The Formative Mechanism of Practical Innovation Competence of Education Masters with Non-education Backgrounds

Practical Innovation in Non-Ed M.Ed. Students

An Empirical Study Based on a Chain Mediation Model

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Abstract. This study aims to explore the formative mechanism of practical innovation competence among Master of Education (M.Ed.) students with non-education backgrounds. Based on Social Cognitive Theory, a chain mediation model was constructed, including supervisor support (SS), institutional support (IS), professional identity (PI), professional foundation (PF), professional ability (PA), pedagogical competence (PEC), and practical innovation competence (PIC). We use AMOS to analyze 231 responses, the results indicate that from the perspective of external drive, both SS and IS significantly and positively predict PI, with IS exerting a greater influence than SS; regarding the internal accumulation process, the chain mediation path of "identity → foundation → ability" is confirmed, and SS is found to directly enhance PA without being mediated by PI; at the level of skill transformation, the formation of PEC ("doing") is supported by both PF ("learning") and PA ("thinking"); in the stage of ultimate output, PIC stems from a "dual-core driving mechanism," which means PA (higher-order thinking) and PEC (educational practice) jointly drive the generation of innovation, with higher-order thinking playing a more central role. Overall, this study reveals a complete logical progression from "external to internal," from "knowledge to action," and ultimately to "innovation."

Keywords: Master of Education (M.Ed.) students, Practical Innovation Competence, Professional Ability, Pedagogical Competence, Structural Equation Modeling (SEM)

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1 Introduction

As emerging technologies such as artificial intelligence increasingly influence education, educators need to possess innovation competence to address new educational contexts and solve emerging complex problems. The Master of Education (M.Ed.) program serves as an "incubator" for cultivating a teaching staff characterized by "high quality, professionalism, and innovation"[14]. Within the core competence framework of M.Ed. students, practical innovation competence stands alongside teacher ethics, teaching ability, and other key pillars that support their professional development [12]. With the growing demand for Multi-disciplinary professionals and the promotion of policies regarding graduate education for professional degrees, the enrollment of M.Ed. programs has continued to expand, notably increasing the proportion of students with non-education background. However, the current M.Ed. cultivation models often overlook their undergraduate professional backgrounds, treating them the same as M.Ed. students with undergraduate degrees in education and adopting the same cultivation model [5].

Research on this group reveals both strengths and weaknesses. Compared to students with an educational background, M.Ed. students with non-education background typically possess a more solid foundation of subject knowledge [3]. However, they generally exhibit lower professional self-efficacy and insufficient professional practice, among other issues. The factors contributing to these challenges extend beyond personal aspects to environmental influences. Personal factors include weak foundational knowledge in education, inadequate professional practice [3], and a lack of initiative in inquiry and reflection, all of which constrain the development of their innovation competences [9]. Environmental factors stem from both supervisors and institutions—whether supervisors provide adequate guidance [11], whether institutions establish an institutional and cultural environment that supports risk-taking, collaboration, and exchange of ideas are prerequisites for fostering innovation [2, 10]. Additionally, cultivating an innovative climate in internship settings can also affect their enthusiasm for innovation [8].

However, the formative mechanism of practical innovation competence remains underexplored. Therefore, this study constructs a chain mediation model to explore how external support (supervisor and institutional support) facilitates the development of internal competencies among M.Ed. students through their professional identity, professional foundation, and professional abilities, ultimately driving the development of their practical innovation competences. The process highlights the "dual-core" driving role of professional ability and pedagogical competence in innovation development among M.Ed. students.

2 Literature Review and Hypotheses

2.1 Theoretical Basis: Social Cognitive Theory

This study employed Bandura's social cognitive theory (SCT) as the overarching analytical framework. SCT opposes unidirectional determinism, which holds that behavior is only governed by internal impulses or external environmental stimuli. Instead, it employs an interactive model termed Triadic Reciprocal Determinism, positing that human functioning arises from the interaction of three factors [1], which are environment, person, and behavior.

