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CASE TECHNOLOGY AS A MEANS OF FORMING RESEARCH ABILITIES OF UNIVERSITY STUDENTS: EVIDENCE FROM HIGHER EDUCATION IN CHINA AND CENTRAL ASIA

A TECNOLOGIA DE CASOS COMO MEIO DE DESENVOLVER AS HABILIDADES DE PESQUISA DE ESTUDANTES UNIVERSITÁRIOS: EVIDÊNCIAS DO ENSINO SUPERIOR NA CHINA E NA ÁSIA CENTRAL

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Abstract
The cultivation of university students' research ability has become a central objective of higher education reform, particularly in systems transitioning toward research- and innovation-oriented learning. This study investigates the effect of case technology on university students' research ability and examines the mediating role of critical thinking in higher education contexts in China and Central Asia. Grounded in inquiry-based learning theory, a conceptual framework was proposed in which case technology functions as the independent variable, research ability as the dependent variable, and critical thinking as the mediating variable. A quantitative research design was employed, with data collected from 312 undergraduate students enrolled in universities in China and Kazakhstan. Descriptive statistics, correlation analysis,

Resumo
O desenvolvimento da capacidade de pesquisa dos estudantes universitários tornou-se um objetivo central da reforma do ensino superior, particularmente em sistemas em transição para um modelo de aprendizagem orientado para a pesquisa e a inovação. Este estudo investiga o efeito da tecnologia de casos na capacidade de pesquisa dos estudantes universitários e examina o papel mediador do pensamento crítico em contextos de ensino superior na China e na Ásia Central. Com base na teoria da aprendizagem baseada na investigação, foi proposto um quadro conceitual no qual a tecnologia de casos funciona como variável independente, a capacidade de pesquisa como variável dependente e o pensamento crítico como variável mediadora. Foi empregado um desenho de pesquisa quantitativa, com dados

regression analysis, and mediation analysis were conducted to test the proposed hypotheses. The results indicate that case technology has a significant positive effect on both research ability and critical thinking. Critical thinking was also found to significantly predict research ability. Moreover, mediation analysis revealed that critical thinking partially mediates the relationship between case technology and research ability. The findings demonstrate that case technology enhances students' research ability not only through direct engagement with research-oriented learning activities but also indirectly by fostering critical thinking. This study contributes to the literature on research-oriented pedagogy by clarifying the cognitive mechanism underlying the effectiveness of case-based instruction and provides practical implications for integrating inquiry-oriented teaching approaches in higher education curricula in China and Central Asia.

Keywords: Case Technology. Critical Thinking. Research Ability. Higher Education. China and Central Asia.

coletados de 312 estudantes de graduação matriculados em universidades na China e no Cazaquistão. Estatísticas descritivas, análise de correlação, análise de regressão e análise de mediação foram realizadas para testar as hipóteses propostas. Os resultados indicam que a tecnologia de casos tem um efeito positivo significativo tanto na capacidade de pesquisa quanto no pensamento crítico. Verificou-se também que o pensamento crítico prediz significativamente a capacidade de pesquisa. Além disso, a análise de mediação revelou que o pensamento crítico medeia parcialmente a relação entre a tecnologia de casos e a capacidade de pesquisa. Os resultados demonstram que a tecnologia de casos aprimora a capacidade de pesquisa dos alunos não apenas por meio do envolvimento direto com atividades de aprendizagem orientadas para a pesquisa, mas também indiretamente, ao fomentar o pensamento crítico. Este estudo contribui para a literatura sobre pedagogia orientada para a pesquisa ao esclarecer o mecanismo cognitivo subjacente à eficácia do ensino baseado em casos e fornece implicações práticas para a integração de abordagens de ensino orientadas para a investigação nos currículos do ensino superior na China e na Ásia Central.

