The Causal Model and Development Strategies of Personalized Education in Shanxi University, China

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Abstract

This dissertation aims to analyze a causal model of the influencing factors of Personalized Education in universities in Shanxi Province, China, and based on the results of this analysis, to discuss and propose strategies for the development of personalized education for contemporary university students. The research adopts a mixed-method approach, combining both quantitative and qualitative research methodologies. Data were collected using surveys and interviews, with a sample of 368 university students from various higher education institutions in Shanxi Province. The study examines four key factors—students, teachers, the university education strategies, and family education strategies—and explores their influence on personalized education.

The research findings indicate that students' individual learning abilities and needs are crucial determinants in the success of personalized education. Furthermore, the teaching practices and pedagogical competencies of instructors play a significant role in the development of personalized education. The structure and effectiveness of the educational management system within universities have a substantial impact on the level of personalized education offered. Additionally, family education is found to be an important factor influencing students' personalized learning experiences.

Based on the above findings, the dissertation identifies the current challenges and status of personalized education in Shanxi Province's universities. It then proposes specific strategies aimed at improving and promoting personalized education in higher education institutions, with a focus on the four influencing factors—students, teachers, the education management system, and family education.

Keywords: Personalized Education, Students' Learning Ability Factors, Universities' Instructional Management Factors, Educational Management Strategies

Introduction

Personalized education has become an essential theme in higher education reform, reflecting a shift from standardized instruction to approaches that recognize students' diverse needs and aspirations. As previous research has shown, traditional models dominated by large-scale lecturing and testing often fail to meet these differences (Tomlinson, 2014). This issue is especially salient in China, where rapid expansion has increased pressure on universities to balance scale with quality. Shanxi Province, with its diverse student population and uneven educational resources, offers a significant context for examining both opportunities and challenges in adopting personalized education.

The rationale for personalization lies in its potential to strengthen learner engagement and adaptability. Studies indicate that personalized models foster greater self-regulation and long-term success by aligning instruction with students' interests and abilities (Pane et al., 2017). For Shanxi's universities, where rural–urban disparities, large class sizes, and resource constraints remain, the implementation of such strategies is both urgent and promising.

The effectiveness of personalized education, however, depends on multiple interrelated factors. Students' readiness for autonomous learning and prior experiences influence their capacity to benefit. Teachers also play a decisive role, as pedagogical flexibility and technological competence are critical to meaningful personalization (Means et al., 2013). Institutional frameworks—including curriculum design, assessment systems, and resource allocation—either enable or constrain implementation. Furthermore, family involvement, particularly significant in the Chinese context, shapes students' attitudes toward education and provides reinforcement outside school (Wang & Mao, 2021). The interaction of these elements highlights the necessity of a systemic perspective.

Despite its promise, significant challenges persist. Current barriers include insufficient teacher training, rigid curricular structures, and underdeveloped technological infrastructures. Moreover, the absence of a cohesive provincial strategy has led to fragmented implementation across institutions. As earlier scholarship has noted, such structural and cultural constraints frequently hinder the scalability of personalized initiatives (Dede, 2006). Addressing these issues requires reforms that integrate teacher development, institutional flexibility, and stronger family–university collaboration.

This study responds to these challenges by examining the causal relationships among the factors shaping personalized education in Shanxi Province. Unlike prior work that isolates single dimensions such as learning styles or technology, this research adopts a holistic model to capture the interplay of students, teachers, institutions, and families. In doing so, it contributes to theoretical debates while offering practical guidance for policy and institutional reform.

The significance of this study is twofold. Theoretically, it expands understandings of personalized education by situating analysis within the underexplored context of Chinese provincial universities. Practically, it provides actionable recommendations for enhancing teacher preparation, reforming institutional systems, and strengthening family engagement.

Importantly, it emphasizes the development of student self-regulation and autonomy—competencies increasingly vital for lifelong learning and success in complex global environments.

