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The 325-Teaching Model: Enhancing High School Students' Physics Skills and Learning Satisfaction

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Abstract
High school physics education often faces challenges such as students' weak practical skills and low learning satisfaction, which hinder the achievement of core competency training goals. This study aims to explore the impact of the 325-Teaching Model (integrating 30% independent learning, 20% practice feedback, and 50% experimental practice) on high school students' physics skills and learning satisfaction. The research was conducted at Shengjing Middle School in Fuyuan County, Yunnan, China, with 33 Grade 10 students as participants who received one semester of 325-Teaching Model based physics instruction. A 13-item 5-point Likert questionnaire was adopted for data collection, and descriptive statistical analysis (frequency , percentage and t-test) was conducted using SPSS 26.0. The results show that the 325-Teaching Model significantly improves students' core physics skills, including conceptual sorting, formula application, experimental design, and practical problem-solving. Meanwhile, it effectively enhances students' learning satisfaction, with most students gaining pleasure and a strong sense of achievement, and showing high willingness to participate in and recommend the model. Future research can expand the sample size with random sampling and conduct longitudinal follow-up studies to further verify the model's long-term effectiveness.
Keywords: 325-Teaching Model, Physics Skills, Learning Satisfaction, High School Student, Physics Learning Ability

Introduction
In the context of global educational reform, cultivating students' core competencies has become the core goal of basic education, and physics, as a discipline integrating logic, practicality, and innovation, plays a vital role in cultivating high school students' scientific literacy and comprehensive abilities. However, traditional high school physics teaching is often dominated by teacher-centered lecturing, which emphasizes theoretical indoctrination but neglects students' active participation and practical exploration (Belay, 2025). This teaching dilemma is further amplified in the context of China's new college entrance examination reform: based on the bibliometric analysis of 342 articles from the CNKI database

between 2016 and 2025 conducted by Qian et al. (2026), senior high school physics teaching faces multiple challenges including subject selection dilemmas and teaching model reconstruction, resulting in students' superficial understanding of physical concepts, weak ability to transfer and apply knowledge, insufficient learning motivation, and ultimately low overall learning efficacy and satisfaction. Concurrently, with the deepening of new engineering disciplines promotion in universities, Zhang, Zheng and Pan (2026) argue that traditional engineering education models are no longer able to meet the needs of technological innovation and industrial transformation, which in turn puts forward higher requirements for basic physics education—making it urgently necessary to adopt innovative teaching models that stimulate students' learning initiative, integrate knowledge learning with skill training, and improve learning satisfaction through enhanced practical and innovation literacy.

Against this background, the 325-Teaching Model, constructed based on constructivist learning theory and experiential learning theory, is proposed as a targeted solution to the aforementioned predicaments in physics teaching. It divides the teaching process into three core components: 30% independent learning, 20% practice feedback, and 50% experimental practice (Liu, 2020), and is supported by the theoretical framework of "Three Familiarizations", "Two Enhancements" and the "5-Step Teaching Method". This structured design aims to guide students to take the initiative in learning, consolidate knowledge through targeted practice, and enhance comprehensive skills through experimental exploration, thereby directly addressing the drawbacks of traditional teaching. While the model is theoretically expected to solve the current dilemmas in physics teaching, its specific empirical impact on students' physics learning ability (including sub-dimensions such as conceptual sorting, experimental design, and practical problem-solving) and learning satisfaction still needs in-depth verification. Existing studies on the 325-Teaching Model have initially shown its positive role in optimizing classroom interaction and improving learning participation, but there is a lack of targeted and systematic research on its impact on the multi-dimensional development of students' physics learning ability; similarly, although some studies have pointed out that innovative teaching models can stimulate students' learning motivation (Noroozi & Sahin, 2023), the specific mechanism and actual effect of the 325-Teaching Model on students' physics learning satisfaction remain unelaborated.