Palavras-chave: *Tecnologia de Casos. Pensamento Crítico. Capacidade de Pesquisa. Ensino Superior. China e Ásia Central.*

1 INTRODUCTION

The cultivation of university students' research abilities has become a central objective of higher education reform in both China and Central Asia. As universities increasingly transition from teaching-oriented institutions to research- and innovation-oriented systems, students are expected to master not only disciplinary knowledge but also core research competencies, including problem formulation, information literacy, analytical reasoning, and academic communication (Brew, 2013. Healey & Jenkins, 2009. Prince & Felder, 2006). These competencies are widely regarded as foundational for knowledge production, lifelong learning, and graduate employability in knowledge-based economies (OECD, 2019).

Despite this strategic emphasis, empirical studies consistently report a mismatch between higher education policy goals and classroom-level instructional practices. Traditional lecture-based instruction remains dominant in many universities across China and Central Asia, often prioritizing content transmission and examination performance over inquiry and evidence-based reasoning (Ambasz et al., 2023. Biggs & Tang, 2011). As a result, students' research abilities are frequently underdeveloped, fragmented, or postponed until the final thesis stage. Undergraduate students, in particular, often lack systematic exposure to research processes, which constrains the early formation of research competence and academic identity (Brew, 2013. Healey et al., 2014).

In China, higher education reforms have increasingly emphasized innovation capacity, undergraduate research, and student-centered pedagogy. Nevertheless, empirical evidence suggests that research-oriented teaching practices remain unevenly implemented, especially in large undergraduate classes (Xiang et al., 2025. Zhou & Xu, 2020). Similarly, higher education systems in Central Asia face persistent challenges related to limited research preparedness, uneven instructional quality, and multilingual learning environments. Policy analyses conducted by international organizations highlight the need for pedagogical innovation to strengthen research capacity and learning outcomes across the region (Ambasz et al., 2023. World Bank, 2020). Moreover, recent empirical studies from Kazakhstan indicate that students' research skills vary significantly depending on instructional design and academic language, underscoring the importance of explicit and structured research-skill development (Baimanova et al., 2025).

In response to these challenges, case technology, also referred to as case-based learning (CBL), has gained increasing attention as a student-centered instructional approach capable of integrating research-oriented learning into regular coursework. Grounded in constructivist and inquiry-based learning theories, case technology engages students in the analysis of complex, ill-structured problems that resemble authentic professional or academic research contexts (Prince & Felder, 2006. Savery, 2015). By requiring students to identify problems, evaluate evidence, consider alternative explanations, and justify conclusions, case technology mirrors the core logic of the research process and thus provides a pedagogical bridge between classroom learning and academic research practice (Brew, 2013).

A growing body of international research demonstrates that case-based and inquiry-oriented instructional approaches are effective in promoting higher-order learning outcomes, particularly critical thinking and analytical reasoning (Gijbels et al., 2005. Savery, 2015). In the Chinese higher education context, meta-analytic evidence shows that case-based learning has a significant positive effect on students' critical thinking skills, which are essential for hypothesis testing and research reasoning (Xiang et al., 2025). In Central Asia, research-based learning models have similarly been shown to enhance students' abilities in research planning, data analysis, and academic presentation (Yermekbayeva et al., 2024).

However, despite these encouraging findings, existing studies have primarily focused on general cognitive or learning outcomes, while the specific mechanisms through which case technology contributes to the development of research ability remain insufficiently explored. In particular, critical thinking what widely recognized as a core cognitive skill underpinning research competence that has rarely been examined as a mediating variable linking instructional design and research ability (Facione, 2015. Gijbels et al., 2005). This limitation is especially evident in studies situated in China and Central Asia, where empirical research adopting mediation models in higher education pedagogy remains scarce.

Therefore, the present study aims to examine the effectiveness of case technology in fostering university students' research abilities and to clarify the mediating role of critical thinking in this relationship. By focusing on higher education contexts in China and Central Asia, this study seeks to provide context-sensitive empirical evidence and to contribute to the broader literature on research-oriented teaching and learning.

1.1 Research objectives

The overall objective of this study is to examine the effect of case technology on university students' research ability and to clarify the mediating role of critical thinking in higher education contexts in China and Central Asia.

Specifically, this study aims to:

1) To examine the effect of case technology on university students' research ability.
2) To examine the effect of case technology on university students' critical thinking.