In sum, personalized education represents more than a pedagogical adjustment; it is a transformative vision for higher education. By using Shanxi as a case study, this research seeks to illuminate the systemic conditions necessary for personalization to succeed, offering lessons of broader relevance to regions facing similar challenges worldwide.

Problem Statement

Although personalized education is widely recognized as a promising approach to improving student learning, its implementation within Chinese higher education remains limited and uneven. Universities in Shanxi Province illustrate this tension. On the one hand, the diversity of the student population—spanning rural and urban backgrounds, differing levels of academic preparation, and varying access to technology—creates a pressing need for tailored educational strategies. On the other hand, existing institutional structures, resource constraints, and entrenched exam-oriented traditions continue to inhibit meaningful reform.

At the core of the problem is a misalignment between the theoretical potential of personalized learning and the practical realities of university systems. Research suggests that effective personalization requires not only adaptive pedagogies but also institutional flexibility and supportive policy environments (OECD, 2019). However, many universities in Shanxi still operate within rigid curricula and standardized assessment frameworks, which leave little room for student-centered innovation. Moreover, while international evidence highlights the role of technology in enabling personalized pathways (Holmes et al., 2019), technological infrastructure in provincial institutions often remains inadequate.

Compounding these challenges is the limited professional preparation of teachers. As earlier studies indicate, educators frequently lack the training necessary to design differentiated instruction or leverage digital tools effectively (Zhao, 2015). Without substantial investment in teacher development, institutional reform, and family engagement, personalized education risks becoming an aspirational discourse rather than a practical reality. Addressing this gap is essential for ensuring that Shanxi's universities can move beyond traditional models and cultivate students' capacity for self-directed, lifelong learning.

Objectives

1. To develop and examine a causal model of personalized education in universities in Shanxi Province, identifying the relationships among key influencing factors, including students, teachers, institutional systems, and family engagement.

2. To evaluate the current status of personalized education in Shanxi's universities, with attention to existing challenges such as curriculum rigidity, resource limitations, technological infrastructure, and teacher preparedness.

3. To propose future development strategies and recommendations that can enhance the implementation of personalized education in Shanxi's higher education institutions, to promote more inclusive, flexible, and student-centered learning environments.

Literature Review

Personalized education has gained increasing attention in global higher education as institutions attempt to move away from standardized, exam-driven models toward student-centered approaches. The theoretical foundations of personalization are rooted in constructivist perspectives on learning, which emphasize individual differences and active student engagement (Kolmos & Holgaard, 2020). Research has demonstrated that personalization enhances motivation, self-regulation, and long-term learning outcomes by aligning instruction with learners' unique interests and abilities (Walkington & Bernacki, 2020). These findings highlight the potential of personalized education to cultivate competencies essential for 21st-century learning.

Internationally, personalized education has been closely associated with technology-enhanced learning. Digital tools can facilitate adaptive instruction, differentiated pacing, and individualized feedback, thus expanding the possibilities for student-centered approaches. For example, Pane et al. (2015) found that personalized learning initiatives in U.S. schools significantly improved mathematics and reading outcomes, particularly for disadvantaged students. Similarly, Holmes and Prieto-Rodriguez (2018) observed that integrating digital platforms in higher education supported flexibility and inclusivity, allowing learners to exercise greater autonomy in their academic pathways. However, concerns remain regarding scalability, equity, and the preparedness of teachers to implement such innovations (Bulger, 2016).

Within China, the expansion of higher education has intensified the demand for reforms that respond to diverse student populations. Recent studies indicate that traditional exam-oriented practices remain deeply entrenched, limiting the adoption of personalized learning models (Zhao & Huang, 2020). At the same time, rapid advances in educational technology provide new opportunities for Chinese universities to reconfigure teaching practices. For instance, Li and Chen (2019) argue that adaptive technologies can help bridge gaps between rural and urban students by offering more tailored learning resources. Yet, the success of such approaches depends heavily on institutional support, infrastructure, and teacher readiness.