Accordingly, the research was designed following the logical pathway of "environmental support → personal literacies → innovation behavior" to construct a model for formative mechanism of practical innovation competence among M.Ed. students with non-education background. In this paradigm, environmental factors manifest as external support, which includes Supervisor Support (SS) and Institutional Support (IS). Personal factors reflect in the internal professional competencies of M.Ed. students, including Professional Identity (PI), Professional Foundation (PF), and Professional Ability (PA). Behavioral factors are represented in actual outcomes such as Pedagogical Competence (PEC) and Practical Innovation Competence (PIC).

2.2 Hypotheses of the Research

2.2.1 The Relationship Between External Support and Professional Identity.

SCT hypothesizes that environmental support will help an individual create a professional identity in one or two ways. With emotional support and resources, they will have a sense of belonging, and even establish a professional identity. Supervisors help M.Ed. students achieve discipline-specific self-efficacy by providing academic advice along with emotional support. In addition, they tell students potential career opportunities and encourage them to become teachers. Institutional support includes the organizational setting and the resources provided by post-secondary educational institutions, such as colleges and universities, in an effort to promote the professional development of M.Ed. students. The course design, access to external placements, and the academic and practical environment established at the institution provide direct venues of professional socialization, reducing students' uncertainty about their future careers. Therefore, the following hypotheses are proposed:

H1: Supervisor support is a positive predictor of professional identity.

H2: Institutional support significantly and positively predicts professional identity.

2.2.2 The Chain Accumulation Mechanism of Professional Literacy.

The development of professional literacy is progressive from professional identity to professional foundation and then professional ability. Professional identity is the psychological identification and emotional belonging of M.Ed. students with regard to the teaching profession and their professional role as teachers. It reflects their recognition of the intrinsic value of education, their willingness to make a long-term professional

commitment to teaching, and their beliefs about their capabilities as teachers. Professional foundations represent the pedagogical and other theoretical "literacy" or knowledge base that M.Ed. students construct or acquire during their studies. Foundational knowledge refers to knowledge of pedagogy, psychology, subject content, and teaching approaches. Professional identity is fuel for individual learning. Students who have a strong professional identity are more likely to devote the time and energy needed to fortifying their pedagogical foundations. Based on this, the following hypothesis is proposed:

H3: Professional identity significantly and positively predicts professional foundation.

Professional ability pertains to the cognitive dimension, emphasizing the M.Ed. students' abilities for diagnosis, analysis, and higher-order thinking through scientific theories and methodologies. Only with a robust professional foundation can students employ higher-order thinking to analyze educational issues, thereby developing systematic professional ability, including research and analytical abilities. Accordingly, the following hypothesis is proposed:

H4: Professional foundation significantly and positively predicts professional ability.

Furthermore, the professional and academic mentorship offered by supervisors can directly improve students' abilities in issue analysis and data management, without solely relying on the intermediates of professional identity. Accordingly, the following hypothesis is proposed:

H5: Supervisor support significantly and positively predicts professional ability.

2.2.3 From "Knowledge" to "Action": The Formation of Pedagogical Competence.

Pedagogical Competence (PEC) defines the operational skills by which M.Ed. students transform professional knowledge into specific educational action within authentic educational contexts. This involves practical competencies such as conducting instructional design within the classroom context, arranging classroom activities, managing classroom discipline, and interacting with students.

Pedagogical competence falls within the area of "doing", requiring a firm foundation of professional knowledge (PF) and higher-order thinking skills (PA) as its underpinning. Higher-order thinking skills enable teachers to make informed decisions in complicated classroom settings, thereby enhancing their ability to design and execute lessons. A solid foundation of professional knowledge – such as pedagogical content knowledge – serves as the direct raw material for teaching activities, and can be directly transformed into specific teaching behaviors. Based on this, the following two hypotheses are proposed:

H6: Professional ability significantly and positively predicts pedagogical competence.

H7: Professional foundation significantly and positively predicts pedagogical competence.

2.2.4 Dual-Core Drive: The Formation of Practical Innovation Competence.

Practical innovation competence highlights the overall competence of M.Ed. students to wisely coordinate concept with experience in handling complex or new educational problems. This will often involve a degree of departure from conventional thinking so as to come up with innovative solutions, find new forms that might "make things work", and produce fresh outcomes in education [17].

