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Multidimensional Measurement and Mechanisms of Doctoral Academic Socialization: An Empirical Analysis Using Structural Equation Modeling

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Abstract This research examines doctoral academic socialization's multifaceted nature through the creation of a culturally competent measurement framework. While conventional approaches have defined socialization as a one-way transmission of knowledge, contemporary doctoral studies require an exploration of how students navigate complex identity formation within diverse cultural contexts. Our research included a survey of 1,222 doctoral candidates from 23 universities in six nations through the application of structural equation modeling investigating interrelations between environmental support, academic self-efficacy, and socialization outcomes. Results showed a four-dimensional framework comprising cognitive development, identity construction, social integration, and value internalization, where the model explained 47% of the socialization and 52% of developmental outcome variances. Cultural setting significantly impacted these pathways such that Eastern students demonstrated 50% mediation through

self-efficacy as opposed to 36.2% for their Western peers, while international students demonstrated weak indirect effects (β=0.19, $p<0.01$). Perhaps tellingly, social integration emerged as the weakest dimension (M=4.42), which calls into question prevailing beliefs on collaborative scholarly development. Productivity in research emerged as the strongest outcome measure (loading=0.84), overshadowing other measures like professional networking and value development. These findings dispute universal doctoral education models, suggesting instead that universities need to construct culturally competent support mechanisms that balance productivity demands with holistic development of scholars, especially the increasingly diverse students navigating inter-cultural learning environments.

Keywords: • doctoral education • academic socialization • cultural context • structural equation modeling • academic self-efficacy

1 Introduction

Academics' socialization in doctoral studies is a significant higher education field of study marked by the ubiquitous process of constructing independent scholars. Earlier models centered on students' socialization toward the mentor and interpreted socialization as almost sequential skill transmission. Recent perspectives, on the other hand, regard it as an intricate process of forming one's identity, intellectual cultures of being a producer of new knowledge and a process of professionalization. This new orientation parallels recent research that ventures into locales where doctoral candidates anywhere transcend technical proficiency and an organic aspect of scholarly identity formation [1, 2].

Doctoral socialization is a process of a sequence of correlated phases. Skill acquisition and role adaptation and identity inclusion—the variables assume forms of multiple kinds on basis of institutions' and cultures' settings [3]. Western educational settings firmly put emphasis on individualism and independent scholarship and therefore allow the constant construction of separate research identities in students; however, Asian settings provide stronger salience towards

fitting-in and belonging to already ratified groups of research [4]. Inter-cultural differences exert central influences on process and outcome of socialization and extant literature does not represent the entire extent of variety of these settings. Research setting pressure also adds an additional pressure on students and incorporates developmental processes encompassed in traditional models.

Theoretical frameworks of doctoral socialization emerged from the convergence of complementary conceptions. Weidman's socialization model is a formal theory of scholarly norms learned by students through educational experiences. Coupled with Bourdieu's theory of cultural capital, the model accounts for the role of social placement and available resources to shape academic pathways [5, 6]. With the advent of digital transformation, one more complication exists as recent scholarly evidence outlines the expanded role of digital social and cultural capital as a support for academic performance [7, 8]. Theoretical sophistication is accounted for in describing academic socialization as a multidimensional construct with dimensions of cognitive development, identity construction, social integration, and values acquisition. Methodological advances in instruments in structural equation modeling offer measures of examining these multidimensional aspects [9, 10]; however, existing gaps are substantial.

The available measurement tools have major limitations. Instruments that have been validated and operationalized are mainly used in specific cultural and national contexts, which could limit their transferability to different educational settings. Incompatibility of these instruments with different theoretical models reduces the holistic evaluation of the socialization process [11, 12]. International students face specific challenges in negotiating a myriad of educational cultures while also constructing their own learning identities [13]. Varying environments like fieldwork, laboratories, and classroom learning provide different socialization experiences that current models fail to differentiate [14, 15]. Internationalization of doctoral studies as reflected by the rising global mobility of students poses more complex problems that current measurement methods fail to solve [16].

The articulated limitations identify serious gaps in current literature on doctoral socialization. Interplays between environmental forces, personal traits, and developmental outcomes are largely unexplored. On a more basic level, the problem of this "black box" arises since doctoral programs operate in international settings that require theoretical compatibility and responsiveness to multicultural environments. Current theoretical mappings, developed largely within Western settings, poorly account for socialization processes relevant to different cultural contexts or for students moving internationally.

This study fills existing gaps by creating and testing a multidimensional measure appropriate for use in diverse multicultural settings. At the core of this research is an examination of the dimensional model of doctoral academic socialization, as well as the interactions between these dimensions that advance student development, and the influence of cultural settings on these interactions. Using structural equation models with data gathered across multiple nations, this study advances both theoretical understanding and practical application. It broadens socialization theory beyond its largely European-American roots, revealing previously concealed influence mechanisms while maintaining awareness of cultural variety. From a practical perspective, it provides evidence-based assessment tools for institutions of higher education to enable the implementation of evidence-based reforms in doctoral education. By bridging theoretical advances with practical applicability, this study encourages re-examination of doctoral studies to better serve diverse student populations. The results have important implications for institutions seeking to create more inclusive and productive doctoral programs. In an increasingly globalized higher education landscape, understanding cultural differences in socialization processes is crucial for enhancing student success.

