Influencing Factors and the Generation Mechanism of Digital Empowerment College Students' Autonomous Learning Ability in Dancesport

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Abstract: This study grounded in social cognitive theory and the technology acceptance model, developed a three-dimensional framework of influencing factors encompassing technology, learner, and environment. A structural equation model was employed to investigate and analyze data collected from 240 dancesport students across five universities. The study found that college students' autonomous learning ability in dancesport was rated at an upper-middle level (M=3.42), with a notable weakness in self-planning skills. The quality of digital teaching resources (β=0.31, $p<0.001$), students' digital literacy (β=0.29, $p<0.001$), and adaptability of tool functions (β=0.21, $p<0.01$) all had significant positive effects on students' autonomous learning ability. Additionally, self-efficacy played a crucial intermediary role in this relationship. The direct effect of teachers' digital teaching ability is not significant, but it has an important indirect impact through the construction of a supportive environment. The research further reveals the three-stage mechanism of resource activation, psychological drive, and behavior generation of digital-enabled autonomous learning ability, and puts forward three-dimensional improvement paths of technology, learners, and environment. This study provides a theoretical basis and practical reference for the digital reform of dancesport education.

Keywords: Digital empowerment; dancesport ; autonomous learning ability; self-efficacy; generative mechanism

1. Introduction

In the third decade of the 21st century, digital technology is fundamentally transforming the landscape of global higher education like never before. The rapid advancements in artificial intelligence, big data, virtual reality (VR), augmented reality (AR), motion capture, and other technologies have made digital survival a reality rather than a mere prediction. This digital transformation in education has become a strategic priority for countries around the world. The United Nations Educational, Scientific, and Cultural Organization (UNESCO) has emphasized in its strategic framework for digital education that digital technology is not just a teaching tool, it is also a key driver in reshaping the education ecosystem and enhancing the equity and quality of education. The Organization for Economic Cooperation and Development (OECD) highlighted in its report "Education Policy Outlook 2025" that rapid digitalization and demographic shifts are transforming how, when, and why people learn. Countries must enhance learners' agency, enabling them to actively identify, acquire, and apply new knowledge and skills in various contexts. The OECD also noted that artificial intelligence (AI) is leading to a new form of learning that is more personalized and autonomous. Students are increasingly viewing AI tools as intelligent tutors that can explain complex concepts and recommend targeted exercises. Driven by this global trend, the teaching mode of higher education institutions is undergoing a profound transformation from teacher-centered, classroom-centered, and textbook-centered to student-centered, autonomous, and personalized. The online learning market is expected to reach $58.45 billion in global revenue in 2024, and the number of users is expected to grow to 1billion in 2028 [1]. In this wave, the cultivation of students' autonomous learning abiliy and digital literacy has risen from the advocacy of educational philosophy to the core goal of talent cultivation. As the OECD Education 2030 project emphasizes, future education must be committed to cultivating lifelong learners who can move forward independently and act purposefully.

Dance teaching, which focuses on physical practice while integrating artistic expression and technical standards, has traditionally relied on the oral and personal teaching method. This approach heavily depends on teachers demonstrating movements in person and providing immediate feedback. However, this reliance on physical presence and real-time interaction presents both unique challenges and significant opportunities for innovation in the context of digital transformation in dance education. Coelho and Menon (2024) examined a sample of 215 online dance learners from eight cities in India using the Unified Theory of Acceptance and Use of Technology (UTAUT) framework [2]. Their analysis revealed that factors such as performance expectations, effort expectations, social influence, convenience, and technical self-efficacy significantly affect the adoption of e-learning in dance education. It is worth noting that this study did not find significant differences in the willingness of distance learning among socio-demographic characteristics such as gender, age, and dance experience. This finding suggests that the accessibility and ease of use of digital technology may determine the effectiveness of digital learning more than individual characteristics of learners. At the level of teaching methods, the application of blended learning in dance education has attracted extensive attention.