3) To examine the mediating role of critical thinking in the relationship between case technology and research ability.

1.2 Research question

Based on the above objectives, this study addresses the following research question:

RQ. To what extent does case technology influence university students' research ability, and does critical thinking mediate this relationship in higher education contexts in China and Central Asia?

1.3 Research hypotheses

In line with the conceptual framework (Figure 1), the following hypotheses are proposed:

H1. Case technology has a significant positive effect on university students' research ability.

H2. Case technology has a significant positive effect on university students' critical thinking.

H3. Critical thinking has a significant positive effect on university students' research ability.

H4. Critical thinking mediates the relationship between case technology and university students' research ability.

1.4 Research feamework

Figure 1

Research Feamework

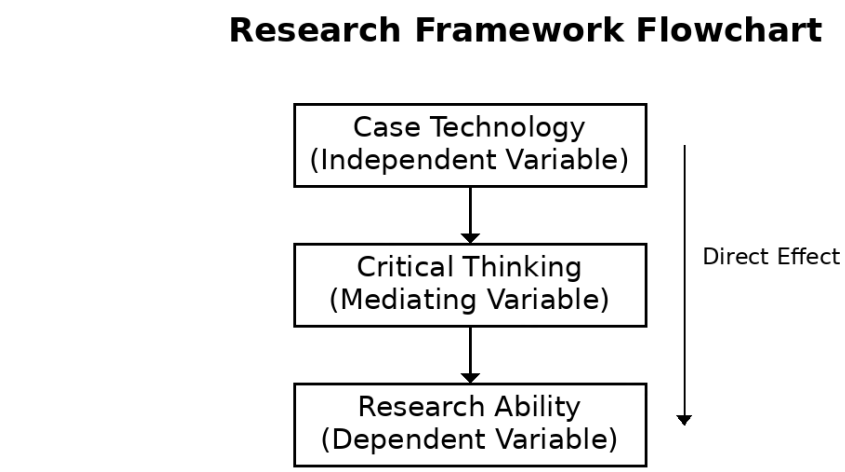

Figure 1. Research framework illustrating the direct and indirect effects of case technology on university students' research ability through critical thinking.

2 LITERATURE REVIEW

2.1 Research abilities in higher education

Research ability is commonly conceptualized as a multidimensional construct encompassing cognitive, methodological, and communicative competencies. Drawing on higher education research, this study operationalizes research ability as including:

1) problem identification,
2) information searching and evaluation,
3) methodological reasoning,
4) data analysis and interpretation, and
5) academic communication (Baimanova et al., 2025).

Empirical evidence from Central Asia suggests that students' research abilities are unevenly developed and strongly influenced by instructional design and language of instruction (Baimanova et al., 2025).

2.2 Case technology and research-oriented learning

Case technology is grounded in constructivist and inquiry-based learning theories, emphasizing active knowledge construction through authentic problem solving (Prince & Felder, 2006). Unlike problem sets with predetermined answers, cases require students to interpret ambiguous information, compare competing explanations, and defend conclusions using evidence.

A growing body of research demonstrates that case-based learning enhances higher-order cognitive outcomes, particularly critical thinking and analytical reasoning (Xiang et al., 2025). These outcomes are theoretically and empirically linked to research ability development.

2.3 Empirical evidence from china and central asia

In China, meta-analytic evidence indicates that case-based learning significantly improves students' critical thinking skills, which serve as a cognitive foundation for hypothesis testing and research reasoning (Xiang et al., 2025). In Central Asia, studies on research-based learning models show significant gains in students' research planning, data analysis, and academic presentation skills (Yermekbayeva et al., 2024).

Table 1

Summarizes representative empirical studies relevant to this research. Empirical Studies on Case- and Research-Based Learning in China and Central Asia

Author(s)	Region	Method	Key Findings
Prince & Felder (2006)	International	Review	Inquiry-based methods enhance higher-order cognition
Xiang et al. (2025)	China	Meta-analysis	CBL improves critical thinking significantly
Yermekbayeva et al. (2024)	Kazakhstan	Quasi-experiment	RBL improves research design and analysis skills
Baimanova et al. (2025)	Kazakhstan	Survey	Research skills vary by instructional language

3 METHODOLOGY

3.1 Research design

This study employed a quasi-experimental design with a treatment group exposed to case technology and a comparison group receiving traditional lecture-based instruction.