2 Methodology

2.1 Research Hypotheses and Conceptual Model

Utilizing Weidman's model of socialization as the conceptual framework, the current study formulates a conceptual model to explore the processes involved in socializing doctoral students. As depicted in Figure 1, environmental support influences academic socialization both directly and indirectly, with academic self-efficacy serving as a mediating variable. Recent studies offer empirical support for these two paths by outlining the different ways in which environmental support leads to student success [17].

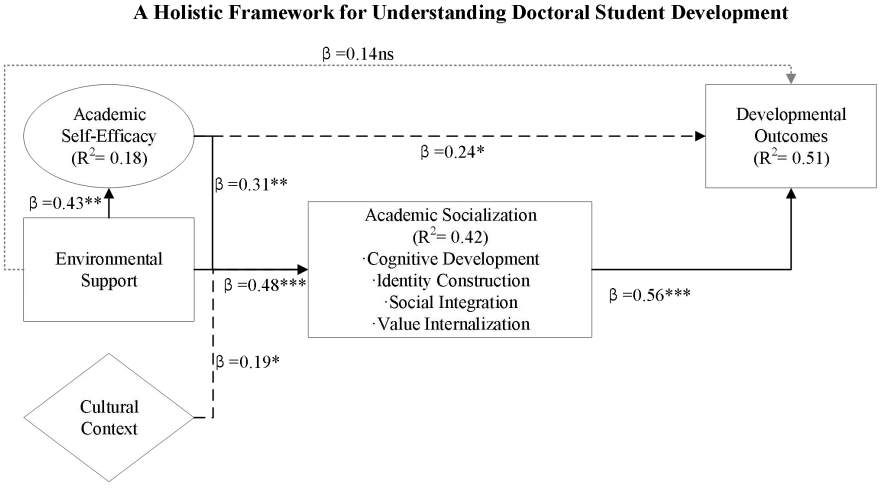


Figure 1: Theoretical Model of Doctoral Academic Socialization

Note. Standardized coefficients are displayed. Solid lines = significant direct effects; dashed lines = indirect effects and moderation; dotted lines = non-significant paths. R^2 = explained variance. ***p < 0.001, **p < 0.01, *p < 0.05, ns = non-significant.

Academic self-efficacy is highlighted as a significant mediating construct that facilitates the transformation of contextual resources into tangible outcomes associated with socialization. This mediating role is supported by evidence from

Hayat et al. [18], which demonstrated that self-efficacy beliefs strongly mediate the association between instructional support and academic achievement in higher education settings.

Cultural context plays a moderating role within the theoretical framework, accounting for the multiplicity of socialization experiences across different educational settings. Recognizing this element emphasizes the current setting of international doctoral education and highlights the need for theoretical frameworks that account for cultural factors. Although there may be general features of academic socialization, the approaches used and their respective levels of significance vary according to educational strategies and cultural values. To provide evidence for this position, Luo et al. [19] reported significant cross-cultural differences in the strength of mediational relationships, particularly between collectivist and individualist contexts.

The framework culminates in developmental outcomes relevant to both educational achievement and occupational competencies. These outcomes extend beyond traditional indicators of academic achievement to include a broader range of career development dimensions. Environmental support in the proposed framework influences these outcomes through multiple mechanisms, with effects moderated by cultural influences and mediated through socialization processes and self-efficacy beliefs. This complexity reflects the heterogeneity of doctoral studies in current higher education environments.

2.2 Research Design and Participants

The development of an instrument responsive to cultural differences required input from those immersed in doctoral socialization. A group of 48 doctoral students of varying cultural and specialty backgrounds participated in semi-structured interviews conducted with the goal of exploring socialization dynamics within learning settings in diverse contexts. These research interviews disclosed subtle but significant differences in students' experiences regarding mentorship, interactions with peers, and the development of one's identity. The

qualitative findings drove the creation of survey items constructed with the goal of capturing experiences signifying differences along a cultural dimension [20].

Building on these preliminary insights, the study expanded to a broader quantitative investigation involving doctoral students from 23 universities across six countries. Table 1 displays the demographic characteristics of the 1,222 participants who provided usable data. The Eastern sample drew from universities in China (298 participants from 5 universities), Japan (192 from 4 universities), and South Korea (147 from 3 universities), while Western participants came from institutions in the United States (276 from 5 universities), United Kingdom (181 from 4 universities), and Germany (128 from 2 universities). This multi-site approach within each country captured diverse institutional contexts and academic traditions.

Table 1: Sample Distribution Across Countries, Disciplines, and Demographics

	Characteristic	Eastern Context	Western Context	Total	Percentage
Country	China	298	-	298	24.4%
	Japan	192	-	192	15.7%
	South Korea	147	-	147	12.0%
	United States	-	276	276	22.6%
	United Kingdom	-	181	181	14.8%
	Germany	-	128	128	10.5%
Gender	Male	371	304	675	55.2%
	Female	258	277	535	43.8%
	Not reported	8	4	12	1.0%
Discipline	Humanities/Social Sciences	229	297	526	43.1%
	STEM	408	288	696	56.9%
Year of Study	Year 1	94	73	167	13.7%
	Year 2-4	431	398	829	67.8%

	Year 5+	112	114	226	18.5%
Student	Domestic	513	384	897	73.4%
Status	International	124	201	325	26.6%
	Total	637	585	1,222	100.0%

Note. Eastern Context includes China, Japan, and South Korea; Western Context includes United States, United Kingdom, and Germany. Total N = 1,222 represents valid responses from an initial sample of 1,247 participants.