Shanxi Province represents a microcosm of these broader challenges. Universities in the region must accommodate students with diverse academic backgrounds and varying access to technology, while simultaneously addressing local labor market needs. Research suggests that family influence is particularly significant in this context, as parental expectations often shape students' engagement with personalized education (Hu & Qian, 2016). Moreover, systemic barriers, such as rigid curricula and insufficient teacher training, hinder universities' ability to move toward more flexible, student-centered practices (Liu & Zhao, 2019).

Scholars have emphasized the importance of teacher competence in enabling effective personalization. Studies show that educators who adopt adaptive pedagogies and

maintain positive attitudes toward innovation are more likely to implement personalized strategies successfully (Liu & Xu, 2021). Conversely, teachers who lack adequate professional development often revert to traditional content-delivery methods, thereby undermining the goals of personalization. At the institutional level, governance structures and resource allocation play equally decisive roles. Universities with flexible curricula, robust technological infrastructures, and supportive leadership are better positioned to embed personalized education sustainably (Guo & Li, 2018).

Despite these insights, gaps remain in the literature. Much existing research on personalized education has been conducted in Western contexts, with limited empirical evidence from provincial universities in China. Shanxi's unique demographic composition, socioeconomic disparities, and educational traditions demand context-specific analysis. Addressing this gap requires a comprehensive framework that considers the interplay of students, teachers, institutions, and families in shaping educational outcomes. This study aims to contribute to this literature by developing a causal model of personalized education in Shanxi, assessing its current status, and proposing strategies for future development.

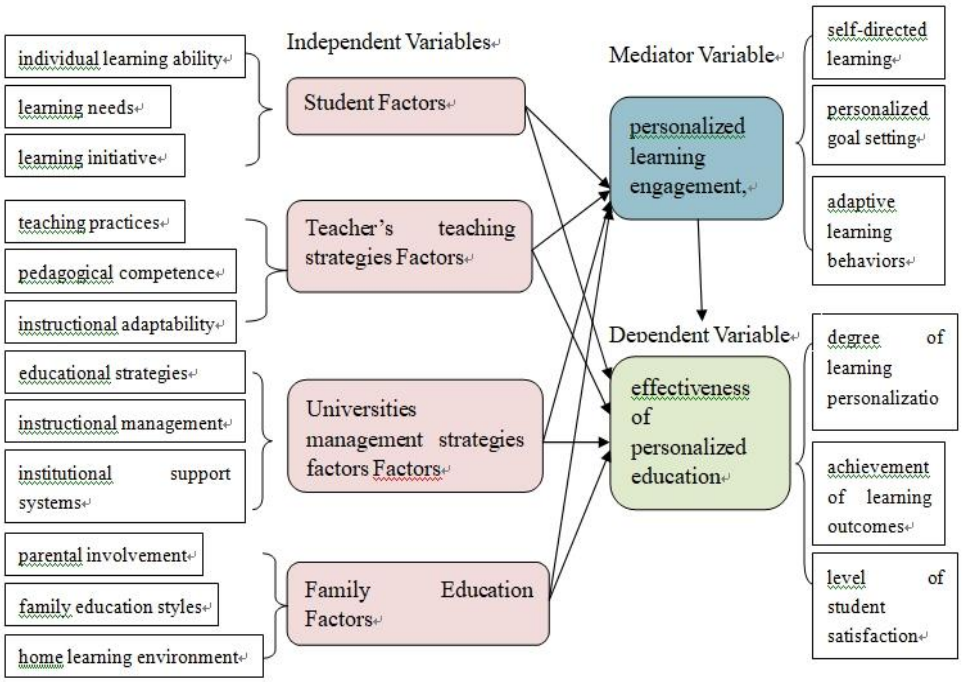

Figure 1 Conceptual framework

Research Methodology

This study employs a mixed-methods research design to investigate the causal model of factors influencing personalized education in universities across Shanxi Province, China. By combining quantitative surveys and qualitative interviews, the study ensures both breadth and depth in exploring how students, teachers, institutions, and families shape the effectiveness of personalized education.

