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AN EMPIRICAL STUDY ON THE MECHANISMS OF AI IN FACILITATING STUDENT LEARNING IN HIGHER EDUCATION INSTITUTIONS IN SICHUAN, CHINA

CHEN QI[1], Khalid Ahmed[2], Syed Wasim Anwar[3], Ruqia Saba Ashraf[4]

[1]INTI International University Malaysia, I24028756@student.newinti.edu.my
[2]INTI International University, Malaysia, khalid.ahmed@newinti.edu.my
[3]University of Technology and Applied Sciences-Ibra, Sultanate of Oman. syed.anwar@utas.edu.om
[4]The Women University, Multan, Pakistan, rsadgk@gmail.com

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Corresponding Author: Khalid Ahmed (khalid.ahmed@newinti.edu.my)

ABSTRACT

This study focuses on the learning practice of Undergraduates in Colleges and universities in Sichuan Province under the empowerment of artificial intelligence (AI) and discusses the application mechanism of AI tools in higher education and its impact on students' learning. Based on Vygotsky's social and cultural theory, exploring community framework (COI), actor network theory (ANT) and other theoretical foundations, combined with qualitative research methods, through semi-structured interviews and topic analysis, this paper reveals the multi-dimensional characteristics of AI empowerment and its relationship with students' learning practice and their educational access. The study found that AI empowerment significantly improved students' learning participation, skill development and autonomy through knowledge bridge mechanism, iterative feedback mechanism, research acceleration mechanism and metacognition support mechanism. However, there are significant differences between formal (institution driven) and informal (student driven) AI practices. Policy ambiguity and tool availability hinder the effective integration of AI. The results of the study provide an empirical reference for optimizing the AI education policy of colleges and universities in the western region and emphasize the importance of cultural change and personalized empowerment mechanism.

KEYWORDS: AI Empowerment; Undergraduate Learning Practice; Educational Access, Higher Education; Qualitative Research; AI Tool Integration.

1. INTRODUCTION

The integration of artificial intelligence (AI) in higher education is a key trend in the transformation of global education (Akala, 2020). China's "14th five-year plan" for education informatization (Ministry of Education of the People's Republic of China, 2021) and other national policies (State Council of the People's Republic of China, 2021) require colleges and universities to "deeply integrate artificial intelligence and teaching". Sichuan Province is an important higher education center in Western China, with 134 higher education institutions, and has become a regional leader in AI adoption (Sichuan Provincial Department of Education, 2023). Quantitative research showed that the results were mixed; For example, Smith et al. (2022) found that the use of adaptive platform of stem undergraduates in Sichuan was positively correlated with their math scores, while Brown et al. (2023) reported that excessive reliance on AI writing tools was associated with lower critical thinking scores in liberal arts courses. The existing qualitative research mainly focuses on the perspective of institutions or educators, ignoring students' initiative in selecting and using AI tools, especially informal tools such as ChatGPT or otter.ai. Based on the background of Sichuan, supported by Vygotsky's (2020) social and cultural theory and the framework of exploring communities (Garrison et al., 2020), this study analyzes the connection mechanism between AI empowerment and undergraduate learning, and provides practical insights for optimizing AI initiatives in Sichuan's higher education sector.

AI represents the urgent need of the global technology wave and contemporary education innovation and is a key dimension of China's education modernization (UNESCO, 2021). In 2021, the Ministry of Education released the "14th five-year plan" for educational informatization (Ministry of Education of the People's Republic of China, 2021), which aims to promote the deep integration of AI and education across the country. As scholars continue to explore Collaborative Methods between AI and education to achieve greater learning outcomes (Akala, 2020), people have renewed interest in the dialogue between technology and education. As the cornerstone of personal development and social equity, education directly determines the potential realization of artificial intelligence. China's national strategy (State Council of the People's Republic of China, 2021) clearly defines AI education as the key driving force to promote teaching reform and improve the quality of education. In higher education, AI integration goes beyond visible aspects such as platform deployment and resource allocation, and covers intangible dimensions such as learning process support, skill development and research ability enhancement (Pan, 2023). Its implementation has a profound impact on students' potential realization and future competitiveness.

To sum up, driven by the needs of times and regional development, it is of great theoretical value and practical significance to explore the relationship between AI empowerment and undergraduate learning practice in colleges and universities in Sichuan Province.

1.1. Problem Statement

In the context of global efforts to promote educational technology and digital learning (Akala, 2020), China regards AI empowerment as a key driving force to promote student development and educational innovation. The national "14th five-year plan" for education informatization (Ministry of Education of the People's Republic of China, 2021) clearly proposes to "deepen the integration of artificial intelligence and education". As a major education province in Western China, Sichuan Province has a perfect higher education system, and the adoption rate of AI in universities has increased significantly (Wang & Zhang, 2024). In addition, the provincial government has actively promoted the AI initiative and set the goal of "fully integrating AI in teaching" (Sichuan Provincial Department of Education, 2023). However, the artificial intelligence empowerment and undergraduate learning practice of the provincial universities still face many practical challenges, and the existing research has not fully solved these core problems.

1.2. Research Questions

RQ1: What discipline-specific mechanisms drive AI empowerment in undergraduates' learning processes in Sichuan's universities?