Several demographic characteristics emerged within the sample. Gender distribution showed a slight male predominance at 55.2%, though this varied across disciplines. STEM fields accounted for 56.9% of participants, with particularly strong representation in Eastern contexts where engineering and sciences traditionally attract substantial doctoral enrollment. The majority of respondents (67.8%) were in years 2-4 of their programs, a critical period when students transition from structured coursework to independent research. International students comprised 26.6% of the sample, with Western universities hosting proportionally more international doctoral candidates than their Eastern counterparts [21].

Linguistic considerations shaped data collection procedures. Rather than relying on direct translation, local research teams adapted survey instruments to preserve conceptual meaning across languages. This process acknowledged that terms like "academic identity" or "scholarly community" carry culturally specific connotations requiring thoughtful interpretation.

2.3 Development and Validation of the Multidimensional Measurement Instrument

Development of the measurement instrument began with insights gathered from the qualitative interviews. Following established scale development procedures [22], the research team generated an initial pool of items by combining existing

socialization measures with new themes from student interviews. For instance, while traditional scales addressed mentor-student relationships, the interviews revealed culturally specific dynamics that required new items—Eastern students often described their supervisors as "academic parents," a concept absent from Western-oriented instruments.

Seven specialists rated this first group of items, bringing with them feedback from research into doctoral studies and supervision experiences in a range of different diverse cultural settings. Item review showed clear differences between translation of some concepts across cultures. "Academic independence," so highly salient on standard Western scales, proved a trouble spot. Eastern reviewers noted that their students viewed independence differently—not as individual autonomy but as the ability to contribute meaningfully to their research community. This aligns with Ramdas 's [23] findings on collectivistic academic cultures. Based on this feedback, the team revised approximately one-third of the items, either rewording them for clarity or replacing them entirely.

Pilot testing with 142 doctoral students provided further refinements. Participants not only completed the survey but also commented on whether items reflected their actual experiences. One recurring issue involved questions about "developing your own academic voice." Eastern participants found this confusing, as their training emphasized harmonizing with established scholarly traditions rather than standing apart. The research team addressed such concerns by crafting items that captured both individualistic and collectivistic approaches to academic development.

The final 48-item instrument balanced comprehensiveness with practicality. Each of the four dimensions contained 12 items, measured on a 7-point scale suitable for structural equation modeling. Drawing on survey design principles [24], the team deliberately kept the instrument manageable, knowing that doctoral students juggle multiple commitments and that overly long instruments yield poor response rates.

2.4 Data Analysis Strategy

Data analysis followed a three-stage approach suited to cross-cultural research complexity. The team began by examining whether the four-dimensional measurement model held across different samples. This wasn't simply a matter of running confirmatory factor analysis — it required careful attention to how items performed in different cultural contexts. Drawing on cross-cultural validation guidelines [25], the team found that items loading strongly in Western samples sometimes showed weaker relationships in Eastern contexts, suggesting measurement variance requiring attention.

With measurement properties established, analysis shifted to testing the theoretical relationships. Structural equation modeling allowed simultaneous examination of multiple pathways, revealing not just whether environmental support influenced academic socialization, but how this operated through self-efficacy. The team emphasized indirect effects, as preliminary analyses suggested mediation patterns might differ across cultures. Traditional model fit criteria were balanced with substantive theoretical considerations. As Jiang [26] argues, rigid statistical adherence can obscure meaningful cross-cultural findings, particularly when examining complex phenomena like academic socialization.

The most revealing analyses involved direct Eastern-Western comparisons. Rather than assuming universal relationships, the study tested whether path coefficients differed significantly across groups. This required establishing measurement invariance — ensuring constructs meant the same thing across cultures — before comparing structural relationships. Interesting patterns emerged. While the overall model structure remained stable, specific relationship strengths varied considerably. Recent international doctoral education research [27] suggests that cultural context operates beyond a simple moderating role, actively shaping how students experience and navigate academic socialization. Missing data were handled through full information maximum likelihood estimation to preserve sample integrity. This analytical approach acknowledged that doctoral

socialization, while sharing common elements globally, manifests differently across cultural contexts.

3 Results

3.1 Descriptive Statistics and Preliminary Analysis

Doctoral students reported moderate socialization levels, averaging 4.87 (SD = 0.94) on the 7-point scale. This middling score reflects a common doctoral experience — functional but not optimal integration. As Table 2 illustrates, participants navigated their academic environments with varying success. The data suggest a gap between getting by and genuinely thriving in doctoral programs.