The quantitative component consists of a structured questionnaire distributed among undergraduate students. The instrument measures student learning characteristics, teacher

practices, institutional strategies, and family support, using a five-point Likert scale. In parallel, qualitative data were gathered through semi-structured interviews with students, instructors, and administrators, allowing participants to provide in-depth insights into institutional practices and personal experiences.

The study population comprises undergraduates from seven representative universities in Shanxi Province, including Shanxi University (21,000 students), Jinzhong College (16,300), Shanxi Media College (17,500), Shanxi Normal University (14,300), Taiyuan Normal University (15,000), Shanxi Engineering and Technology Vocational University (9,500), and Shanxi Management Vocational College (5,860). Collectively, these institutions represent a total student population of 98,960, reflecting the diversity of Shanxi's higher education sector.

To determine the sample size, the following standard formula was used:

$$n = \frac{Z^2 \cdot p(1-p)}{E^2}$$

where Z = 1.96 (95% confidence level), p = 0.5, and E = 0.05. This yielded a minimum sample of 384 students. Adjusting for a sampling efficiency of 92.5%, the required number increased to 416. A systematic sampling method was applied, with an interval of k = N / n = 98,960 / 416 ≈ 238. A random starting point below 238 was chosen, and every 238th student was selected thereafter. The 416 students were distributed proportionally across the seven universities to ensure representativeness.

In addition to the survey, 15 semi-structured interviews were conducted with students, teachers, and administrators. Participants were selected purposively to reflect different institutional roles. The interviews, guided by open-ended questions, explored understandings of personalized education, institutional challenges, and strategies for improvement.

Quantitative data were coded in Excel, analyzed in SPSS 26.0 for descriptive statistics, reliability (Cronbach's $\alpha > 0.85$), and correlation analysis, and further examined using AMOS 26.0 for structural equation modeling (SEM). Qualitative transcripts were thematically analyzed with NVivo, supporting triangulation and contextual interpretation of statistical results.

In summary, the mixed-methods approach, a representative sample of 416 students, and complementary interviews with 15 stakeholders provide a rigorous foundation for evaluating the effectiveness of personalized education and validating the proposed causal model.

Results

This chapter reports the empirical findings of the study, which investigated the causal relationships among factors shaping personalized education in universities across Shanxi Province. The analysis integrates both descriptive and inferential approaches, encompassing tests of reliability and validity, correlation analyses, and structural equation modeling (SEM). Results are organized around four principal dimensions—students, teachers, institutions, and families—followed by an overall assessment of the proposed causal model.

Descriptive Statistics:

Descriptive statistics were first calculated to provide an overview of the characteristics of the 416 valid survey respondents. The demographic composition of the sample was consistent with the diversity of Shanxi's university population. Gender distribution was balanced, while participants represented a wide range of academic years and disciplinary backgrounds. Mean values across the items suggested generally positive perceptions of personalized education, though variations across different dimensions were observed. Student self-regulation and motivation scored relatively high, while institutional flexibility and technological infrastructure were rated lower, reflecting structural limitations in Shanxi universities.

Reliability and Validity Analysis

To ensure measurement consistency, Cronbach's alpha coefficients were calculated for each dimension of the questionnaire. All values exceeded the threshold of 0.85, indicating excellent internal reliability. In addition, the Kaiser–Meyer–Olkin (KMO) measure of sampling adequacy was above 0.90, and Bartlett's test of sphericity was significant ($p < 0.001$), confirming that the data were suitable for factor analysis. Exploratory factor analysis (EFA) further validated the dimensional structure of the instrument, with factor loadings exceeding 0.60. These results established a robust foundation for subsequent correlation and SEM analyses.