A quasi-experimental study on modern dance education in Chinese colleges and universities found that the improvement of students' dance performance (η^2=0.24) and intrinsic motivation in the mixed teaching group was significantly better than that in the traditional face-to-face teaching group, and the decline of non-motivation was more obvious [3]. The researcher explained this finding under the framework of self-determination theory and believed that blended learning effectively stimulated intrinsic motivation by meeting students' needs of autonomy, competence, and belonging. The study further points out that blended learning can enhance technical proficiency, participation, and autonomous learning in creative performing arts disciplines (such as modern dance) [3]. The integration of motion capture and artificial intelligence technologies at the technical tool level has created new opportunities for autonomous learning in dance. Esaki and Nagao (2024) developed a set of autonomous dance training systems based on VR technology [4]. This system employs unmarked motion capture technology to record dances' movements in real time and map them onto VR avatars. Additionally, it uses deep learning to evaluate dance performances from multiple perspectives and provide feedback to users. The reference guidance model of the system can predict scores given by professional coaches with an accuracy of about ±1 point on a 10-point scale. Wang et al. (2026) introduced an intelligent dance motion recognition and correction system that integrates 3D motion capture with a spatiotemporal attention map convolutional network [5]. This system achieved a recognition accuracy of 92.3% on a dataset of 10,836 video clips covering 86 motion categories across five dance types. User research shows that learners who get feedback acquire skills significantly faster than the control group. Miko et al. (2025) systematically reviewed the research on the application of 17 focused pose estimation and deep learning models in the field of dance and motion learning, and pointed out that motion-based AI processing can realize the positioning and recognition of the human body and body parts in image media, providing a technical basis for motion feedback in dance teaching [1]. In the field of augmented reality and virtual reality, Han et al. (2025) proposed the afferdance system, a personalized dance learning system based on AR, which can convert the dance video selected by the user into an interactive learning experience and guide the action execution by integrating a 3D reference avatar, audio synchronization, and adaptive visual prompts [6]. The system faces the limitations of traditional dance teaching, such as fixed time and place, being unable to carry out personalized learning based on individual level, and bottlenecks such as the lag in the production of online self-learning content, and the unavailability of specific learning materials. These technological advances show that digital tools are moving from auxiliary roles to enabling roles, providing unprecedented technical support for the autonomy, personalization, and accuracy of dance learning.

While the existing research offers a comprehensive empirical foundation and theoretical insight into the use of digital technology in dance education, it falls short in thoroughly exploring the core mechanism by which digital empowerment fosters learners' ability to engage in autonomous learning. Most studies have concentrated on the willingness to adopt technology—often analyzed through frameworks like UTAUT—or on the effects of technology application, such as comparing blended learning with traditional teaching methods. However, there is a noticeable absence of systematic empirical research examining the pathways and psychological mechanisms that transform digital technology into enhanced autonomous learning capabilities. Furthermore, the investigation of how various influencing factors interact is inadequate. Current studies typically focus on a single dimension—be it technology, learners, or teachers—neglecting a holistic analysis of how these multidimensional factors interact and influence autonomous learning abilities through mediating variables. As Pavlou and Burke (2025) studied 94 art education teachers around the world, although teachers' acceptance of online technology is generally positive, there are still significant reservations in the teaching of Performing Arts (such as dance and drama), and technical difficulties and insufficient training are the main obstacles [7]. Based on the above research background and gap analysis, this study focuses on the following core issues: what is the current situation of college students' autonomous learning ability in dancesport in the context of digital empowerment? What factors affect the formation of this ability? How do these factors interact, and through what mechanism do they jointly generate autonomous learning ability?

2. Literature review and research hypothesis

2.1 Literature review

In the theoretical modeling of technology acceptance, the Technology Acceptance Model (TAM) and the Unified Theory of Acceptance and Use of Technology (UTAUT) are the two most influential frameworks for this study. TAM, proposed by Davis in 1989, suggests that an individual's willingness to adopt technology and their actual usage behavior are primarily driven by two factors: perceived usefulness and perceived ease of use. On the other hand, UTAUT, developed by Venkatesh and others, integrates elements from planned behavior theory, social cognition theory, and other theoretical frameworks. It expands on the factors influencing technology adoption by identifying four core dimensions: performance expectation, effort expectation, social influence, and facilitating conditions [8]. Both models are widely utilized in educational technology research and provide a solid theoretical foundation for this study, which aims to understand college students' willingness to adopt and use digital learning tools for dancesport. It is worth noting that some studies have begun to integrate Tam and autonomous learning theory. For example, based on constructivist learning theory, Dreyfus skill acquisition model, and TAM, some scholars have developed a dance training system based on Augmented Reality (AR), aiming to solve the long-standing problems of low learning retention rate and low learning efficiency in dance skill learning. Through the quantitative analysis of 86 subjects, this study found that the