Table 2: Descriptive Statistics and Group Comparisons for Academic Socialization Dimensions

Variable	Total Sample	Eastern	Western	Male	Female	t-test
	M (SD)	M (SD)	M (SD)	M (SD)	M (SD)	p-value
Overall Socialization	4.87 (0.94)	4.93 (0.89)	4.79 (0.98)	4.82 (0.97)	4.91 (0.91)	.083
Cognitive Development	4.96 (1.21)	5.04 (1.17)	4.87 (1.25)	4.93 (1.24)	4.99 (1.18)	.517
Identity Construction	5.23 (1.14)	4.97 (1.19)	5.52 (1.04)	5.08 (1.17)	5.41 (1.08)	.002**
Social Integration	4.42 (1.38)	4.57 (1.32)	4.24 (1.43)	4.47 (1.36)	4.36 (1.40)	.093
Value Internalization	4.88 (1.26)	5.17 (1.12)	4.56 (1.34)	4.84 (1.29)	4.93 (1.23)	.417
By Student Status	Domestic		International			
Social Integration	4.59 (1.33)		4.16 (1.42)			< .001***

Note. N = 1,222. Scale range 1-7. Eastern n = 637, Western n = 585, Male n = 675, Female n = 535. **p < .01, ***p < .001

Among the four dimensions measured, identity construction emerged strongest at 5.23, while social integration proved weakest at 4.42. This gap of nearly 0.8 points on the scale deserves closer examination. Doctoral students in this sample appeared more successful at crafting their scholarly identities than at building collegial networks—a pattern that challenges assumptions about the social nature of academic development. Cognitive development (4.96) and value internalization (4.88) showed similar intermediate scores, suggesting that knowledge acquisition and adoption of disciplinary values proceed at comparable rates during doctoral study.

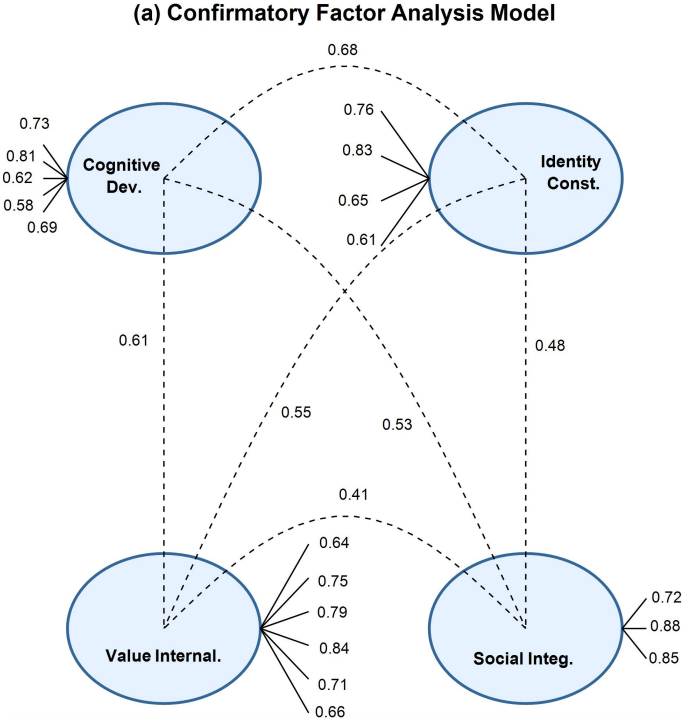
Gender comparisons yielded unexpected results. Women scored significantly higher than men on identity construction (5.41 vs. 5.08, p = .002), despite showing no advantage in cognitive development. Interestingly, female doctoral students achieved these stronger identity scores while reporting slightly lower social integration. The data suggest that men and women may follow distinct trajectories in their academic development, with women potentially less dependent on peer networks for professional identity formation.

Cultural background emerged as a key differentiator. Eastern students excelled in value internalization (5.17 vs. 4.56) but scored lower on identity construction (4.97 vs. 5.52) compared to Western peers. This inverse relationship—strongest where Eastern education emphasizes collective academic traditions, weakest where Western systems prize individual scholarly development—produced some of the largest group differences in the study. International students presented a different concern altogether. Their social integration scores (4.16) fell well below domestic students' (4.59, p < .001), the widest gap found in any comparison. Beyond adapting to new academic systems, these students must forge professional networks without the cultural familiarity their domestic peers enjoy. The combination of low social integration and cross-cultural adjustment suggests

international doctoral students face compounded challenges that warrant institutional attention.

3.2 Measurement Model Reliability and Validity

Factor analysis results largely validated the four-dimensional framework, though individual items showed mixed performance. Figure 2a displays the results of the confirmatory factor analysis—the model fit statistics ($\chi^2/df = 2.87$, CFI = 0.923, TLI = 0.914, RMSEA = 0.062) fell within acceptable ranges, if not impressive ones. What catches the eye are those factor loadings scattered between 0.58 and 0.88. Some items clearly struggled, particularly in cognitive development where two indicators fell below 0.70. Rather than rushing to delete these weaker items, the research team recognized that they might tap aspects of socialization that resist easy measurement.