RQ2: What formal and informal AI practices do Sichuan undergraduates adopt, and how do these practices align with or diverge from institutional AI initiatives?

RQ3: What individual and institutional factors shape whether AI empowers or hinders deep learning among Sichuan undergraduates?

1.3. Research Significance

In the context of global promotion of educational technology and digital learning (Akala, 2020), Sichuan Province, as the core area of higher education in Western China, has important theoretical and practical value in studying the

correlation between AI empowerment and student development. The existing research mainly focuses on the national level or the eastern developed regions, and the background analysis of the western provinces is insufficient, especially the lack of systematic empirical research on the AI gap of higher education in Sichuan Province (Gururaj et al., 2020). The theme of this study is "the mechanism and practice of AI enabled learning of Sichuan University Students in China". The purpose of this study is to fill the gap in regional research theoretically by analyzing the impact mechanism of "process enabling" (curriculum, guidance, resources) on students' learning (Pan, 2023). This study uses a combination of qualitative research (Creswell & Poth, 2020) and semi-structured interviews to build a "student Professor institution" collaborative intervention system to promote a more technologically inclusive higher education environment in Sichuan province and ultimately realize a virtuous cycle between educational technology and student development.

2. LITERATURE REVIEW

This section first outlines the key concepts and theoretical framework that guide this study. It draws on Vygotsky's (2020) socio-cultural theory, Garrison's (2020) exploratory community (COI) framework, Latour's (2021) actor network theory (ANT) and Zimmerman's (2020) self-regulated learning theory as its basic support. These theories provide an analytical framework for testing the institutional logic of AI empowerment and the mechanism of affecting undergraduate learning practice. However, the existing research has not integrated these theories into the background of Sichuan multidisciplinary higher education institutions, resulting in a lack of localized application (Gururaj et al., 2020).

2.1. Theoretical Framework

2.1.1. Vygotsky's Sociocultural Theory

Vygotsky (1978) believed that learning is a social process mediated by tools and symbols. In the context of artificial intelligence, tools such as chatgpt can be used as cultural tools for "more knowledgeable people" or intermediary learning, which may expand the near end development area (ZPD). In Sichuan Province, with support, students may use AI to understand complex concepts beyond their current level. However, the theory also shows that the tool must be properly used in the social context to be effective, highlighting the potential pitfalls of using artificial intelligence alone.

2.1.2. Community Of Inquiry (Coi) Framework

Garrison et al. (2001)'s social existence theory shows that individual learning is achieved through interaction and collaboration. In Universities in Sichuan Province, AI tools can promote or hinder three kinds of existence: cognitive existence, social existence and teaching existence. This "lack of humanity" may reduce students' sense of community and belonging.

2.1.3. Actor-Network Theory (Ant)

Latour's (2005) ANT points out that agency is distributed among human and non-human actors, and the network of relationships between students, teachers, AI tools, institutional policies, and infrastructure shapes the outcomes of AI integration. Gender stereotypes in tool design are restricted to educational equity.

2.1.4. Education Equity Theory

Rawls' educational equity theory (1971) emphasizes the "principle of difference", that is, the distribution of educational resources should be inclined to vulnerable groups.

2.1.5. Social Cognitive Career Theory

Lent et al. (1994) believe that individual career development is affected by the interaction of self-efficacy, outcome expectations and environmental factors. Artificial intelligence empowerment can promote students' career development by improving self-efficacy.

2.2. AI In Higher Education

AI in higher education refers to the social practice that ensures the effective integration of AI technology in obtaining educational resources, creating learning environment and obtaining academic achievement opportunities by eliminating systemic barriers (UNESCO, 2021). UNESCO defines it as inclusive and fair recognition of individual differences, emphasizing not only formal equality, but also substantive equity in the process of Education. As an institutional practice of using artificial intelligence in higher education, it responds to the policy requirements of "deepening the integration of artificial intelligence and education" in the "14th five year plan for educational informatization" (Ministry of Education of the People's Republic of China, 2021) and "Sichuan Provincial Educational artificial intelligence initiative" and "integrating

comprehensive artificial intelligence into teaching" (State Council of the People's Republic of China, 2021; Sichuan Provincial Department of Education, 2023). This can solve the dilemma of "visible integration and hidden fragmentation" of Sichuan University. Based on Vygotsky's (2020) social and cultural theory and Latour's (2021) ANT, "tool mediation" extends to hidden dimensions such as curriculum and teachers, providing a localized framework for the integration of AI in western universities (Gururaj et al., 2020).

2.3. Linkages Between of AI Empowerment and Undergraduate Learning Practices

Social cognitive career theory (Lent et al., 2022) shows that AI empowerment enhances skill development and autonomous learning by optimizing environmental factors such as nondiscriminatory tool acquisition and fair distribution of AI resources, to improve students' self-efficacy. Pan (2023) research shows that AI empowerment can narrow the higher education cost gap of Sichuan students by 12%, reduce academic path dependence, and enhance professional competitiveness. Zhou and Zhang (2023) found that the tool sensitive design of stem courses in Sichuan University has improved students' participation rate, enhanced research ability, improved learning objectives such as management positions, and directly improved professional competitiveness. Bandura (2021) believes that nondiscriminatory learning guidance (artificial intelligence empowerment) reduces the implicit prejudice about "whether students are suitable for stable learning", prevents the reduction of self-efficacy, and encourages independent life planning. UNESCO (2021) emphasizes that integrating AI into classroom interaction can reduce students' self-restraint, especially help private university students break through the shackles of traditional ideas (Baily & Holmarsdottir, 2020) and improve their autonomy in learning planning.