As noted, practical innovation does not occur in a vacuum. It is nourished not only by the educational practice (operational dimension) but also by the higher-order thinking (cognitive dimension). It is within pedagogical competence that the context and ground for innovation are provided. In real teaching experience, only genuine problems can be found, and thus usable innovative solutions can be suggested. The ability to think critically and solve problems, as part of professional ability, is the very source of innovation; its extent measures its altitude and bottomless depth. Accordingly, the following two hypotheses are proposed:

H8: Pedagogical competence significantly and positively predicts practical innovation competence.

H9: Professional ability significantly and positively predicts practical innovation competence.

2.3 Construction of the Theoretical Model

Based on SCT and the nine hypotheses proposed above, we construct the following chain mediation model (as shown in Figure 1), aiming to reveal the complete generation pathway from external support to practical innovation competence. This model follows the "Environment → Person → Behavior" framework. Specifically, SS and IS act as environmental stimuli that influences students' internal personal factors (PI, PF, and PA). These internal drivers, in turn, facilitate the practical behavioral outcomes (PEC and PIC).

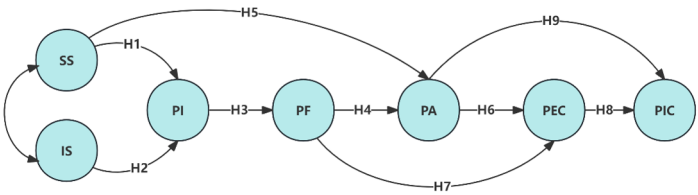

Fig. 1. Hypothetical Model of the Formative Mechanism for PIC of M.Ed. Students

3 Methodology

3.1 Participant

This study adopted a questionnaire survey and collected 231 valid responses (N = 231) from M.Ed. students at three non-"Double First-Class" universities in China's frontier

regions. A purposive sampling strategy was used to target M.Ed. candidates from non-education undergraduate backgrounds, who are undergoing a significant cross-disciplinary transition. To address the inherent heterogeneity within this group, participants were categorized based on their undergraduate disciplines: STEM (e.g., engineering, natural sciences), Humanities and Social Sciences (e.g., management, literature, law), and Arts. Notably, 79% of the participants graduated from non-teacher-training institutions with no prior pedagogical coursework. This diverse disciplinary composition allows for a comprehensive exploration of how students from varied knowledge structures reconstruct their professional identity and develop practical innovation competence within the field of education.

3.2 Measures

All measurement instruments included in this study were derived from established scales created both domestically and globally, with localized modifications made to conform to the pedagogical context of M.Ed. programs in China. Questionnaires included a five-point Likert scale (1 = Strongly disagree; 5 = Strongly agree). External support is based on SCT [1] and the scale developed by Zhang et al. [16], consisting of two observed constructs: supervisor support and Institutional support.

Internal professional literacy comprises three observed constructs: professional identity, professional foundation, and professional ability. Among these, professional identity was derived from Wei's Teacher Professional Identity Scale [13]; professional foundation and professional ability were informed by the research of Peng and Tang [10].

Based on the models of pedagogical competence and innovative competence proposed by Warner [4], Ye [15], and Liao [7], the construct of practice output comprises two observed constructs: pedagogical competence and practical innovation competence.

3.3 Data Analysis Strategy

This study initially utilized SPSS (ver 23.0) for descriptive statistics, reliability, and validity analyses. Subsequently, the AMOS (ver 24.0) software was used to construct the Structural Equation Model (SEM). Given that the data met the assumption of normality, the Maximum Likelihood Estimation (MLE) method was utilized to test the hypothesized paths. And the model's fit was assessed using fit indices such as χ^2/df, CFI, TLI, RMSEA, and GFI.

4 Results

4.1 Measurement Model

This study first examined the measurement model. As shown in Table 1, the composite reliability (CR) for all latent variables ranged between 0.829 and 0.930, indicating excellent reliability of the scales. Regarding validity, the average variance extracted

(AVE) for each variable was close to or exceeded the standard of 0.5. Although the AVE value for professional identity was 0.493, slightly below 0.5, its CR value of 0.829 indicates the convergent validity of this variable is still acceptable, according to the criteria set by Fornell and Larcker [2].