selection of learning theory, learning environment, training tools, skill acquisition technology, and AR technology type together determines the learning effect and user acceptance of the dance training system. The research results provide empirical support for the application of AR systems in dance autonomous learning and confirm the generally accepted attitude of users in exploring cutting-edge technologies to acquire dance skills [9].

In terms of the theoretical construction of autonomous learning ability, the concepts of ternary interactive determinism and self-efficacy proposed by social cognitive theory constitute the core theoretical cornerstone for understanding the process of autonomous learning [10]. Bandura emphasized that the relationship among individual factors (cognition, emotion), behavior factors, and environmental factors is dynamic and interactive, and the sense of self-efficacy, that is, the individual's belief in whether they can complete a task, plays a key role in the mediation of motivation [10]. This theoretical framework provides an important analytical path for understanding the generation mechanism of autonomous learning ability in the digital enabling environment: digital technology, as an environmental factor, drives the generation and maintenance of students' autonomous learning behavior through the psychological intermediary of influencing students' self-efficacy. Self-determination theory (SDT), proposed by Deci and Ryan in 1985, provides another important theoretical perspective for understanding how digital technology can stimulate learning motivation [11]. The theory holds that when the learning environment can meet the individual's independent needs (having a sense of control over behavior), competency needs (obtaining a sense of achievement in activities), and belonging needs (obtaining recognition and interaction in the group), the individual's intrinsic motivation will be effectively stimulated. In the field of dance education, existing studies have examined the impact of blended learning on college students' modern dance performance and learning motivation under the SDT framework, and found that the improvement of students' dance performance and intrinsic motivation in the blended teaching group is significantly better than that in the traditional face-to-face teaching group, and the decline of extrinsic motivation is more obvious. Researchers believe that blended learning can effectively stimulate students' intrinsic motivation by meeting their needs of autonomy, competence, and belonging.

2.2 Research hypothesis and model construction

Based on literature review and theoretical analysis, this study proposes four core hypotheses and their sub-hypotheses, and constructs a research model mediated by self-efficacy.

H1: The characteristics of digital teaching resources have a significant impact on students' ability to learn autonomously. The ease of use and perceived usefulness of these resources (H1a) are essential for students to adopt technology successfully. This, in turn, can directly or indirectly promote autonomous learning by enhancing self-efficacy (H1b).

H2: Individual traits of learners significantly influence their ability to learn autonomously. A student's digital literacy (H2a) serves as the foundation for effectively utilizing resources, while self-efficacy (H2b) acts as a crucial psychological motivator driving their active engagement in learning.

H3: The functional adaptability of digital tools plays an important role in fostering autonomous learning. The extent to which tool functions match the needs of dancesport learning—such as action feedback and correction suggestions (H3a)—directly impacts both the learning experience and outcomes, thereby boosting students' confidence in mastering the material (H3b).

H4: Teachers' digital teaching skills indirectly affect students' autonomous learning abilities by creating an appropriate environment. While the direct impact (H4a) of a teacher's abilities on a student's autonomous learning may not be significant, the indirect effect of fostering a supportive environment and enhancing students' self-efficacy (H4b) is vital.

3. Methods

In this study, the stratified cluster sampling method was used to select five comprehensive, normal, and sports colleges in Central China, and the freshmen to senior students in the dancesport elective class were investigated. The research adopts the self-compiled questionnaire of college students' digital autonomous learning of dancesport. The questionnaire consists of three parts: basic information, dancesport Autonomous Learning Ability Scale (12 questions, including three dimensions of self-planning, monitoring, and evaluation), and the influencing factors scale (including the quality of digital resources, students' digital literacy, tool function adaptability, teachers' digital teaching ability, self-efficacy, and other dimensions, a total of 28 questions). All the scales were scored with a five-point Likert scale. Through the pre-survey (n=85) test, the overall Cronbach's α coefficient of the questionnaire is 0.905, and the α coefficient of each dimension is between 0.82 and 0.89. The factor structure extracted by exploratory factor analysis is consistent with the theoretical conception, and the cumulative variance interpretation rate is 72.3%, indicating that the reliability and validity of the questionnaire are good. SPSS 27.0 was used for descriptive statistics and one-way ANOVA, and AMOS 24.0 was used to construct a structural equation model (SEM) for path analysis and mediation effect test.