2.4. The Impact of AI Empowerment on Undergraduate Learning

Sichuan Province has established an institutional framework through the "Sichuan Education AI Initiative (2021-2030)" (Sichuan Provincial Department of Education, 2023), which clearly requires "to increase the proportion of students using AI in stem disciplines such as science, technology, engineering and mathematics", to directly promote students' participation in these fields. According to the data of 2025, the proportion of stem students in Sichuan using artificial intelligence is 39%, ranking first in the country. In the incubator of "Ai innovation space" in Chengdu high tech Zone, the success rate of student innovators in obtaining funds is twice that of peers who do not use AI, which shows how AI empowerment can directly improve learning competitiveness.

Sichuan's AI empowerment practice has global reference value: China has the highest enrollment rate of higher education in the world. As a Western model, Sichuan's "formal integration informal empowerment" method provides a sample of "combining policy rigidity with cultural flexibility" for developing countries. This approach is not only in line with Rawls' principle of difference (1971), which solves the problem of discipline segregation through resource allocation, but also transforms educational achievements into social productivity through innovative projects such as "Jinjiang community service", to realize the localized implementation of the quality education goal of sustainable development goal 4 (UNESCO, 2021).

2.5. Challenges In the Implementation of AI Empowerment

The study reveals a sharp contrast between explicit integration and implicit division. Although there are equal opportunities to use AI tools, there are still serious disciplinary segregation in the use of tools. Although the distribution of visible resources seems to be balanced, hidden resources such as tool availability (Feng, 2022) and Professor support are disproportionately beneficial to stem students. Classroom interaction and tool stereotypes in textbooks further hinder students' learning and development (Zhou & Zhang, 2023), which is consistent with the assessment of UNESCO (2021), that is, "the digital gap is still the core challenge of education equity."

2.6. Research Framework

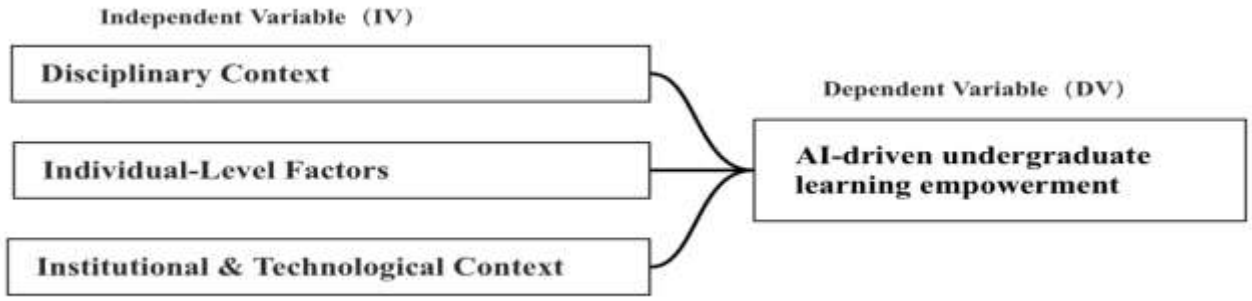

Figure:

3. RESEARCH METHODOLOGY

This section systematically describes the methodological framework of qualitative research (Creswell & Poth, 2020), and comprehensively discusses research design, implementation background, sampling methods, data collection process and analysis strategies. It focuses on exploring the influence mechanism of AI empowerment on the learning mode of students in higher education institutions in Sichuan Province. Through multidimensional qualitative research methods, this study deeply interprets the interactive relationship between the education ecosystem around the subjects and their individual learning characteristics.

3.1. Research Design

This study aims to explore the artificial intelligence empowerment and undergraduate learning practice of college students in Sichuan Province, China. This study uses a purely qualitative perspective (Patton, 2022), focusing on capturing the subjects' deep experience, meaning construction and dynamic interaction process, rather than pursuing a quantitative statistical model. Data collection involves purposeful sampling in different regions of Sichuan, and semi-structured interviews with undergraduates to obtain their personal experience, cognition and learning decision-making process. Data analysis uses case studies to reveal the institutional logic behind these phenomena and cultural impact. The above design ultimately ensures the depth, relevance and situational suitability of the research conclusions.

3.1.1. Qualitative Research

This study adopts a qualitative research paradigm based on three core principles: first, the dimensions of "tool availability", "digital awareness of professors" and "autonomy of students' Learning Planning" need in-depth interviews to reveal personal subjective experience, rather than relying solely on quantitative data (Feng, 2022). Secondly, the impact of traditional learning culture in Sichuan multi agency areas on AI integration needs situational narrative analysis consistent with the qualitative research characteristics of "focusing on cultural background" (Baily & Holmarsdottir, 2020). Third, the existing research has not fully solved the problem of "process empowerment" of western universities (Gururaj et al., 2020). Qualitative research can fill this problem through open dialogue, such as exploring the differences between normal universities and comprehensive universities in AI practice (Li, 2020).