Table 1. Reliability and Validity Analysis

Factor	Item	λ	CR	AVE
Supervisor Support	SS1	.854	.897	.744
	SS2	.932		
	SS3	.797		
Institutional Support	IS1	.856	.901	.694
	IS2	.782		
	IS3	.876		
	IS4	.816		
Professional Identity	PI1	.713	.829	.493
	PI2	.693		
	PI3	.652		
	PI4	.768		
	PI5	.680		
Professional Foundation	PF1	.776	.894	.629
	PF2	.843		
	PF3	.844		
	PF4	.756		
	PF5	.739		
Professional Ability	PA1	.745	.898	.594
	PA2	.770		
	PA3	.792		
	PA4	.771		
	PA5	.773		
	PA6	.773		
Pedagogical Competence	PEC1	.894	.905	.706
	PEC2	.878		
	PEC3	.813		
	PEC4	.770		
Practical Innovation Competence	PIC1	.762	.93	.654
	PIC2	.833		
	PIC3	.803		

	PIC4	.820
	PIC5	.827
	PIC6	.835
	PIC7	.780

4.2 Model Fit

Using AMOS to conduct the SEM analysis, with partial covariance allowed among the dimensions, the final model fit indices are presented in Table 2. χ^2/df = 2.028, indicating an appropriate level of model complexity; $RMSEA = 0.067$, below the critical threshold of 0.08; CFI, IFI and other fit indices all satisfied the recommended criteria.

Table 2. Model Fit Indices

Index	Criteria	Model Value	Result
χ^2/df	<3.0	1038.446/512=2.028	Excellent
RMSEA	<.08	.067	Good
CFI	>.90	.914	Excellent
TLI	>.90	.905	Excellent
GFI	>.80	.796	Acceptable

4.3 Path Analysis and Hypothesis Testing

Figure 2 presents the standardized path coefficients and the explanatory power (R^2) of each endogenous variable. The findings suggest that the model exhibits robust explanatory capacity for all core variables. Specifically, the model accounts for 82% of the variance in the ultimate dependent variable PIC ($R^2 = .82$), and 68% and 57% of the variance in the mediating variables PA and PEC, respectively. This indicates that the chained mediation model constructed in this study effectively reveals the formation mechanism of PIC among M.Ed. students.

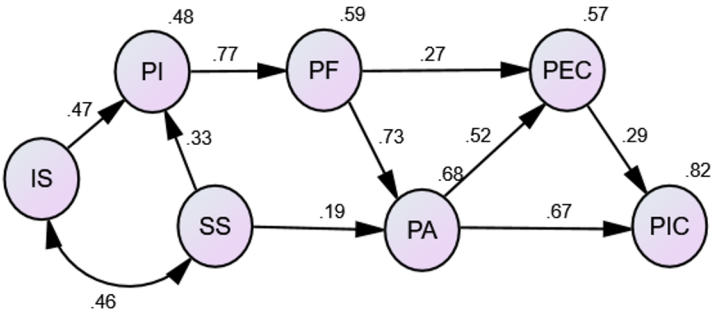

Fig. 2. Structural Model of PIC for M.Ed. Students with Non-Education Backgrounds

The significance test results for the path coefficients are presented in Table 3. Findings indicate that all nine path hypotheses proposed in this study demonstrate significant positive effects ($P < .001$).

Table 3. Results of the tests of hypotheses

Path	B	S.E.	t	p	β	Result
H1: SS → PI	.307	.067	4.575	***	.331	Supported
H2: IS → PI	.421	.069	6.121	***	.474	Supported
H3: PI → PF	.697	.078	8.986	***	.767	Supported
H4: PF→ PA	. 741	.079	9.389	***	.726	Supported
H5: SS→ PA	. 160	.048	3.297	***	.186	Supported
H6: PA→ PEC	. 598	.129	4.635	***	.520	Supported
H7: PF→ PEC	.321	.125	2.564	.010	.273	Supported
H8: PEC→ PIC	.279	.067	4.141	***	.287	Supported
H9: PA→ PIC	. 753	.096	7.857	***	.672	Supported

Note: B: unstandardized regression weight; S.E.: standard error of regression weight; t:t-values (critical ratios) ; p: level of significance, *** p <.001, ** p <.005, * p <.05; β: standardized regression weight

This study employed maximum likelihood estimation to calculate the path coefficients of the SEM, with specific test results presented in Table 3. The data in Table 3 indicate that the absolute values of the critical ratios (C.R. values, i.e., t-values) for all nine proposed hypothetical paths exceed 1.96, with corresponding p-values below 0.05. This confirms that all research hypotheses are supported by the data.