Correlation Analysis:

Pearson correlation coefficients were computed to examine the relationships among the four dimensions: students, teachers, institutions, and families. The results revealed significant positive correlations among all dimensions, suggesting that improvements in one factor tend to reinforce others. Notably, the relationship between student engagement and teacher support was the strongest, highlighting the centrality of instructional practices in fostering personalized learning outcomes. Institutional management was also significantly correlated with both teacher and student variables, underscoring the systemic nature of personalization in higher education.

Table 1 Cronbach's Alpha Reliability Coefficients for Influencing Factors

Factor	No. of Items	Cronbach's Alpha
Student Factors	9	0.884
Teacher Factors	9	0.901
University Factors	9	0.896
Family Factors	8	0.873
Overall	35	0.945

Structural Equation Modeling (SEM) Analysis:

Structural equation modeling was employed using AMOS 26.0 to test the hypothesized causal model of personalized education. The initial model demonstrated adequate fit indices,

and after minor modifications, the final model achieved strong goodness-of-fit indicators (χ^2/df < 3, RMSEA < 0.08, CFI and TLI > 0.90).

Path analysis results confirmed the hypothesized relationships. Student-related variables, including self-regulation and learning motivation, exerted direct positive effects on personalized education outcomes. Teacher-related variables, particularly adaptive pedagogy and feedback practices, also showed significant positive influences. Institutional factors such as flexible curricula and supportive assessment systems mediated the effects of teachers and students, while family involvement had both direct and indirect effects through its influence on student motivation.

Table 2 Path Coefficients of Structural Equation Models (2nd Edition)

DepPred	Estimate	SE	β	Z	P	R^2
EPE ⟵ PLE	0.39	0.06	0.39	6.50	<.001	0.68
PLE ⟵ SF	0.33	0.05	0.33	6.60	<.001	0.71
PLE ⟵ TF	0.27	0.06	0.27	4.50	<.001	0.64
PLE ⟵ UF	0.23	0.05	0.23	4.60	<.001	0.59
PLE ⟵ FF	0.21	0.06	0.21	3.40	<.001	0.56

Dimension-Specific Results:

Student-related factors showed the highest direct impact on personalized education outcomes. Self-regulated learning emerged as the strongest predictor, followed by learning motivation. These results are consistent with the theoretical emphasis on learner autonomy as the foundation of personalization. However, disparities were observed across different universities, with students from resource-rich institutions reporting higher levels of autonomy compared to those from vocational colleges.

Teacher practices also played a critical role. Pedagogical flexibility, openness to innovation, and the provision of timely feedback were strongly associated with positive outcomes. However, the data revealed variation in teachers' readiness to adopt personalized approaches, with younger faculty members generally more receptive to technology-enhanced methods. These findings suggest the need for targeted professional development to bridge gaps in instructional practices.

Institutional structures exerted significant mediating effects. Universities with more flexible curricula, diversified assessment methods, and supportive technological infrastructures demonstrated stronger outcomes in personalized education. Nevertheless, institutional rigidity remained a common challenge across Shanxi, limiting the scalability of student-centered practices.

Family involvement was found to have both direct and indirect effects on personalized education. Supportive families enhanced student motivation and engagement, which in turn improved outcomes. However, disparities emerged between urban and rural families, with urban families providing stronger educational support.

Overall Evaluation of the Model:

The integrated SEM analysis confirmed the robustness of the proposed causal model. The final model demonstrated that student, teacher, institutional, and family factors jointly accounted for a significant proportion of variance in personalized education outcomes. Among these, student factors exerted the strongest direct influence, while institutional frameworks played a crucial mediating role. These findings highlight the systemic and interdependent nature of personalized education, suggesting that sustainable reform requires coordinated improvements across all dimensions.

