courses such as “Industrial Heritage and Engineering Technology History” to narrate technological evolution and process innovation in Liaoning’s industrial development; design-oriented institutions may offer “Spatial Reinvention and Creative Design of Industrial Heritage” to explore the adaptive reuse of industrial architectural heritage; management-oriented institutions may offer “Industrial Heritage Preservation and Industrial Transformation” to analyze industrial and cultural issues in the revitalization of old industrial bases.

Second, integrate into existing courses. Industrial cultural heritage resources should be introduced as teaching cases into various professional courses. In engineering programs, classic equipment and process cases from industrial heritage can illustrate technical principles and design philosophies; in humanities and social sciences such as history and sociology, industrial heritage can serve as micro-samples of social change for thematic seminars. Through “case-based” integration, industrial cultural heritage can be transformed from “extracurricular resource” to “in-class material.”

Third, build curriculum resource repositories. University faculty and museum experts should collaborate to compile casebooks of industrial heritage teaching materials and develop digital resources such as multimedia courseware and video materials. The repository should cover industrial heritage cases from different industries and periods to meet the teaching needs of various disciplines and courses.

5.2 Practical Integration: Establishing “Campus-External” Linked Practical Teaching Platforms

Practice is a critical link in heritage-based education, and a three-dimensional practical system extending from the classroom to society should be constructed.

First, establish practical teaching bases. Universities should be encouraged to build stable cooperative relationships with industrial museums and heritage parks to co-construct practical teaching bases. Base development should move from “signing agreements” to “shared construction”—establishing normalized mechanisms for curriculum co-construction, faculty sharing, and joint project research. The industry-university-research cooperation model between University of Science and Technology Liaoning and the Anshan Steel Museum, focusing on heritage preservation and cultural digitalization, is worth emulating.

Second, diversify practical teaching formats. Beyond traditional visits, diverse practical projects should be designed. Inquiry projects on “Craft Wisdom and Technological Elements of Industrial Heritage” can be set up, organizing students to conduct field surveys and archival work; “Stories Behind Industrial Heritage” documentation projects can be designed to train students’ oral history collection and narrative skills; and “Creative Design of Industrial Heritage” workshops can be conducted to engage students in adaptive reuse practices.

Third, construct immersive teaching scenarios such as “workshop classrooms.” Leveraging the authentic spaces of industrial heritage, classroom teaching can be moved into real workshops, factories, and open-pit mines. Conducting instruction in authentic industrial environments allows students to experience the spatial atmosphere and technological logic of industrial production, achieving the pedagogical effect of “learning in context and comprehending through experience.”

5.3 Technology Empowerment: Building Digital Education Platforms

Digitalization provides strong support for expanding the educational functions of industrial cultural heritage.

First, promote the digitalization of industrial cultural heritage. Technologies such as 3D scanning,

virtual reality (VR), and augmented reality (AR) should be employed to convert the physical forms of industrial heritage into digital educational resources. Digitalization not only facilitates permanent preservation but also enables distance education and online learning.

Second, construct digital teaching platforms. An integrated digital platform combining industrial heritage exhibitions, online course instruction, and virtual simulation experiences should be developed. Students can remotely "visit" industrial heritage sites and "experience" industrial production processes in virtual scenarios through the platform. The platform should also include teaching management, learning records, and outcome assessment functions to provide data support for teachers' instructional optimization.

Third, innovate digital teaching methods. Teachers should be encouraged to employ digital technologies for immersive and interactive instruction. VR technology can reconstruct historical production scenarios, enabling students to understand technological evolution through "first-hand" immersion; digital twin technology can simulate the operational principles of industrial equipment to supplement engineering course teaching.

5.4 Collaborative Advancement: Building a Multi-Stakeholder Educational Community

The integration of industrial cultural heritage into higher education is a systematic endeavor requiring collaborative participation from multiple stakeholders.

First, establish university-local government coordination mechanisms. Universities and local governments should be urged to establish coordination mechanisms for heritage-based education. Local governments should incorporate the educational function of industrial cultural heritage into cultural development and educational planning. Universities should proactively engage with local heritage management authorities to establish regular communication and cooperation channels.

Second, deepen university-museum cooperation. Universities should forge in-depth partnerships with industrial museums and heritage management bodies. Cooperation should expand from visitor reception to curriculum co-construction, joint research, and personnel exchanges. Museum experts should be invited to university classrooms, while university faculty and students should participate in content development and educational activities at cultural venues.

Third, strengthen faculty development. Faculty teams for industrial heritage education should be built by type and by discipline. Through field visits to heritage sites, specialized training, and teaching seminars, teachers' familiarity with and instructional application of industrial cultural heritage should be enhanced. Meanwhile, corporate engineers and museum experts should be recruited as external mentors to enrich teaching capacity.

6. Conclusion

Liaoning, as a nationally significant old industrial base, possesses extraordinarily abundant industrial cultural heritage resources. These resources are not only material witnesses to industrial development history but also carriers of rich technical knowledge, craft wisdom, and spiritual traditions, holding distinctive educational value. Effectively integrating them into the higher education system represents both a creative transformation of industrial cultural heritage and an innovative expansion of higher education models.

This study demonstrates that the integration of industrial cultural heritage into higher education should follow a systematic transformation logic from "resources" to "curriculum" and then to "competencies." At the resource level, the types, characteristics, and distribution of Liaoning's industrial heritage should be systematically reviewed to clarify their educational values. At the curriculum level, educational transformation should be achieved through course development, case integration, and repository construction. At the practical level, campus-external linked practical

platforms should be established to allow students to gain experience and growth in authentic settings. At the support level, digital technology empowerment and multi-stakeholder collaborative participation are essential.

Currently, Liaoning has made certain progress in integrating industrial cultural heritage into higher education, yet challenges remain, including insufficient resource transformation, overly simplistic integration methods, incomplete practical systems, and weak faculty support. Addressing these difficulties requires systematic advancement from the four dimensions of curriculum teaching, practical platforms, digital technology, and collaborative mechanisms. It should be noted that different universities have distinct positioning, disciplinary structures, and geographical conditions, so integration pathways should be tailored accordingly. Engineering institutions may emphasize the educational transformation of industrial technology history and engineering ethics; art and design institutions may focus on spatial reinvention and creative expression of industrial heritage; comprehensive universities may prioritize industrial social history and regional cultural studies. Future research could further examine evaluation systems for the educational outcomes of industrial heritage and differentiated integration models for different heritage types, so as to deepen theoretical inquiry and optimize practices. Only in this way can Liaoning's rich industrial cultural heritage be truly converted into an educational force that nourishes student development.

Acknowledgement

This work was supported by 2026 Research Project on Social and Economic Development of Liaoning Province under Grant 2026lslqnkt-050.

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