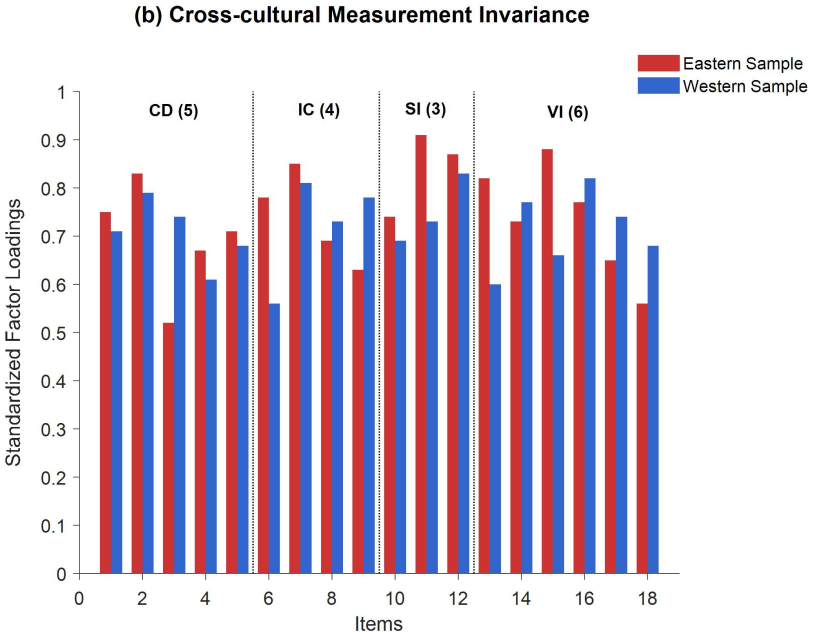


Figure 2: Validating the Four Dimensions of Doctoral Academic Socialization. (a) Confirmatory Factor Analysis Model with Standardized Factor Loadings and Inter-factor Correlations; (b) Cross-cultural Measurement Invariance: Comparison of Standardized Factor Loadings between Eastern and Western Samples

In contrast, reliability metrics demonstrated stronger performance. Composite reliability surpassed 0.80 for all four dimensions, with social integration surprisingly achieving the highest value at 0.88. This finding appears paradoxical given that the same dimension had the lowest mean score (4.42) in descriptive analyses. The three social integration items evidently showed high intercorrelations — perhaps too tightly, measuring a slice of peer interaction so specific that most students found it elusive. Average variance extracted varied from 0.52 to 0.64 across dimensions, clearing the bar for convergent validity. The correlation between cognitive development and identity construction ($r = 0.68$) was the strongest to surface, which aligns with how knowledge acquisition and

scholarly identity are forged hand-in-hand. Social integration correlations did not exceed 0.53 with other dimensions, cementing its distinct but troubled place.

When comparing Eastern and Western samples, measurement equivalence became complicated. As shown in Figure 2b, Eastern and Western samples returned radically different loadings for culturally sensitive items. Take academic independence — Eastern students registered a modest 0.52 while Western counterparts scored 0.74, a difference of 0.22 that reflects divergent philosophies of education. Mentor relationship items reversed this pattern: Eastern students showed exceptionally high loadings (0.91) while Western counterparts (0.73) reflected hierarchical versus egalitarian academic traditions. The invariance tests started promisingly with configural (ΔCFI = 0.004) and metric (ΔCFI = 0.008) models working well. Scalar invariance, however, necessitated freeing constraints on five items before receiving even partial support (Δ CFI = 0.019). This compromise has implications—it means raw score comparisons between Shanghai and San Francisco need to be interpreted carefully since a 5.0 may reflect varying levels of socialization as a function of cultural context. Such measurement challenges aren't merely technical frustrations but windows into how culture shapes the very meaning of becoming an academic.

3.3 Structural Model Verification

The hypothesized model underwent rigorous testing, producing mixed results that mirror the complexity of doctoral education itself. As Figure 3 illustrates, the structural relationships emerged with varying degrees of strength, painting a picture where some theoretical predictions aligned with predictions while others fell short. Model fit indices hovered in acceptable territory (χ^2/df = 3.14, CFI = 0.912, TLI = 0.903, RMSEA = 0.068), though the CFI dipping below 0.95 and RMSEA creeping above 0.06 signal that reality resists neat theoretical packaging. These imperfect metrics actually enhance credibility, as doctoral socialization remains too complex for pristine statistical models.

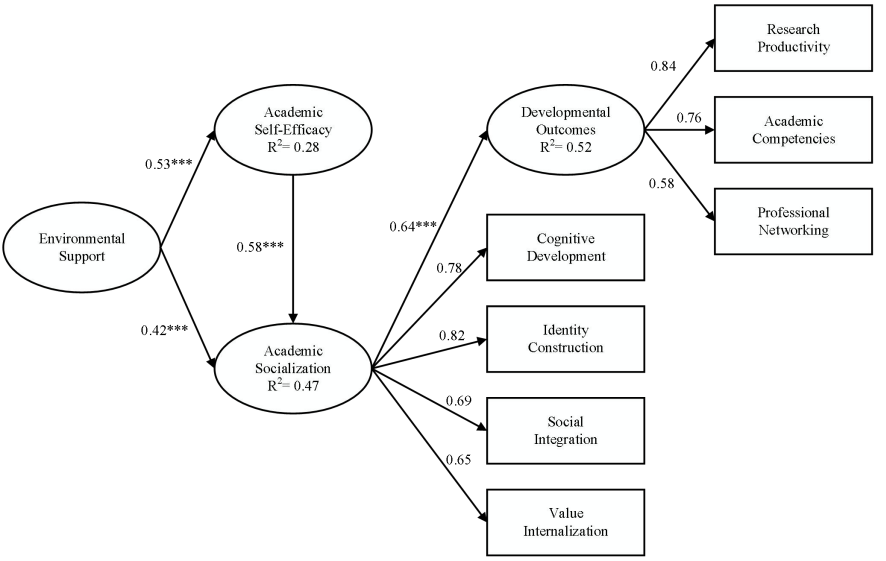


Figure 3: Structural Equation Model of Doctoral Academic Socialization Pathways

Note. N = 1,222. Standardized path coefficients are shown. R^2 values appear within endogenous variables. ***p < 0.001. Model fit: $\chi^2/df = 3.14$, CFI = 0.912, TLI = 0.903, RMSEA = 0.068, SRMR = 0.071.