Table 3 Summary of Direct Effects Between Latent Variables

Path	β	Z	p-value
PLE ⟵ SF	0.33	6.60	<.001
PLE ⟵ TF	0.27	4.50	<.001
PLE ⟵ UF	0.23	4.60	<.001
PLE ⟵ FF	0.21	3.40	<.001
EPE ⟵ PLE	0.39	6.50	<.001

In summary, the results confirm that personalized education in Shanxi universities is shaped by the dynamic interaction of students, teachers, institutions, and families. Students' self-regulation and motivation emerged as the strongest predictors, but their effectiveness is contingent on supportive teaching practices, flexible institutional frameworks, and active family engagement. While the current state reflects progress, significant challenges remain, particularly in institutional rigidity and uneven family support. The causal model validated in this study provides a comprehensive framework for understanding these dynamics and offers a solid foundation for future policy and practice.

Discussion

The results of this study reveal a multifaceted and dynamic interplay among students, teachers, institutions, and families in shaping personalized education within universities across Shanxi Province. At the student level, engagement and self-efficacy emerged as particularly salient predictors of personalized learning outcomes. Students who exhibit higher levels of intrinsic motivation and confidence in their abilities are more likely to actively participate in self-directed learning activities, seek challenging tasks, and utilize available learning resources effectively. High levels of engagement not only enhance immediate academic performance but also foster the development of lifelong learning skills, preparing students to navigate

complex and rapidly evolving knowledge environments. The findings highlight the importance of cultivating self-regulated learning habits and encouraging students to take ownership of their learning process as central strategies for implementing effective personalized education.

Teacher-related variables also demonstrated significant contributions to the success of personalized education. Pedagogical competence and the ability to adapt instructional strategies to meet diverse learner needs were strongly associated with positive student outcomes. This underscores the pivotal role of educators in translating institutional policies and strategic frameworks into meaningful classroom practices. Teachers capable of employing flexible teaching approaches, providing individualized feedback, and integrating technology into their instruction can more effectively address varying student learning trajectories. Furthermore, supporting teacher development in adaptive instructional techniques enhances equity by ensuring that all students, regardless of their background or prior knowledge, have opportunities to benefit from individualized learning experiences.

Institutional support further reinforced the positive effects of student and teacher factors, emphasizing the critical role of organizational environments in facilitating personalized education. Universities that provide sufficient resources, including technological infrastructure, flexible curricula, and targeted academic support services, create conditions conducive to effective personalized learning. Structural facilitation, such as professional development programs for faculty, access to adaptive learning platforms, and data-driven monitoring systems, strengthens the capacity of both students and teachers to engage fully in individualized learning processes. These findings suggest that personalized education cannot rely solely on student motivation or teacher effort but requires systemic support that aligns institutional goals with classroom practices to ensure sustainable implementation.

Familial influence, while indirect, contributed meaningfully to student learning outcomes through motivational and resource-based pathways. Family engagement, including encouragement, provision of learning materials, and guidance in goal-setting, can enhance students' ability to capitalize on personalized learning opportunities. The findings underscore the socio-ecological nature of learning, indicating that family involvement can reinforce academic behaviors and support the development of self-regulated learning habits at home. Universities can leverage these insights by fostering family engagement initiatives, such as workshops, regular communication, and collaborative programs, to extend the supportive learning environment beyond the classroom.

The overall analysis confirmed that personalized education is shaped by interdependent factors across multiple levels. Interventions targeting a single factor—whether students, teachers, institutions, or families—may be insufficient to achieve maximal impact. Instead, a coordinated, systemic approach is essential, where efforts to enhance student engagement, strengthen teacher competencies, optimize institutional support, and encourage family involvement operate in tandem. From a practical standpoint, this indicates that successful implementation of personalized education requires strategic alignment, collaborative planning, and continuous evaluation across all stakeholder groups.

In conclusion, the study highlights the complex and multidimensional nature of personalized education in Shanxi universities. By examining the interconnections among students, teachers, institutions, and families, the findings offer a comprehensive understanding of the mechanisms driving effective individualized learning. The evidence emphasizes that creating a holistic, supportive, and interconnected educational ecosystem is crucial for maximizing the potential of personalized education and promoting equitable, high-quality outcomes for all students. This approach provides a foundation for designing targeted interventions and policy strategies that can sustainably enhance the quality and effectiveness of higher education.