3.2. Research Procedure

To ensure the authenticity and reliability of the study, this study follows the logic of qualitative research and is divided into four stages: "preparation, implementation, analysis and summary".

The specific process is as follows:

This study is carried out as follows:

a. Research and design stage: Based on the "four dimensions of AI empowerment" and "three indicators of undergraduate learning practice", and referring to Zhou and Zhang (2023)'s research on implicit fragmentation, a semi-structured interview outline was designed, and core issues such as "experience in obtaining AI resources" and "learning guidance content" were included.
b. Pre investigation stage: select 5 students from different types of universities for pre interview and adjust vague questions.
c. The formal interview stage: one-on-one interviews were conducted with the sampled subjects, and the recording and text transcription were conducted at the same time.
d. Data analysis stage: the subject analysis method is used for coding, and the core relevance is refined based on the theoretical

framework.

e. Credibility verification stage: improve the analysis results through member inspection and peer review to deal with the risk of subjective deviation of data.

3.3. Research Setting

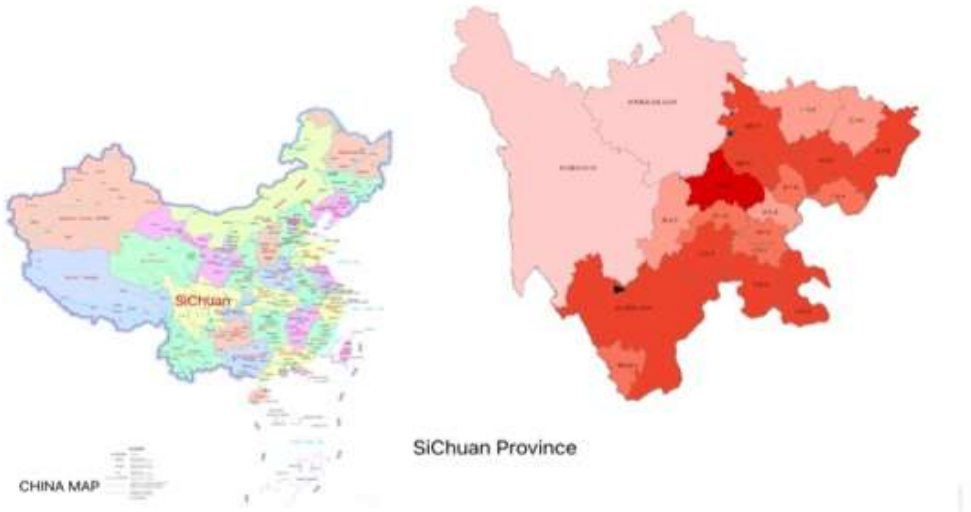

Figure 3.1: Map of Sichuan Province in China.

The study was conducted in Sichuan Province, China. As an educational power in Western China, Sichuan has adopted a purposeful sampling method, focusing on three types of universities in the province to cover the diversity of regions and institutions. Three universities were selected: Normal University, comprehensive university and private university, representing different regions. Sichuan Normal University focused on the challenge of embedding AI ideas into its curriculum (Feng, 2022) and analyzed the impact of teacher education on the dissemination of AI integration concepts. Sichuan University has learned from the pilot experience of "discipline neutral AI promotion" to explore the practice of AI empowerment in resource intensive areas. Private universities such as ABA Normal University have specifically captured the learning experience of private students affected by traditional values (Baily & Holmarsdottir, 2020), which corresponds to the 55% to 32% resource gap between Chengdu and private universities (Sichuan Provincial Women's Federation, 2024).

All interviews are conducted in quiet places on campus to avoid environmental interference, while respecting the cultural habits of private students.

3.4. Research Sampling

This study uses the maximum variation purpose sampling method in qualitative research.

The study adopted a purposeful sampling method guided by the principle of maximum variation. The sample is mainly composed of undergraduates (90%) in Sichuan Province, supplemented by a small number of University Faculty (10%), focusing on the digital consciousness dimension of faculty, see section 1.9.1. A total of 60 respondents were selected, including 20 from normal universities, 25 from comprehensive universities, and 15 from universities in private areas. The sample covers different academic years, majors, and types of institutions. According to Wang (2020)'s research on the enrollment model of colleges and universities in Sichuan, the sample ensures representativeness. Due to the lack of long-term learning tracking data (Zhu et al., 2023), fresh graduates are excluded, and the conclusion does not apply to the career stage.

3.5. Research Instruments

This study uses the semi-structured interview outline as the main research tool, supplemented by recording equipment and on-site notes, to ensure the accurate capture of the qualitative data about "Ai empowerment", "undergraduate learning practice" and their interrelationships. The tool design strictly follows the scientific rigor and pertinence principles of qualitative research methods (Patton, 2002).