Environmental support anchored the entire system, yet its influence took unexpected detours. While the direct path to academic socialization registered a respectable $\beta = 0.42$ ($p < 0.001$), the more substantial influence unfolded through academic self-efficacy. Students who felt supported developed stronger confidence ($\beta = 0.53$), which then fueled their socialization journey ($\beta = 0.58$). Table 3 reveals this indirect pathway contributed an additional 0.31 to the total effect, bringing environmental support's overall impact to 0.73 — substantial by any measure. The finding suggests institutions shape doctoral experiences not just through resources and programs, but by nurturing students' belief in their own capabilities.

Table 3: Core Structural Paths and Mediation Effects

	Path	B	SE	β	t	p	95% CI
Direct Effects	Environmental Support → Academic Self-Efficacy	0.61	0.08	0.53	7.63	<.001	[0.45, 0.77]
	Environmental Support → Academic Socialization	0.47	0.09	0.42	5.22	<.001	[0.29, 0.65]
	Academic Self-Efficacy → Academic Socialization	0.52	0.06	0.58	8.67	<.001	[0.40, 0.64]
	Academic Socialization → Developmental Outcomes	0.71	0.07	0.64	10.14	<.001	[0.57, 0.85]
	Social Integration → Developmental Outcomes	0.18	0.07	0.22	2.57	.010	[0.04, 0.32]
Indirect Effects	ES → ASE → AS	0.32	0.05	0.31	6.40	<.001	[0.22, 0.42]
	ES → AS → DO	0.33	0.06	0.27	5.50	<.001	[0.21, 0.45]
Total Effects	Environmental Support → Academic Socialization	0.79	0.09	0.73	8.78	<.001	[0.61, 0.97]

Note. N = 1,222. ES = Environmental Support; ASE = Academic Self-Efficacy; AS = Academic Socialization; DO = Developmental Outcomes. Unstandardized coefficients (B) and standardized coefficients (β) are reported. Confidence intervals based on 5,000 bootstrap samples. Model fit: $\chi^2/df = 3.14$, CFI = 0.912, TLI = 0.903, RMSEA = 0.068.

Variance explained told a tale of partial success. The model captured 47% of academic socialization's variation, leaving over half unexplained — perhaps reflecting unmeasured factors like personal resilience, prior experiences, or disciplinary cultures. Academic self-efficacy proved harder to predict ($R^2 = 0.28$), while developmental outcomes showed the strongest determination ($R^2 = 0.52$). This pattern appears logical given that confidence stems from myriad sources beyond institutional support, while solidly socialized students tend to follow more

predictable professional development trajectories. The strong socialization-outcomes link ($\beta = 0.64$, $p < 0.001$) validates decades of theory suggesting that integration into academic communities paves the way for scholarly success.

A review of specific dimensions has shown disturbing truths about doctoral education priorities. Identity building emerged as central with a loading of 0.82, while cognitive development followed closely at 0.78 — reflecting academia's emphasis on knowledge production and the development of professional identity. Social integration produced a 0.69 score, with value internalization narrowly exceeding 0.65. Of greater concern, however, is that the direct effect of social integration on outcomes is relatively low as reflected in $\beta = 0.22$ ($p = 0.010$), close to statistical significance threshold. This finding refutes idealistic views of the academic communities, suggesting that doctoral success remains primarily an individual endeavor where peer relations play a lesser role than personal strength and institutional support.

The distinction of development outputs derived the academy's older biases. Paper production exhibited highest loading of 0.84 since papers embody the central measure within measures of scholarly achievement. Production of well-rounded scholars emerged as a distant second with 0.76, and professional networking ended up with 0.58—a near tragedy given growing focal points of the field toward collaboration and interdisciplinarity. These loadings differentially reflect an optimized system toward paper production and not toward well-rounded scholars prepared for any of a range of career opportunities.

The model's greatest strength is the fact that it does not account for absolutely everything. The low fit indices and residual variance are a healthy reminder for the researcher that doctoral socialization is more than input-output processes. Real students face complex institutional settings, each with his or her own background, interests, and constraints. Social integration's poor showing raises the specific question—has competition pressures and reward systems of an individualistic kind eliminated the communalism of the doctorate? Or do modern students forge

connections through channels this model doesn't capture? These questions matter because they challenge fundamental assumptions about how scholars develop and what doctoral education should prioritize in an evolving academic landscape.