4.3.1 The Influence of External Support on Professional Identity.

The data in Table 3 indicate that the external support environment significantly and positively predicts professional identity among M.Ed. students. Specifically, the influence coefficient of SS on PI is 0.331 ($t = 4.575, p < .001$). The influence coefficient for IS on PI is 0.474 ($t = 6.121, p < .001$). H1 and H2 are supported, indicating that SS and IS constitute crucial external drivers for enhancing M.Ed. students' PI, with IS exerting a relatively stronger influence.

4.3.2 Internal Transformation of the Professional Literacy Chain.

Within the internal mechanisms of professional development, PI strongly predicted PF ($\beta = .767, p < .001$), supporting H3. Subsequently, PF significantly and positively influenced PA ($\beta = .726, p < .001$), supporting H4. Moreover, the study identified a significant direct path: SS also exerted a direct positive predictive effect on PA ($\beta = .186, p < .001$), supporting H5. This indicates that SS not only operates indirectly by enhancing PI but also directly promotes the growth of students' PA.

4.3.3 Development of Pedagogical Competence.

In terms of the development of PEC, PA played a primary facilitating role ($\beta = .520, p < .001$), supporting H6. Concurrently, PF also had a direct and substantial impact on PEC ($\beta = .273, p < .05$), thereby supporting H7. This signifies that a strong theoretical foundation and higher-order research thinking collectively underpin the development of classroom teaching skills.

4.3.4 The Final Driving Force of Practical Innovation Competence.

For the ultimate dependent variable, PIC, the model indicates it is influenced by a 'dual-core drive'. PEC showed a significant positive impact ($\beta = .287, p < .001$), supporting H8; PA also exerted the strongest positive predictive effect ($\beta = .672, p < .001$), supporting H9. This finding confirms that PA (thinking) and PEC (doing) are the two key wheels driving the formation of innovation.

5 Discussion

5.1 The Primacy of Institutional Support in Professional Socialization

Interestingly, one central finding was that for M.Ed. students from non-education backgrounds, while both dimensions of external support positively predicted professional identity, support from their institution ($\beta = .474$) exerted greater influence than that from their supervisor ($\beta = .331$). Here, we have a more intricate picture of M.Ed. training and development. While the supervisor–student apprenticeship is frequently considered the rite of postgraduate passage, for M.Ed. students, whose cultivation is geared toward application, the institutional platform is paramount. This can be explained through the lens of "Legitimate Peripheral Participation"[6]. For students from non-education backgrounds, the transition to an M.Ed. involves a cross-disciplinary leap. While a supervisor provides individual guidance, the institutional support —including teaching practicums, curriculum resources, and professional policy—acts as the "community of practice" that grants these "outsiders" a legitimate identity. The broader institutional environment provides a more stable and comprehensive socialization framework than individual mentorship, helping students reduce the psychological cost of role transition and fostering a deeper sense of belonging.

5.2 The "Engine" of Identity and the Multiple Pathways of Competence Development

We found support for our chain mediation path "Identity (PI) → Foundation (PF) → Ability (PA)", confirming that professional identity is the psychological "engine". However, the confirmation of the direct paths SS → PA (H5: $\beta = .186, p < .001$) and PF → PEC (H7: $\beta = .273, p = .01$) provides a more nuanced understanding of the competence formation mechanism.

This bypassing effect, specifically within H5, suggests that supervisor support operates through a dual- faceted mechanism: while it fosters identity via emotional encouragement (the indirect path), it also provides "instrumental scaffolding" that directly enhances technical proficiency. For M.Ed. students with non-education backgrounds, who may still be in a state of "identity suspension," the supervisor's direct involvement in research training acts as a technical shortcut. This means that professional ability can be cultivated through task-oriented mentoring even before a robust professional identity is fully internalized.