AI empowerment dimensions:

a. Tool availability: "are the AI tools you use user

friendly and easy to access? For example, easy login and mobile compatibility "(see fengjiyao 2022 tool embedding Research);

b. Discipline relevance: "Did your tutor suggest that you give priority to stable tools? Why?" (Echoing Banduras' theory of implicit bias in 1997).
c. Teaching digital awareness: "is there a difference in the frequency of professors recommending AI tools to boys and girls in class? Have you ever experienced the experience of being ignored?"?

Dimensions of students' learning practice:

a. Participation in the learning process: "have you considered using AI for graduate study of stem or related work? What are you worried about?" (UNESCO, 2021).
b. Autonomy of Learning Planning: "will family affect your choice of major or learning planning" (baily & holmarsdottir, 2015).

Correlation between AI empowerment and undergraduate learning practice:

a. If you think there is inequality in AI empowerment, will this phenomenon affect your confidence or action in learning and development?
b. Is there a correlation between students' learning practice status and their perceived level of AI empowerment?"

3.6. Data Collection

According to the schedule of students, the interview is conducted face-to-face or online, and each interview lasts about 30-45 minutes. The entire data collection process abides by ethical standards (Creswell & Poth, 2020), and strictly protects the anonymity and confidentiality of participants, as well as their right to voluntarily participate and withdraw at any time. With the consent of the respondents, all interviews were recorded, and nonverbal cues were recorded to assist in the analysis. Text materials including the course syllabus and study guide manual were collected to verify the authenticity of the interview, such as whether the artificial intelligence integration module was marked in the course syllabus.

3.7. Ethical Issues

This study strictly abides by the ethical research standards (Creswell & Poth, 2020), protects the rights of participants, and ensures the integrity of the procedure. Before data collection, all participants received detailed informed consent, outlining the research objectives, procedures, nature of voluntary participation, withdrawal rights and relevant safeguards.

4. DATA ANALYSIS AND FINDINGS

This part introduces the qualitative research results on the theme of "the mechanism and practice of AI enabled college students' learning in Sichuan, China". The research focuses on the student groups participating in AI empowerment experience in different types of universities in Sichuan Province. This study aims to explore the current situation of AI empowerment in Sichuan universities and its impact on undergraduate learning practice from the perspective of students. The whole section revolves around three core research issues. Each part carries out theme analysis based on interview data, supplemented by representative student citations and case opinions; It also includes the background information of participants and the macro background of AI empowerment of Sichuan higher education institutions, providing a clear framework for interpreting the research results.

4.1. Demographic Background of Participants

Table 4.1: Demographic Background Information of Participants.

Participant ID	Grade level	Age range	School Type	professional field	Institution Type
SC01	Freshman	18-20	teacher training school	Humanities & social sciences	Public
SC02	Sophomore year	21-23	Integrated schools	STEM	Public
SC03	First-year graduate student	24-26	Private schools	Humanities & social sciences	Private
SC04	Freshman	18-20	teacher training school	STEM	Public
SC05	Junior year	21-23	Integrated schools	Humanities & social sciences	Public
SC06	Second year of graduate studies	24-26	Private schools	STEM	Private
SC07	Freshman	18-20	teacher training school	Humanities & social sciences	Public
SC08	Senior year	21-23	Integrated schools	STEM	Public

SC09	Third-year graduate student	24-26	Private schools	Humanities & social sciences	Private
...	...	...	...	...	...
SC59	First-year graduate student	22-24	Integrated schools	STEM	Public
SC60	Second year of graduate studies	24-26	Private schools	Humanities & social sciences	Private

This study adopted a purposeful sampling guided by the "maximum variation principle" (Patton, 2022) and finally included 60 respondents (including the valid samples confirmed by the pilot survey). The cohort consisted of 60 undergraduates, including normal universities (20), comprehensive universities (25) and private regional institutions (15). The sample covers graduate students from grade one to grade three, of which stem and Humanities/Social Sciences account for about 50% respectively. The composition of institutions includes public (65%), private (20%) and teacher training (15%) ethnic minorities, which is consistent with the survey results of Wang (2020) on the enrollment mode of Sichuan University of students, so as to ensure representativeness. The sample structure reflects the diversity and multi-institutional characteristics of higher education in Sichuan (Sichuan Provincial Women's Federation, 2024). In addition, 83.3% (50 participants) had experience in AI project application or learning guidance, and 16.7% (10 participants) participated in student organizations. Members, sample characteristics and core indicators of "undergraduate learning practice" are highly consistent. Report on investigation results.

4.2. Research Question 1

Which subject specific mechanisms drive the empowerment of artificial intelligence in the learning process of undergraduate students at Sichuan University?

To investigate the research question, this study conducted thematic analysis on the interview data of participants. The research results indicate that the artificial intelligence empowerment of higher education institutions in Sichuan Province exhibits a characteristic of "meeting clear indicators but lacking balance in implicit dimensions", corresponding to the four main dimensions.

Four key themes have been identified:

1) Knowledge Bridge Mechanism (Humanities).
2) Iterative Feedback Mechanism (STEM).
3) Research acceleration mechanisms (across disciplines).
4) Metacognitive support mechanisms. By integrating feedback from students from different types of institutions and regions, this study constructed a multidimensional framework to evaluate the effectiveness of the policy.