4. Results and discussion

In this study, a stratified sampling method was employed to distribute questionnaires to students enrolled in dancesport elective classes across five colleges and universities, which included comprehensive, normal, and specialized sports

institutions nationwide. A total of 280 questionnaires were distributed, and all 280 were returned. After excluding invalid responses, 240 valid questionnaires were considered, resulting in an effective response rate of 85.7%. The sample's basic demographic information is as follows: there were 112 boys (46.7%) and 128 girls (53.3%). The distribution of class standings among respondents was as follows: 10.42% freshmen, 32.5% sophomores, 39.16% juniors, and 17.92% seniors. Additionally, 76.67% of the participants reported having studied dance for more than three years. The detailed demographic information is presented in Table 1.

Table 1 Sample basic information distribution (n=240)

Variable	Category	Number	Percentage
Gender	Male	112	46.67
	Female	128	53.33
Grade	Freshman	25	10.42
	Sophomore	78	32.5
	Junior	94	39.16
	Senior	43	17.92
School type	Comprehensive University	31	12.92
	Normal University	59	24.58
	Sports Colleges	150	62.5
Years of study in dancesport	Less than 1 year	8	3.33
	1-2 years	16	6.67
	2-3 years	32	13.33
	More than 3 years	184	76.67
Weekly autonomous practice duration	Less than 1 hour	27	11.25
	1-3 hours	68	28.34
	3-5 hours	104	43.33
	More than 5 hours	41	17.08

4.1 Current situation of autonomous learning ability

The survey shows that the overall score of college students' autonomous learning ability in dancesport was 3.42 (SD=0.85), which is above the medium level. The scores of each dimension from high to low were: self-evaluation ability (M=3.58), self-monitoring ability (M=3.45), and self-planning ability (M=3.24). One-way ANOVA showed that students in different grades ($f=7.15$, $p<0.001$) and years of study ($f=9.02$, $p<0.001$) had significant differences in autonomous learning ability, and higher grades and long-term students had stronger ability. There was no significant gender difference ($t=-1.86$, $p>0.05$).

4.2 Analysis of influencing factors

According to the survey results regarding students' use of digital tools and resources, the utilization rate of short video platforms (such as Bilibili and Douyin) is the highest, with 78.5% of students frequently using them. In contrast, the utilization rates for professional AI motion feedback systems (22.8%) and VR/AR equipment (9.6%) are considerably lower. The use of video resources is significantly greater, with 83.2% of students frequently engaging with short teaching videos, compared to only 45.1% using graphic resources and 18.7% using interactive resources. Regarding teachers' digital teaching abilities, the results indicate that a majority of teachers use WeChat groups (84.5%) and multimedia courseware (73.2%). However, the percentage of teachers utilizing video playback for analysis (46.5%) and AI tools to assist in teaching (10.2%) was notably low. Additionally, when it comes to the perception of the learning environment, students express high levels of satisfaction with the multimedia dance classroom (mean score of 3.88) and the campus network (mean score of 3.62). Conversely, satisfaction levels regarding high-end equipment, such as smart mirrors and motion capture systems, were low, with a mean score of only 2.85.

4.3 SEM and hypothesis testing

The structural equation model fitting results of this study are: $\chi^2/DF=2.31$, GFI=0.918, CFI=0.942, RMSEA=0.055, SRMR=0.047, and the overall fitting is good. The path analysis results are shown in Table 2. This study found that

college students' overall self-learning ability in dancesport was above average, but their self-planning skills were notably weak, which aligns with findings from previous research [12]. Students in higher grades and those with longer study durations demonstrated stronger self-learning abilities, confirming the positive impact of accumulated learning experience. The use of digital technology showed a pattern of high popularity but low depth. While students frequently utilize popular tools such as short videos, the rate of usage for more specialized and advanced tools remains very low. This situation highlights the significant potential for technology to enhance learning but also reveals a gap between the available technological tools and the actual needs of subject learning. Furthermore, teachers' digital competencies exhibit a structural imbalance, characterized by strong basic communication skills but weak abilities in deep teaching techniques.

