

AN ANALYSIS OF STEM INTERDISCIPLINARY TALENT CULTIVATION IN TAIWAN'S HIGHER EDUCATION: A SOCIOLOGICAL PERSPECTIVE

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ABSTRACT

This article examines the cultivation of interdisciplinary STEM talent in Taiwan's higher education through a sociological lens. From a social-structural perspective, STEM education functions not only as a driver of innovation and economic development but also as a critical site for the reproduction of power relations. Ensuring equitable development of interdisciplinary talent therefore requires educational policies and institutional arrangements to confront the underlying mechanisms of social reproduction—including disparities rooted in gender, class, and cultural capital. By addressing these structural inequities, higher education institutions can create conditions in which students from diverse social backgrounds have equitable opportunities to participate, succeed, and flourish.

Keywords: critical thinking, interdisciplinary education, knowledge economy, STEM, higher education

1.0 INTRODUCTION

The global knowledge economy and digital transformation have positioned STEM education as a central focus of national talent development policies (Marginson, 2017). Science, Technology, Engineering, and Mathematics (STEM) interdisciplinary education has been highly acclaimed as a key educational reform approach for cultivating students and human resources in the twenty-first century. In Taiwan, facing challenges such as industrial upgrading, population aging, and youth outmigration, the government has launched initiatives such as the "Industry–Academia Collaboration Program" and the "Interdisciplinary Innovation Talent Cultivation Plan" to cultivate STEM professionals with innovative and cross-domain competencies through higher education (Ministry of Education, 2023a). However, from a sociological perspective, the cultivation of STEM talent is not merely a technical or pedagogical issue but is deeply intertwined with structural inequalities. Drawing on Bourdieu's (1986) theory of social reproduction, access to STEM education and related occupational fields is often mediated by unequal distributions of economic, social, and cultural capital. Students from privileged backgrounds tend to possess the linguistic codes, cultural dispositions, and symbolic resources that align with institutional expectations, reinforcing existing hierarchies. Moreover, females are underrepresented in Science, Technology, Engineering, and Mathematics (STEM) fields all over the world. To encourage more girls to choose STEM majors and careers, it is critical to increase their interest in STEM careers. Many studies have investigated the factors that influence females' entry into STEM fields, but few studies have

explored the gender differences in the relationships between these factors. Hence, gender stereotypes and cultural biases embedded in STEM fields continue to marginalize women and underrepresented groups. In Taiwan, empirical studies indicate that female students and those from rural or working-class families are less likely to pursue STEM majors due to socialization processes and limited access to supportive learning environments (Bourdieu and Passeron, 1977; Eccles, 2009; Shih, 2024; Wang and Degol, 2017; Wang, N., Tan, A. L. and Zhou, X. et al., 2023; Ye, Shih, & Wang, 2022). These inequalities highlight how STEM education functions as a site of both opportunity and exclusion. Thus, efforts to promote innovation and excellence in STEM education must simultaneously address the hidden mechanisms of stratification and exclusion that shape who can participate, succeed, and lead in the knowledge economy. This article analyzes the cultivation of interdisciplinary STEM talent in Taiwan's higher education from a sociological perspective.

2.0 THE CULTIVATION OF INTERDISCIPLINARY STEM TALENT IN TAIWAN'S HIGHER EDUCATION SOLELY FROM A SOCIOLOGICAL PERSPECTIVE

2.1 Institutional level

Policies initiated by Taiwan's Ministry of Education—such as the Interdisciplinary Talent Cultivation in Smart Technology Program, the Higher Education Sprout Project, and the AI Interdisciplinary Curriculum Design Initiative—underscore the national emphasis on cross-disciplinary integration and innovation. Nevertheless, university evaluation and admissions systems continue to prioritize research output and disciplinary specialization, thereby constraining institutional incentives and structural support for genuine interdisciplinary collaboration (Ministry of Education, 2023b). From a sociological perspective, this institutional tension between policy advocacy for interdisciplinarity and the entrenched disciplinary structures of higher education reflects a deeper contradiction within the academic field. Drawing on Bourdieu's (1988) field theory, higher education operates as a site where academic capital and symbolic power are unequally distributed, reproducing hierarchical distinctions between disciplines. While governmental policies advocate flexibility and collaboration across domains, the evaluation mechanisms that regulate academic promotion, funding allocation, and institutional prestige continue to reproduce the traditional hierarchy of disciplines (Bourdieu, 1988; Marginson, 2010). This hierarchy privileges fields endowed with greater symbolic capital—particularly those aligned with established scientific paradigms—while marginalizing emerging or hybrid areas of study. To advance interdisciplinary STEM talent cultivation in Taiwan's higher education, it is essential to establish a reflexive institutional framework that redefines academic value beyond disciplinary boundaries. Such a framework should align evaluation criteria, funding incentives, and professional development mechanisms with the goals of interdisciplinarity and societal relevance, promoting a more equitable and innovative academic ecosystem (Bourdieu, 1986; Nowotny, Scott, & Gibbons, 2001). To advance interdisciplinary STEM talent cultivation in Taiwan's higher education, a more reflexive institutional framework is required—one that redefines academic value beyond disciplinary boundaries and encourages collaboration through supportive evaluation systems, resource allocation, and professional development mechanisms. Such transformation necessitates not only policy reform but also a cultural shift within academia toward recognizing interdisciplinarity as a legitimate and essential form of scholarly practice.