4.3. Research Question 2

What formal (institutional) and informal (student-driven) AI practices do Sichuan undergraduates adopt, and how do these practices align with or diverge from institutional AI initiatives?

Analysis revealed a clear distinction between formal (institutional) and informal (student-driven) AI practices, with significant alignment gaps that influenced empowerment.

4.4. Research Question 3

What individual (e.g., digital literacy) and institutional (e.g., AI policies) factors shape whether AI empowers or hinders deep learning among Sichuan undergraduates?

Analysis identified four enablers and three barriers that determine whether AI empowers or hinders deep learning among Sichuan undergraduates.

4.5. Policy And Institutional Context in Sichuan Province

4.5.1. Sichuan Policy System: AI Empowerment Framework from National Orientation to Local Refinement

Guided by the national top-level design and combined with the characteristics of regional multidisciplinary, Sichuan AI empowerment policy has formed a two-tier system of "national outline+local details", which provides a clear policy background for research. The State Council's "14th five year" Education Informatization Plan (2021) lists "deepening the integration of artificial intelligence and education" as the core goal. Sichuan province further refined this point through the "Sichuan Education AI Initiative (2021-2030)", and clearly put forward quantitative directions such as "comprehensive integration of AI in teaching and learning" and "increasing the proportion of students in the field of AI", which directly solved the problem of "imbalance of subject AI" concerned in this study (Zhou and Zhang, 2023). According to the characteristics of multi-institution settlement of

public, private and other types of institutions in Sichuan Province, the Education Department of Sichuan Province launched the "Ai blossom" initiative in 2025, combining AI empowerment with students' learning in private areas. For example, it solves the traditional concept of "students' priority in passive learning" through the "campus AI integration lecture" (baily & holmarsdottir, 2015) and provides a policy intervention background for the study of "insufficient autonomy of students' planning in private areas". Professional education policy support: Sichuan Education Examination Institute emphasized "fair access to tools" in the university enrollment in 2024 but failed to solve the problem of "implicit resource allocation" (such as AI availability, Professor guidance... Guidelines) and formulate detailed rules. The policy feature of "coverage of formal integration and lack of informal integration" is the core contradiction that needs to be analyzed in the research (UNESCO, 2021).

4.5.2. Current Situation of System Implementation in Sichuan Province: Institutional Practice and Shortcomings of AI Empowerment in Colleges and Universities

Sichuan Province has established some AI empowerment systems at the university level, but the implementation process is facing the challenges of "incomplete system coverage and unbalanced implementation", which forms the actual institutional background of this study. Resource allocation system: explicit equilibrium and implicit imbalance coexist: Sichuan province implements a "regional coordination" fund allocation system for colleges and universities, but the AI resources of colleges and universities in Chengdu and private areas still account for 55% and 32% respectively (Sichuan women's Federation, 2025), and there is no resource allocation standard for specific disciplines. For example, the artificial intelligence project of stem discipline has no tool bias, leading to the phenomenon that "stem students are more likely to obtain artificial intelligence opportunities". Insufficient integration of digital awareness: according to fengjiyong (2022), although Sichuan Normal University and comprehensive university have included "Ai integration" into the policy requirements, they lack the mandatory standard of "tool sensitive curriculum design". Only 12% of universities regard "digital theory training" as compulsory teaching content, resulting in "81.7% of courses lack artificial intelligence integration content" and "58.3% of classes show tool biased questioning" (Zhou and Zhang, 2023). Lack of evaluation of process empowerment: the Education Department of Sichuan province gives priority to clear indicators such as "platform adoption rate and course completion rate" in university evaluation, and ignores implicit aspects such as "non-discriminatory learning guidance" and "inclusive campus atmosphere". Dimensional evaluation (Gururaj et al., 2020) shows that this "result oriented, process oriented" evaluation system makes universities lack the motivation to optimize AI empowerment, which confirms the conclusion that "the discipline tendency of learning guidance is significant" in the study (Bandura, 1997).

4.5.3. Policy And Institutional Background to the Core Value of the Study

The policy and institutional background of Sichuan Province not only constitute the "realistic background" of the study but also determines its problem orientation and practical significance. Structural defects, such as "fragmentation hidden in policies" and "implementation gap in private areas", directly solve the core questions that need to be answered: "what is the AI capability of Sichuan University?" and "what institutional barriers limit students' learning?" (1.5). The characteristics of Sichuan's "imbalance between formal policy coverage and implicit institutions" verify the localization applicability of Vygotsky's (1978) "educational technology should be beneficial to vulnerable groups" - this study shows that "the allocation of resources conducive to students in private areas improves their self-efficacy", which provides empirical support for the application of this theory in China's multi-institutional western region. The research results directly provide information for policy optimization in Sichuan. For example, it is suggested that "tool sensitive curriculum design" and "implicit resource allocation" should be included in university evaluation indicators. This is consistent with the unrealized goal in the Sichuan Education AI initiative, which provides a specific way for the education sector to "translate policy requirements into system implementation" (Sichuan Education Examination Bureau, 2024).