Table 2 Path coefficient and hypothesis test of SEM

Hypothesis	Path	Standardized path coefficient (β)	S.E.	C.R.	p value	Results
H1a	digital resource quality → autonomous learning ability	0.21**	0.063	3.09	0.002	Supported
H1b	digital resource quality → self-efficacy	0.27***	0.060	4.50	<0.001	Supported
H2a	Students' digital literacy → autonomous learning ability	0.29***	0.065	4.43	<0.001	Supported
H2b	Students' digital literacy → self efficacy	0.31***	0.062	5.00	<0.001	Supported
H3a	Tool function adaptability → autonomous learning ability	0.19**	0.071	2.68	0.007	Supported
H3b	Tool function adaptability → self-efficacy	0.25**	0.065	3.86	<0.001	Supported
H4a	Teachers' digital ability → autonomous learning ability	0.10	0.070	1.43	0.153	Not supported
H4b	Teachers' digital ability → self efficacy	0.21**	0.063	3.36	<0.001	Supported
	Self efficacy → autonomous learning ability	0.37***	0.072	5.14	<0.001	

**p < 0.01, ***p < 0.001

At the same time, the mediating effect test showed that self-efficacy played a significant role in mediating the effects of digital resource quality (indirect effect=0.10, p<0.01), digital literacy (indirect effect=0.11, p<0.001), tool adaptability (indirect effect=0.09, p<0.01), and teachers' digital ability (indirect effect=0.08, p<0.01) on autonomous learning ability. On the other hand, the SEM verifies the core assumptions of this study and systematically reveals the core generation logic of digitally enabled autonomous learning ability. First, multidimensional factors constitute the enabling basis. Research has confirmed that students' digital literacy (total effect 0.40) is the most influential factor on autonomous learning ability, and it is the core processor that transforms external technical resources into internal capabilities. As a key external driving force, the quality of digital resources and the adaptability of tool functions depend on students' internal quality and psychological state [13]. Second, self-efficacy plays an vital role. All external factors (e.g., resources, tools, teachers) indirectly promote autonomous learning ability by significantly improving students' self-efficacy. This shows that the empowerment of technology is not the direct "infusion" ability, but by enhancing students' sense of mastery and success expectations, stimulating their intrinsic motivation of active planning, persistent practice, and reflective evaluation, to generate ability in behavior practice. The activation of psychological motivation is the key switch for empowerment to take effect. Third, the transformation and hidden value of teachers' roles. The direct effect of on teachers' digital teaching ability is not significant, but its indirect effect through self-efficacy is significant. This profoundly reveals that in the digital environment, the role of teachers should be transformed from a knowledge imparter to an enabling guide. The core value of teachers is no longer to directly instill knowledge, but to enhance students' confidence through a carefully designed digital learning environment, personalized guidance, and emotional support. This influence is recessive and powerful.

5. Conclusion

This study draws the following conclusions through empirical analysis: (1) college students' autonomous learning ability of dancesport is in the upper middle level, self-planning ability is the biggest weakness, and there are significant

differences in grades and learning years. (2) The quality of digital resources, students' digital literacy, and the adaptability of tool functions are the core driving factors to improve autonomous learning ability, in which self-efficacy plays a key intermediary role. (3) The direct empowerment of teachers' digital teaching ability is limited, but its indirect effect is significant through the construction of a supportive environment and the improvement of students' psychological motivation. (4) The core mechanism of digital empowerment is to activate students' internal psychological motivation (self-efficacy) through external support, to drive continuous autonomous learning behavior, and finally generate and consolidate ability.

However, this study also has some limitations, mainly including that the sample is mainly concentrated in the central region, which can be expanded to the national scope for regional comparison in the future. As a cross-sectional study, longitudinal tracking design can be adopted in the future to more accurately reveal the dynamic evolution process of capability generation. It is an important direction of future research that we have not explored the path of differentiated empowerment of students with different learning styles.

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Data Sharing Agreement

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

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