This study is committed to filling the above research gaps, and its novelty is reflected in two key aspects: first, it conducts a targeted empirical test on the 325-Teaching Model's impact on both the cognitive skill dimension (physics core skills) and affective dimension (learning satisfaction) of high school students, making up for the lack of comprehensive evaluation of the model in existing research; second, it constructs a dual theoretical analysis framework based on Revised Bloom's Taxonomy and Actor-Network Theory to interpret the model's effectiveness, realizing the combination of cognitive development theory and social network theory in the evaluation of science education teaching models. For the contribution to the social sciences, especially the field of educational science, this study first provides rigorous empirical evidence for the practical application of constructivist and experiential learning theories in high school physics teaching, enriching the empirical research literature of innovative teaching models in basic science education; second, it clarifies the micro-mechanism of how time allocation-based teaching models improve students' learning ability and satisfaction, providing a new research perspective for the optimization of instructional design in disciplinary education; third, it puts forward actionable implementation suggestions based on empirical results, which can serve as a practical reference for educational policymakers and front-line physics teachers to reform teaching models, and also lay a foundation for the cross-disciplinary application of the 325-Teaching Model in other science subjects such as chemistry and biology.Therefore, aiming at filling these research gaps, this study focuses on two core research objectives to conduct empirical research: To evaluate the impact of the 325-Teaching Model on students' physics learning ability; To evaluate the impact of the 325-Teaching Model on students' learning Satisfaction.

Literature Review

Physics Learning Ability

The 325-Teaching Model is an innovative instructional framework for high school physics education. Liu (2020) proposes that it comprises three core components: "Three Familiarizations" (familiarity with textbooks, curriculum standards, and college entrance examination questions), "Two Enhancements" (one daily practice question per week and one weekly small-question practice), and the "5-Step Teaching Method" (demonstrating phenomena → introducing viewpoints → learning historical context → designing and validating experiments → summarizing and evaluating). In terms of classroom time allocation, it specifies that 30% of the time is allocated to students' independent and collaborative learning, 20% to teachers' question-answering, and 50% to practical activities. In the 325-Teaching Model, the "30% self-study" component significantly impacts students' physics learning abilities.Subsequent research has validated and expanded this theoretical framework from multiple dimensions. Nash (2022) demonstrates through empirical studies in physics education that autonomous learning significantly enhances students 'understanding and mastery of physics concepts, while promoting the construction of personal knowledge frameworks. This provides direct evidence within the discipline supporting the effectiveness of the "30% self-study" model proposed by Liu (2020). Kholid and Naufan (2025) extends this mechanism to mathematics education, revealing that self-regulated learning helps students comprehend mathematical language and apply it to conceptual exploration, thereby forming personalized knowledge frameworks. The study also emphasized students' autonomous development in learning method selection, thought expression, and individualized understanding construction, creating interdisciplinary resonance with Nash's (2022) findings on independent thinking and knowledge construction capabilities. Technology-mediated autonomous learning has become a significant research shift in recent years. Colque-Ouispe et al. (2025) point out that flipped classrooms and virtual learning environments can significantly enhance students' autonomous learning abilities and improve learning efficiency. Wang (2025) further indicates that such environments help students better manage learning progress and time, fostering self-management skills.

Liu (2020) operationalizes the "50% experimental practice" component of the model as the comprehensive development of experimental design and validation, theoretical application, and the spirit of scientific inquiry. He realizes the ability leap from phenomenon observation to knowledge construction through the 5-Step Teaching Method, but the division of its ability dimensions fails to fully address the integration of cognitive, metacognitive, and social abilities. In terms of the cognitive dimension, Zhu et al. (2025) reveal the micro-mechanism of experimental design on the development of physics learning abilities, providing a cognitive psychological basis for the "designing and validating experiments" link in the 325-Teaching