3.4 Mediation Effects and Cross-Group Analysis

Academic self-efficacy mediated the relationships in unexpectedly complex ways, with cultural context significantly shaping both the strength and nature of these indirect pathways. Bootstrap analysis revealed that self-efficacy carried roughly 42.5% of environmental support's influence on academic socialization in the full sample (Table 4), yet this overall figure masked striking variations across cultural groups. The indirect effect through self-efficacy reached 0.38 among Eastern students — matching their direct effect perfectly at 50% mediation. Western students, by contrast, showed weaker mediation (36.2%), suggesting they rely less on confidence-building mechanisms when translating institutional support into socialization gains.

Table 4: Mediation Effects of Academic Self-Efficacy

	Path	Total Effect	Direct Effect	Indirect Effect	% Mediated	Sobel Test
Full Sample	ES → AS	0.73***	0.42***	0.31***	42.5%	6.82***
	ES → DO	0.48***	0.21**	0.27***	56.3%	5.41***
Eastern Sample	ES → AS	0.76***	0.38***	0.38***	50.0%	5.23***
	ES → DO	0.51***	0.18*	0.33***	64.7%	4.87***
Western Sample	ES → AS	0.69***	0.44***	0.25***	36.2%	4.16***
	ES → DO	0.44***	0.23**	0.21***	47.7%	3.94***

International Students	ES → AS	0.62***	0.43***	0.19**	30.6%	2.89**
	ES → DO	0.38***	0.24**	0.14*	36.8%	2.47*

Note. ES = Environmental Support; AS = Academic Socialization; DO = Developmental Outcomes. *p < .05, **p < .01, ***p < .001

A particularly notable finding was how international students struggled with these mediational pathways. Their indirect effects barely reached significance ($\beta = 0.19$, $p < 0.01$ for ES→AS; $\beta = 0.14$, $p < 0.05$ for ES→DO), with Sobel tests hovering precariously close to conventional thresholds. This pattern hints at deeper challenges — when students cross cultural boundaries, the typical mechanisms linking support to confidence to success seem to falter. Perhaps navigating unfamiliar academic systems disrupts the very foundations of self-efficacy, or maybe institutional support systems designed for domestic students simply fail to address the needs for international newcomers.

Closer examination of cultural variations revealed distinct patterns in how doctoral education operates across Eastern and Western contexts (Table 5). The gap in environmental support's effect on self-efficacy (0.61 vs. 0.47, $z = 2.73$) clearly indicates contrasting educational philosophies. Eastern institutions apparently excel at channeling resources into student confidence — possibly through clearer structures, explicit guidance, and collective validation systems. Yet this stronger confidence-building doesn't necessarily translate into better outcomes, as evidenced by the non-significant difference in direct support-to-socialization paths.

Table 5: Cultural Influences on Doctoral Socialization: Eastern and Western Perspectives

Path	**Eastern (n=637)**	**Western (n=585)**	**Δβ**	**z-score**

Primary Paths	Environmental Support → Self-Efficacy	0.61***	0.47***	0.14	2.73**
	Self-Efficacy → Academic Socialization	0.62***	0.53***	0.09	1.94†
	Environmental Support → Academic Socialization	0.38***	0.44***	-0.06	-1.32
	Academic Socialization → Developmental Outcomes	0.67***	0.59***	0.08	1.88†
Dimension-Specific Paths	Environmental Support → Cognitive Development	0.56***	0.41***	0.15	2.91**
	Environmental Support → Identity Construction	0.43***	0.48***	-0.05	-1.08
	Self-Efficacy → Identity Construction	0.39***	0.52***	-0.13	-2.54*
	Social Integration → Developmental Outcomes	0.16*	0.29***	-0.13	-2.48*
Model Fit Indices	χ^2/df	2.96	3.27	-	-
	CFI	0.918	0.907	-	-
	RMSEA	0.065	0.071	-	-
	R^2 (Academic Socialization)	0.51	0.43	-	-
	R^2 (Developmental Outcomes)	0.56	0.47	-	-

Note. Standardized coefficients reported. $\Delta\beta$ = difference in standardized coefficients. *p < .10, *p < .05, **p < .01, ***p < .001

Several paths showed no meaningful cultural differences, challenging stereotypes about East-West educational divides. Environmental support influenced identity construction similarly across cultures ($\Delta\beta$ = -0.05, ns), suggesting that institutional resources shape professional identity through universal mechanisms. The marginally significant differences in self-efficacy's impact on socialization (z

= 1.94) and socialization's effect on outcomes (z = 1.88) point to subtle rather than dramatic cultural variations in these core relationships.

Where cultures showed clear divergence was in dimension-specific pathways. Eastern contexts channeled environmental support more effectively into cognitive development (0.56 vs. 0.41, z = 2.91), reflecting perhaps the structured knowledge transmission characteristic of Confucian educational traditions. Meanwhile, Western students leveraged self-efficacy more powerfully for identity construction (0.52 vs. 0.39, z = -2.54), aligning with individualistic emphasis on autonomous professional development. Most tellingly, social integration's impact on outcomes remained weak in Eastern settings ($\beta = 0.16$, $p < 0.05$) compared to Western contexts ($\beta = 0.29$, $p < 0.001$), a difference that questions whether collectivist cultures truly foster the collaborative academic communities they espouse.