3.2 Participants

Participants were 312 undergraduate students from universities in China (n = 162) and Kazakhstan (n = 150), enrolled in education and social science programs.

3.3 Instructional intervention

The treatment group participated in a 12-week case-based instructional module structured around four inquiry stages:

1. Case analysis and problem identification
2. Evidence collection and literature review
3. Methodological justification and analysis
4. Presentation, critique, and reflection

3.4 Measures

Research ability was measured using a validated multi-dimensional scale adapted from prior studies (Baimanova et al., 2025). All items were rated on a five-point Likert scale.

Table 2

Constructs and Measurement Indicators

Construct	Number of Items	Sample Indicator
Problem Identification	5	Ability to formulate research questions
Information Literacy	6	Ability to evaluate academic sources
Methodological Reasoning	5	Justification of research methods
Data Interpretation	4	Ability to explain results
Academic Communication	5	Clarity of written arguments

3.5 Data analysis

Data were analyzed using descriptive statistics, independent-samples *t* tests, and multiple regression analysis to examine the effect of case technology on research abilities.

4 RESULTS

4.1 Descriptive statistics

Table 3

Descriptive Statistics of Research Ability Scores

Group	M	SD
Case Technology	4.02	0.51
Traditional Instruction	3.46	0.57

4.2 Correlation analysis

Pearson correlation analysis was conducted to examine the relationships among the main variables.

Table 4

Correlations among Case Technology, Critical Thinking, and Research Ability

Variable	1	2	3
1. Case Technology	—		
2. Critical Thinking	.56***	—	
3. Research Ability	.61***	.64***	—

Note: $p < .001$***

Table 4.2 indicates that case technology was significantly and positively correlated with critical thinking ($r = .56$, $p < .001$) and research ability ($r = .61$, $p < .001$). Critical thinking was also strongly correlated with research ability ($r = .64$, $p < .001$). These results provide preliminary support for H1–H3 and justify further regression and mediation analyses.

Correlations among Case Technology, Critical Thinking, and Research Ability

4.3 Hypotheses testing: direct effects

Multiple regression analyses were conducted to test the direct effects proposed in H1–H3.

Table 5

Regression Results for Direct Effects

Dependent Variable	Predictor	β	t	p
Research Ability	Case Technology	.41	8.73	< .001
Critical Thinking	Case Technology	.56	11.24	< .001
Research Ability	Critical Thinking	.47	9.62	< .001

As shown in Table 4.3, case technology had a significant positive effect on research ability ($\beta = .41$, $p < .001$), supporting H1. Case technology also significantly predicted critical thinking ($\beta = .56$, $p < .001$), supporting H2. Furthermore, critical thinking significantly predicted research ability ($\beta = .47$, $p < .001$), supporting H3.

4.4 Mediation analysis

To test the mediating role of critical thinking (H4), mediation analysis was conducted using a bootstrapping procedure with 5,000 resamples.

Table 6

Mediation Analysis Results

Path	**Effect**	**Boot SE**	**95% CI**
Direct effect (Case Technology → Research Ability)	.22***	.04	[.14, .30]
Indirect effect (via Critical Thinking)	.19***	.03	[.13, .26]
Total effect	.41***	.05	[.32, .50]

Table 4.4 shows that the indirect effect of case technology on research ability through critical thinking was significant, as the 95% confidence interval did not include zero. The direct effect remained significant after including the mediator, indicating a partial mediation effect. Therefore, H4 was supported.

4.5 Summary of hypotheses testing

For clarity, the results of hypotheses testing are summarized in Table 4.5.

Table 7

Summary of Hypotheses Testing Results

Hypothesis	Statement	Result
H1	Case technology → Research ability	Supported
H2	Case technology → Critical thinking	Supported
H3	Critical thinking → Research ability	Supported
H4	Mediation effect	Supported (Partial mediation)

4.6 Summary of findings

This chapter reported the empirical results of the study based on descriptive statistics, correlation analysis, regression analysis, and mediation analysis. The analyses

were conducted to test the proposed relationships among case technology, critical thinking, and university students' research ability.