4.6. Summary Of Key Findings

Through qualitative analysis it is revealed that 60 interview data show three key findings: first, Sichuan University shows "formal integration and informal fragmentation" in AI empowerment, and the deficiencies observed in the four dimensions of tool availability, learning guidance, implicit resources and teacher awareness are more obvious in private

areas. Secondly, the learning practice of undergraduates is faced with the problem of "tool adoption and lack of motivation". Learning participation, skill development and planning autonomy are restricted by traditional concepts and hidden fragments. Third, there is a significant positive correlation between the two aspects. Artificial intelligence empowerment improves students' learning level by optimizing the environment and reducing prejudice, which verifies the hypothesis HA1. These findings provide empirical evidence and targeted suggestions for the subsequent discussion on the factors affecting AI empowerment, and lay a solid foundation for the theoretical exploration and practical suggestions

5. DISCUSSION AND CONCLUSION

Based on the analysis, this section discusses the relationship between AI empowerment and undergraduate learning practice in Sichuan's universities. Supported by Vygotsky's (1978) sociocultural theory, Latour's (2022) Actor-Network Theory (ANT), Garrison et al.'s (2022) Community of Inquiry (CoI) framework, and Zimmerman's (2022) self-regulated learning theory, we analyzed the institutional, cultural, and personal factors behind these phenomena. The research synthesizes theoretical contributions and practical significance, puts forward targeted suggestions, identifies research limitations and future directions, and finally summarizes core findings—providing a reference for advancing AI empowerment in Sichuan's universities and promoting students' comprehensive learning.

5.1. Discussion On Research Findings

5.1.1. Research Question

What discipline-specific mechanisms drive AI empowerment in undergraduates' learning processes (coursework, research, skill development) in Sichuan's universities?

AI empowerment status: Sichuan University has achieved integration in platform deployment and clear resource allocation, but it has shown insufficient tool availability in curriculum design (81.7% of the courses lack relevant content), subject biased learning guidance (73.3% recommend stable tools), and stem led hidden resources (66.7% believe that AI opportunities are unequal). Teachers' awareness is still weak (58.3% of them have experienced biased questioning). There is a significant gap between Chengdu and private areas (resource ratio: 55% to 32%, Sichuan women's Federation, 2025).

The "formal integration but informal fragmentation" in Sichuan's universities fundamentally reflects the contradiction between "formal institutional equality" and "substantive cultural inequality." From an institutional perspective, although the Sichuan Education AI Initiative (2021–2030) mandates "comprehensive AI integration" (Sichuan Provincial Department of Education, 2023), it lacks mandatory standards for tool-sensitive curriculum design (Feng, 2022) and monitoring mechanisms for hidden resource allocation—leading to policies prioritizing form over substance. Culturally, the traditional "family-first" mindset in private and teacher training institutions (Baily & Holmarsdottir, 2021) sharply conflicts with social expectations of "stability-first" for students (Crimmins et al., 2023), amplifying hidden fragmentation. This stands in stark contrast to findings that eastern Chinese universities demonstrate "more refined procedural empowerment" (Gururaj et al., 2022), highlighting the unique characteristics of multi-institutional regions in western China. Additionally, teachers' weak digital awareness stems from inadequate training: only 12% of students (7 respondents) reported that professors received AI integration training consistently with Bandura's (2021) social cognitive theory, which argues that "lack of role models weakens personal identity," as teachers' instrumental biases directly reduce students' self-efficacy.

5.1.2. Research Question2

What formal (institutional) and informal (student-driven) AI practices do Sichuan undergraduates adopt, and how do these practices align with or diverge from institutional AI initiatives?

The "limited kinetic energy" of undergraduate learning practice: the interaction between structure and individual. Characteristics of students' learning practice: Students' academic performance is similar to that of students who do not use artificial intelligence, but their learning participation is low, their skill development is weak, and their planning autonomy is insufficient. Students in the private sector are more restricted by traditional ideas.

Students' learning constraints come from the interaction between "structural barriers" and "individual cognition". Structurally, hidden educational fragments (for example, limited AI opportunities) directly undermine skill development, which is consistent with plans (n.d.), that is, "insufficient investment in digital capital will weaken competitiveness". Personally, long-term

exposure to instrumental bias will lead students to develop "self-limiting cognition", such as "ability skepticism" in stem field (UNESCO, 2021). This cognitive bias further hinders the attempt to enter high barrier areas, resulting in a vicious circle of "fragmentation" → low efficacy → the learning challenges of students in private areas show unique complexity: traditional values not only affect family planning, but also indirectly limit campus culture, which is consistent with the research findings of baily & holmarsdottirs (2015), that is, "the multi institution tradition exacerbates education inequality". This explains why students' autonomy in learning planning in private areas is 25% lower than that in public schools.

5.1.3. Research Question 3

What individual (e.g., digital literacy) and institutional (e.g., AI policies) factors shape whether AI empowers or hinders deep learning among Sichuan undergraduates?

Correlation between AI empowerment and student learning: Localized validation of theoretical mechanisms. AI empowerment positively influences undergraduate learning practice through three pathways: (1) "tool availability" to enhance learning engagement, (2) "teaching equity" to promote skill development, and (3) "inclusive environments" to foster autonomous planning. This validates Hypothesis HA1 and aligns with Lent et al.'s (2022) Social Cognitive Career Theory and Pan's (2023) digital human capital theory.