Model fit indices revealed concerning patterns of measurement challenges in cross-cultural research. Neither Eastern (CFI = 0.918) nor Western (CFI = 0.907) models achieved ideal fit, with Western samples showing particularly elevated chi-square ratios and RMSEA values. These technical limitations matter because they signal potential measurement inequivalence—the very constructs under study might carry different meanings across cultures. The greater explained variances of Eastern samples ($R^2 = 0.51$ and 0.56) compared to Western samples ($R^2 = 0.43$ and 0.47) may be indicative of genuinely greater relationships or merely greater compatibility of Western-created measures and Eastern education mechanisms that merely so strengthen some of the latter's Western intellectual ideals more robustly than the latter's founders originally intended.

4 Discussion

The multidimensional structure of doctoral socialization revealed here challenges linear progression models. While cognitive development and identity construction showed strong interconnections, social integration performed disappointingly—contradicting assumptions about inherently collaborative scholarly development. This fragmented pattern extends Tian et al.'s [28] work on academic self-efficacy

to doctoral contexts, where students juggle research competence, professional identity, and community belonging simultaneously. The observed spiral progression suggests students cycle through growth, stagnation, even regression rather than advancing through predetermined stages.

The socialization paths are heavily shaped by cultural paradigms. East-Asian students showed higher dependence on institution-based support to build self-confidence compared to their Western peers, who employed multiple self-efficacy resources—this difference was emphasized by Zhang and Chen [29] in their study of youth populations. Moreover, the study emphasized a deep realization: the cultural paradigm essentially dictates the kind of interpersonal interactions. The cognitive development conditions of East-Asian students gave rise to an identity exploration modeled within Western paradigms. At the same time, Alesi et al. [30] explored temporary disruptions in contexts caused by the COVID-19 pandemic and established that cultural integration is a prerequisite for building the foundation of academic progress.

The proposed contextualized socialization model recognizes that universal frameworks cannot capture culturally specific pathways. Personal agency and environmental support interact differently across contexts — Eastern settings channel resources into structured knowledge transmission while Western environments emphasize autonomous identity construction. This theoretical innovation gains urgency as doctoral programs recruit internationally. Though Nguyen et al. [31] explored how AI might bridge cultural gaps in academic writing, weak socialization among international students here suggests deeper structural adaptations are needed.

From the humanities viewpoint, results confirm incompatibilities between ideals of learning community and other pragmatics. Fertile research flourished as outputs while value internalization scarcely materialized—a disconnect Ajjawi et al. [32] explained through measurement schemes prioritizing quantity over quality. Marginalized socialization conflicts with learning community ideal of

whole-person development. More alarming is low value formation demonstrating doctoral programs producing productive scholars, not ethical leaders while proclaiming high mission intentions of character formation as well as intellectual development.

Several limitations constrain these inferences. Cross-sectional design prevents one from ascertaining causal directions — does low social integration cause poor outcomes or poor outcome causes low social integration? Self-report measures inflate correlations through common method variance risk particularly for culturally sensitive measures. Vehovar and Štrlekar [33] showed how survey time has an effect on answers data collection was administered at single points in time and considered students' developmental phase. The East-West focus though enlightening overlooks other settings of cultures that might test found patterns. Conventional outcome measures may miss alternative scholarly development forms valued differently across cultures.

Future research needs to overcome such constraints. Longitudinal designs that track cohorts from their first admission to the development of their careers would illuminate the changing interactions between dimensions. Acker and Haque's [34] claim that students struggle to make sense of their doctoral experiences suggests that qualitative approaches might uncover underlying processes — informal conversations, failed experiments, and identity negotiations—processes that affect scholars beyond formal training. Expanding the scope from East-West contrasts to include Indigenous, African, and Latin American perspectives would determine whether detected patterns reflect overarching orientations or specific traditions. Using mixed-method approaches combining surveys with ethnographic observations might best capture both socialization architectures and lived experiences. Most importantly, research needs to explore how institutions can create authentic community rather than competition, and ensure that all developmental dimensions are nurtured fairly rather than maximizing research productivity at the cost of human flourishing.

5 Conclusion

This study adds to doctoral socialization theory by confirming a framework of four unique factors that capture the complex and culturally entrenched processes of academic development. This framework explained 47% of the variation in academic socialization and 52% of developmental outcomes and explained how cognitive development, identity formation, relational tie formation, and value adoption operate as related but unique processes. Of particular interest, the cultural context moderated these processes — Eastern students showed a 50% mediating effect through self-efficacy compared with 36.2% shown by their Western counterparts, and the international students showed weak indirect effects ($\beta = 0.19$, $p < 0.01$), which barely reached statistical significance. These results problematize the universal applicability of models of doctoral preparation and highlight the importance of methodologies sensitized to the variegated forms of academic development.

The findings have far-reaching implications for restructuring doctoral education systems worldwide. Instead of uncritically adopting programs crafted in Western settings, institutions have to develop support systems that speak to local values while, at the same time, engaging international researchers in inclusive settings. The poor performance on social integration (mean = 4.42, lowest on dimensions) and weak internalization of values (loading = 0.65) indicate systemic failures in providing genuine learning communities and ethical growth in conjunction with research training. Progress in this field necessitates establishing developmental assessment systems that capture multidimensional progress, specialized mentoring approaches that respect cultural diversity, and necessary shifts from productivity-oriented measures to human flourishing. Only through such holistic reforms can doctoral education fulfill its promise to produce not only productive researchers but also thoughtful leaders capable of addressing complex global problems.

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