The descriptive results indicated that students reported moderate to high levels of case technology exposure, critical thinking, and research ability. Correlation analysis showed significant positive relationships among all key variables, providing initial support for the hypothesized associations.

Regression analyses confirmed the direct effects proposed in the research model. Case technology had a significant positive effect on research ability and critical thinking, and critical thinking significantly predicted research ability. These findings support Hypotheses H1, H2, and H3.

Mediation analysis further demonstrated that critical thinking partially mediated the relationship between case technology and research ability. The indirect effect through critical thinking was significant, while the direct effect remained significant after the mediator was included, supporting Hypothesis H4.

Overall, the results provide empirical support for the proposed research framework, indicating that case technology contributes to the development of university students' research ability both directly and indirectly through critical thinking. These findings establish a clear empirical basis for the discussion and implications presented in the following chapter.

5 CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

This study examined the role of case technology in the development of university students' research ability, with a particular focus on the mediating role of critical thinking, in higher education contexts in China and Central Asia. Drawing on inquiry-based learning theory and employing a quantitative research design, the study proposed and empirically tested a conceptual framework linking instructional design, cognitive processes, and research competence.

The empirical results demonstrate that case technology has a significant positive effect on university students' research ability. Students who experienced case-based

instructional practices reported higher levels of research competence, indicating that engaging learners in authentic, problem-oriented tasks can effectively support the development of research-related skills. This finding confirms the value of integrating research-oriented pedagogy into regular undergraduate instruction.

In addition, the study found that case technology significantly enhances students' critical thinking, and that critical thinking, in turn, has a significant positive effect on research ability. Mediation analysis further revealed that critical thinking partially mediates the relationship between case technology and research ability. This result suggests that case technology contributes to research competence not only through direct engagement with research-like activities, but also by fostering higher-order cognitive skills that enable students to apply and transfer these experiences more effectively.

Overall, the findings validate the proposed research framework and provide empirical evidence that instructional approaches grounded in inquiry and case analysis play an important role in cultivating university students' research ability. By clarifying the cognitive mechanism underlying this relationship, the study contributes to the literature on research-oriented teaching and offers context-sensitive evidence relevant to higher education reform in China and Central Asia.

5.2 Recommendations

Based on the findings and conclusions of this study, several recommendations are proposed for higher education institutions, educators, and future research.

5.2.1 Recommendations for Higher Education Institutions

Universities in China and Central Asia should consider systematically integrating case technology into undergraduate curricula, particularly in courses where research ability is a core learning outcome. Rather than confining research training to final-year projects, institutions are encouraged to embed case-based and inquiry-oriented learning activities throughout the academic program to support the gradual development of research competence.

In addition, institutional support should be provided through curriculum design guidelines, teaching workload arrangements, and professional development programs that encourage instructors to adopt research-oriented pedagogies.

5.2.2 Recommendations for teaching practice

Instructors are encouraged to design and implement cases that reflect authentic academic or professional research contexts, emphasizing problem identification, evidence evaluation, and reasoned argumentation. Case discussions should be structured to promote critical questioning and reflective thinking, rather than focusing solely on correct answers.

Furthermore, assessment strategies should align with the objectives of case-based learning by evaluating students' analytical processes, use of evidence, and clarity of academic communication, in addition to final outcomes.

5.2.3 Recommendations for future research

Future studies may extend this research by adopting longitudinal designs to examine the long-term effects of case technology on students' research ability. Comparative studies across disciplines or countries may also provide deeper insights into contextual factors influencing the effectiveness of case-based instruction.

In addition, future research could explore other potential mediating or moderating variables, such as self-regulated learning, academic motivation, or learning engagement, to further clarify the mechanisms through which instructional design influences research competence.

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Authors' Contribution

All authors contributed equally to the development of this article.

Data availability

All datasets relevant to this study's findings are fully available within the article.

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