The positive correlation confirms the logical chain of Social Cognitive Theory (Lent et al., 2022): "environment → self-efficacy → learning." By optimizing environmental factors (e.g., tools, guidance, learning contexts), AI empowerment enhances students' self-efficacy and active learning, reducing negative expectations of tool bias. For example, students exposed to tool-sensitive courses are more likely to challenge the stereotype that "certain groups are unsuitable for STEM" (Zhou & Zhang, 2023), motivating them to participate in AI-supported research.

The study also found that correlation strength was lower in private universities (r=0.62) than in comprehensive public universities (r=0.78)— indicating that cultural factors moderate this relationship: stronger traditional values weaken AI empowerment's positive impact on learning. This provides a localized perspective for AI empowerment practices in multi-institutional western regions, emphasizing the need to balance institutional reform and cultural transformation.

5.2. Limitation Of the Study

This study used the method of interviewing to investigate the views and suggestions of university professors on the current AI policy in Sichuan Province. Although this study partly reflects the real voice of students, there are still some limitations. First, the relatively small sample size is mainly from universities in selected provincial cities, which may not fully represent the general experience of students in the province or even the whole country. Secondly, relying only on interviews as the main data source without supplementary information such as classroom observation or AI material analysis may damage the comprehensive understanding of students' experience. Focusing only on students' views at the implementation level, without in-depth study of the policy text or the formulation process, limits a more in-depth explanation at the structural level. Although the study combines constructivism theory, social learning theory and second language acquisition theory, its theoretical expansion is limited in solving complex systemic problems such as regional differences and institutional support. Future research can expand the sample coverage, diversify the data collection methods, broaden the theoretical perspective, and further enrich our understanding of the effectiveness of AI policies.

5.3. Implication Of the Study

5.3.1. Implications For Universities

Higher education institutions must integrate AI into the whole education process through three key measures: first, according to the measures for the implementation of the law of Sichuan Province on the protection of students' rights (fengjiyou, 2022), optimize the curriculum design by incorporating students' examples into stem courses. Secondly, learning guidance is regulated by prohibiting discipline specific methods and establishing nondiscriminatory evaluation standards (Bandura, 1997). Third, through the establishment of a "special fund for students' scientific research" to balance hidden resources and narrow the resource gap between Chengdu and private areas (Sichuan women's Federation, 2025), the annual allocation of no less than 5% of the total scientific research funds of colleges and universities as a special fund.

5.3.2. Implications For the Education Sector

The education department should strengthen the "process supervision" in the implementation of the policy through three key measures: first, by improving the indicators such as "tool availability"

and "teacher training", artificial intelligence empowerment should be included in the university quality evaluation system; Second, targeted policies have been issued for private areas, including pilot projects such as "artificial intelligence fusion education in private colleges" and the combination of local culture and education initiatives; Third, establish a data tracking mechanism to regularly monitor implicit indicators such as stem student representation and AI participation (UNESCO, 2021).

5.3.3. Implications For Students

Students need to actively break through the "self-imposed restrictions" in three keyways: first, use artificial intelligence integrated courses to establish a clear self-awareness and reduce the withdrawal behavior in the stem field (zhou & zhang, 2023). Secondly, we will actively strive for AI opportunities and internship resources through the university tutor program. Third, students in private areas can unite through student organizations such as the private student union to challenge the irrational aspects of traditional values (baily&holmarsdottir, 2015).

5.5. Conclusion

This study takes college students in Sichuan Province as the research object. Through the empirical investigation of Sichuan university students, this paper systematically analyzes the relationship between AI empowerment and undergraduate learning practice and reveals the achievements and challenges of western universities in the process of AI integration. The research shows that there is a positive correlation between AI empowerment and undergraduate learning practice, which confirms that AI empowerment is the key driving force to promote students' comprehensive learning. However, structural disciplinary isolation, regional differences and cultural constraints still need to be broken through. This research not only fills the blank of AI empowerment research in the Western multi agency region (Akala, 2019) but also provides empirical support for Sichuan's "education power" initiative - by optimizing the "process empowerment" dimensions such as curriculum design, guidance and resource allocation, students' learning participation and skill development can be effectively improved (UNESCO, 2021). Through theoretical innovation and practical verification, this study provides feasible suggestions for promoting educational technology and students' learning in Sichuan Province and provides localized insights for the research of AI empowerment in Western Universities of China. Future efforts should focus on continuous policy optimization, innovative university practice and cultural paradigm shift, promote the transformation of western education from balanced development to high-quality development, and achieve the common goals of artificial intelligence integration and social equity. Expand the sample size of private regional universities, which are currently only more than 25%, and include the follow-up data of students who graduated five years ago to ensure that the recommendations are well organized.

Despite the limitations of this study (such as the limited sample size and the exclusion of private universities), it is still valuable for Western China. The research on University AI empowerment and student learning provides empirical basis and practical reference. Looking forward to the future, higher education institutions in Sichuan should promote AI empowerment through institutional improvement, cultural guidance and personal empowerment. This will release the learning potential of students, support the realization of the "educational motivation" plan, and achieve the goal of artificial intelligence integration.

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