Similarly, the validation of H7 (PF → PEC) illustrates the logic of "Knowledge-Action Integration." Even though its predictive power is secondary to the path through higher-order thinking (PA), it suggests that a solid theoretical foundation can directly translate into pedagogical skills in certain practical contexts. In this sense, supervisors function not only as "spiritual guides" but also as "expert scaffolds" (supporting H5), while the professional foundation serves as the "direct toolkit" (supporting H7) for instructional practice.

5.3 "Unity of Knowledge and Action": The Formative Logic from Literacy to Innovation

The model clarifies the "Knowledge-to-Action" mechanism underpinning Pedagogical Competence (PEC). In line with H6 and H7, PEC is not an isolated technical skill but part of the larger constructs which are professional ability ($\beta = .520$) and professional foundation ($\beta = .273$). For M.Ed. students coming from non-education disciplines, the development of practical competence seems to lie less in rote learning of theoretical knowledge and more in the application of higher-order thinking in research. In other words, "thinking like an educator" (PA) is the necessary prerequisite for successfully "acting like an educator" (PEC).

On these terms, the construction of final Practical Innovation Competence (PIC) displays a "dual-core" system backed by both "Head" (PA, professional ability) and "Hand" (PEC). Notably, the influence of PA on PIC ($\beta = .672$) is much stronger than that of PEC ($\beta = .287$).

This offers an essential insight: innovation is as much a cognitive act as an operating one. However much we emphasize external performance (PEC), what drives educational innovation is what is going on inside the students' heads, such as their abilities to diagnose problems, analyze data, and design solutions (PA). Refuting the misconception of "practice" as "doing more teaching", we identify the elements of high-level practical innovation as contingent upon a background of research thinking and theoretical depth.

5.4 Beyond the Deficit: The Unique Competence Formation Pattern of Non-Education Background Students

With an R^2of 0.82 (see Figure 2), the research model of practical innovation competence demonstrates strong explanatory power, suggesting that M.Ed. students with non-education backgrounds have unique advantages in terms of innovation generation in

the educational settings. Rather than considering students to be at a ‘deficit’ [9], the data strongly indicate that the path from professional ability to innovation competence ($\beta = .672$) stands out. Once the disciplinary expertise from their undergraduate major is integrated with their professional identity as educational practitioners, it serves as a unique driver for practical innovation. The high percentage of explained variance indicates that for M. Ed. students with non-education backgrounds, the formation of professional identity is not a continuous development but a reconstruction following a discontinuity. Due to the lack of prior professional socialization, these students rely heavily on external support to serve as 'identity anchors.'

The study also reveals that supervisor support alleviates the 'impostor anxiety' common among M.Ed. students with non-education backgrounds by providing authoritative validation. Meanwhile, institutional support reduces the psychological costs of role transition by fostering an inclusive environment. Ultimately, this external 'trust from others' is transformed into the students' 'self-confidence,' catalyzing the internal identification of 'being a teacher.'"

6 Conclusion and Practical Implications

This study examines the formation mechanisms of practical innovation capacity among M.Ed. students with non-education backgrounds from a social cognitive perspective. Findings indicate that, in terms of external drivers, institutional support more significantly predicts professional identity than supervisor support. Regarding internal mechanisms of professional development, strong professional identity robustly predicts professional foundation, which in turn influences professional ability. Both professional ability and professional foundation directly and significantly influence the development of pedagogical competence. Regarding the ultimate dependent variable—practical innovation competence—professional ability and pedagogical competence serve as the two key drivers propelling its development.

Based on these findings, several practical recommendations can be offered for cultivating M.Ed. students with non-education backgrounds: first, higher education institutions should attach importance to building high-quality practice bases and curriculum systems, which can most strongly predict students’ professional identity; second, supervisors should maintain a balance between providing emotional support and delivering targeted skills training while supervising students; third, as we find a good correlation between professional ability and practical innovation competence, M.Ed. Programs should not sacrifice theoretical research cultivation in order to intensively train only skills, as "thinking" brings forth "innovation".

This study is limited by its cross-sectional design and reliance on self-reported data, which may affect causal inference and objectivity. Future research should employ longitudinal tracking and objective performance metrics (e.g., teaching portfolios). Additionally, exploring how specific undergraduate disciplines (e.g., STEM vs. Humanities) moderate these formation pathways would provide more personalized insights for teacher cultivation.

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