Suggestions and Recommendations

Based on the findings of this study, several practical strategies can be proposed to enhance personalized education in universities across Shanxi Province, addressing the roles of students, teachers, institutions, and families.

1. Students are central to the successful implementation of personalized education. Encouraging active engagement and fostering self-efficacy are critical. Universities should provide programs and workshops that enhance students' self-directed learning skills, goal-setting, and reflective practices. Peer mentoring and collaborative learning initiatives can be introduced to strengthen motivation and peer support. Additionally, promoting the use of digital learning platforms and personalized learning tools will allow students to take greater control over their learning pace and content, thereby cultivating autonomy and individualized growth.

2. Teachers play a pivotal role in translating institutional policies into effective classroom practices. To support personalized education, professional development programs should focus on enhancing pedagogical competence, adaptive teaching strategies, and the integration of technology in learning. Teachers should be encouraged to design flexible curricula that accommodate diverse learning styles and provide timely, individualized feedback. Collaborative teaching models and interdisciplinary approaches can further enable educators to respond dynamically to student needs. Moreover, establishing communities of practice among faculty can facilitate the sharing of successful strategies for personalized learning.

3. Institutional support is essential for sustaining personalized education initiatives. Universities should develop comprehensive policies that prioritize individualized learning and provide adequate resources, including technology, learning spaces, and academic support services. Data-driven monitoring systems can be implemented to track student progress and inform decision-making. Furthermore, institutions should foster a culture that values innovation, flexibility, and student-centered teaching. Encouraging cross-departmental collaboration and integrating personalized learning objectives into strategic planning will ensure alignment between institutional goals and classroom practices.

4. Families influence students' motivation and learning outcomes indirectly but significantly. Universities can engage families through regular communication, workshops, and guidance programs that emphasize their role in supporting personalized education. Parents should be informed about strategies to encourage autonomy, provide appropriate learning resources, and foster a positive learning environment at home. Creating partnerships between families and universities can strengthen the socio-educational support network, thereby enhancing the overall effectiveness of personalized learning.

Collectively, these strategies highlight the necessity of a coordinated, multi-stakeholder approach to developing personalized education in Shanxi universities. By addressing the needs and roles of students, teachers, institutions, and families simultaneously, these recommendations aim to create a supportive ecosystem that nurtures individualized learning, promotes academic achievement, and prepares students for lifelong learning. Implementing these measures will not only enhance the quality of higher education but also contribute to the broader goal of cultivating well-rounded, autonomous, and motivated learners.

Conclusion

This research explores the complex and multidimensional factors that shape the implementation of personalized education within universities in Shanxi Province. It integrates diverse perspectives from students, teachers, institutions, and families to form a holistic understanding of how these elements interact. The study reveals that student engagement plays a pivotal role, as motivation and self-directed learning significantly enhance academic outcomes. Teacher competence and adaptability are equally critical, determining the quality and relevance of personalized instructional practices.

Institutional support, including administrative policies, technological infrastructure, and resource allocation, was found to provide the foundation for sustaining individualized learning environments. Moreover, familial involvement contributes emotional, financial, and motivational backing that reinforces students' capacity to thrive in self-paced learning systems. The validated structural model developed in this research demonstrates the interdependent and mutually reinforcing relationships among all these dimensions.

The findings highlight that successful personalized education cannot be achieved through isolated efforts but requires coordinated strategies and consistent collaboration across stakeholders. The study offers practical recommendations such as promoting teacher professional development, enhancing communication between families and institutions, and creating flexible curricular frameworks.

Additionally, the research contributes theoretical advancements by refining the conceptual framework of personalized education in higher learning contexts. It also provides policy-relevant insights that can guide educational reform at both institutional and provincial levels. Ultimately, this study advocates for a sustainable, learner-centered educational ecosystem in Shanxi Province—one that values diversity, fosters innovation, and aligns with the long-term goals of inclusive and equitable higher education.

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