2.1 Social structural level

From a sociological perspective, the cultivation of interdisciplinary STEM talent is not merely an issue of educational techniques or curriculum design but is profoundly shaped by the hierarchical and unequal relationships embedded within the social structure. Bourdieu's (1986) theory of social reproduction posits that the education system serves as a key arena through which social inequalities are reproduced and legitimized via the unequal distribution of cultural, social, and symbolic capital. These forms of capital operate unequally across social groups, granting advantage to some while constraining others—a pattern that is particularly evident in STEM education. First, students from higher socioeconomic backgrounds tend to possess greater amounts of cultural capital that can be converted into academic advantages, such as language proficiency, technological literacy, and familial support (Eccles, 2009; Reay, 2004). These resources enable them to better align with institutional expectations, thereby gaining advantages in educational and career trajectories. In contrast, students from disadvantaged or rural backgrounds often face barriers to entering STEM fields due to a lack of relevant capital and learning support (Wang & Degol, 2017; Wang et al., 2023). Second, gender and cultural representation constitute additional dimensions of structural exclusion. Persistent gender stereotypes and male-dominated cultures in STEM disciplines continue to restrict women's participation and achievement (Eccles, 2009; Cheryan et al., 2017). In Taiwan, although women's participation in higher education has increased significantly, their representation in STEM-related disciplines such as engineering, information technology, and physics remains disproportionately low. This suggests that equality in access to education has not yet translated into substantive equality in disciplinary choices and career outcomes. Therefore, from a social structural standpoint, STEM education functions not only as a means of fostering innovation and economic growth but also as a site for the reproduction of power relations. Achieving equitable cultivation of interdisciplinary talent requires educational policies and institutional frameworks to address these hidden mechanisms of social reproduction—including disparities in gender, class, and cultural capital—so as to ensure that students from diverse backgrounds have equal opportunities to participate, succeed, and thrive.

2.2 Curriculum and pedagogical transformation

"Instruction" is the core of educational practice. "Instruction" includes teaching and learning. It is a subject that education practice must face (Shih, 2018a, 2018b). At the curriculum and pedagogical level, Taiwan's higher education must move beyond traditional disciplinary silos and foster integrated learning environments where STEM education connects with ethical reasoning, cultural awareness, and social responsibility. The integration of humanities and social sciences into STEM programs enables students to critically examine the social implications of technological advancement, thereby cultivating reflective and socially responsible scientific citizenship (Noddings, 2013; Stilgoe, Owen, & Macnaghten, 2013). Interdisciplinary curriculum design should adopt inquiry-based and project-based learning approaches that address authentic social and environmental issues, encouraging students to apply STEM knowledge in contextually meaningful ways. For example, collaborative community projects that link engineering and environmental sustainability can foster not only technical competence but also empathy and civic engagement (Kolmos, Hadgraft, & Holgaard, 2016). Furthermore, dialogic pedagogies inspired by Freire (1970) can promote reciprocal learning among students from diverse disciplinary backgrounds, creating spaces for shared

reflection on technology's ethical and societal dimensions. Teachers play a pivotal role in this transformation. Professional development programs should equip educators with the capacity to facilitate interdisciplinary dialogue and integrate socio-cultural perspectives into STEM teaching (Beers, 2005). Ultimately, curriculum reform should not merely aim for skill acquisition but cultivate moral imagination and critical thinking—empowering students to envision technology as a tool for social good rather than merely as an instrument of economic progress (Biesta, 2020).

3.0 DISCUSSION: Toward socially responsible and culturally reflexive STEM education

Taiwan's STEM education should move beyond a narrow focus on technical competence toward cultivating technological citizens who possess not only scientific literacy but also social responsibility and cultural understanding. As Dewey (1916) emphasized, education must connect knowledge with lived experience and democratic participation, enabling learners to understand the social implications of scientific progress. In this sense, STEM education should foster not only problem-solving and innovation but also ethical reflection and civic engagement.

Higher education institutions, in particular, should create “dialogic spaces” (Freire, 1970) that bring together students from science, engineering, and the humanities to critically engage with social issues and the ethical dimensions of technology. Such spaces encourage mutual understanding and reflexivity, breaking down disciplinary silos that often separate technological advancement from humanistic inquiry.

At the policy level, efforts should prioritize gender equity and inclusive access to STEM learning for students from socioeconomically disadvantaged backgrounds. Empirical studies in Taiwan indicate that gender stereotypes and social stratification continue to shape access to STEM disciplines and career pathways (Shih, 2020; Wang & Degol, 2017; Wang et al., 2023). Reducing these disparities requires educational policies that not only support equal participation but also challenge the structural and cultural biases embedded within the STEM system. From a sociological standpoint, the cultivation of interdisciplinary STEM talent is not solely a matter of knowledge and skill development—it is deeply entangled with social structures, power relations, and processes of cultural reproduction. Therefore, educational reform should balance institutional justice with cultural innovation, fostering a socially responsible and culturally responsive academic ecosystem that links technological progress with ethical awareness and inclusive development (Bourdieu, 1986; Marginson, 2010; Nowotny, Scott, & Gibbons, 2001; Wang et al, 2024).

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