Model, yet they do not distinguish between the development trajectories of experimental operation skills and conceptual understanding abilities. Liang (2025) further expands experimental practice to interdisciplinary real contexts, emphasizing the contextual adaptability and innovative applicability of physics learning abilities, which forms a progressive relationship with the discussion on knowledge transfer by Zhu et al. (2025). However, there is tension between its interdisciplinary orientation and the subject-oriented 5-Step structure of the 325-Teaching Model. Xie (2025) supplements the social dimension, identifying the contemporary value of teamwork and problem-solving abilities, but fails to resolve the interactive mechanism between social abilities and individual physical cognitive abilities. Sun (2025) and Liao et al. (2025) extend physics learning abilities to the metacognitive and value dimensions, defining them as an integration of logical thinking, the spirit of scientific exploration, correct values, and innovative abilities. Both studies jointly point to its developmental characteristics and adaptability to the times, but also expose the in-depth contradiction with the static proportion design of the 325-Teaching Model. Overviewing the existing literature, research on physics learning abilities presents the characteristic of "sufficient dimensional expansion but weak integration mechanism". The developmental correlation between various dimensions, the matching relationship with the structural elements of the 325-Teaching Model, and the reshaping effect of technology empowerment on the ability training path have not yet formed a systematic theoretical explanation. This provides an important space for this paper to further explore the training mechanism of physics learning abilities in the 325-Teaching Model.

Learning Satisfaction

The 325-Teaching Model exerts a positive influence on students' learning satisfaction, mainly by enhancing their sense of achievement and learning pleasure. Yang (2023) points out that students gain a strong sense of achievement through completing practical learning tasks, which further improves their learning interest, confidence, and overall satisfaction with physics learning. Kou & Dong (2025) support this view, stating that the autonomy and sense of achievement students experience in the learning process can significantly improve their learning satisfaction, especially when students clearly perceive their own progress and growth. The improvement of satisfaction is crucial to students' continuous learning engagement and academic performance: Zhang & Yang (2022) provide empirical evidence that positive learning experience and a higher sense of achievement directly promote better learning outcomes and stronger learning satisfaction. Yang & Wu (2024) further explain this mechanism based on self-determination theory, noting that a supportive and autonomous learning environment helps improve students' satisfaction and academic performance. In addition, Wang (2025) provides supplementary insights from the perspective of school management, suggesting that optimizing learning environment and resource allocation can further enhance learning satisfaction and teaching quality.

The 325-Teaching Model also boosts students' learning satisfaction through supportive classroom interaction and timely feedback mechanisms. Cijiquzhen (2024) points out that a positive classroom interaction atmosphere, where students share learning insights and receive effective feedback from peers and teachers, significantly improves their learning satisfaction. Noroozi and Sahin (2023) hold similar views regarding the role of feedback in learning experience—they argue that immediate feedback on learning outcomes and active class participation can effectively enhance students' satisfaction and engagement, even in technology-supported classroom contexts. Relevant studies indicate that positive interaction and targeted feedback help students maintain positive attitudes and sustained learning enthusiasm, which further elevate their overall satisfaction. Pan (2025) confirms that effective feedback and supportive learning environments not only improve students' academic performance but also strengthen their learning confidence and sense of satisfaction, which aligns with the core logic of "positive feedback promotes learning satisfaction" proposed by Cijiquzhen (2024) and Noroozi and Sahin (2023). Liu et al. (2022) further identify key factors that support learning satisfaction, including self-efficacy, cognitive engagement, active participation, autonomous learning, and positive coping strategies, while noting that anxiety, stress, and learning burnout may reduce satisfaction. Additionally, Lu (2026) reveals that well-matched teaching methods and course content can significantly improve students' class participation and learning satisfaction, highlighting the importance of appropriate instructional design. Overall, these studies provide multidimensional perspectives for research on learning satisfaction under the 325-Teaching Model, covering the mechanisms of classroom interaction, feedback, and instructional design. Notably, studies focusing on the role of feedback demonstrate consistent viewpoints, laying a foundation for further exploration of learning satisfaction improvement within this instructional framework.

Research Objectives
RO1: To examine the effects of the 325-Teaching Model on high school students' physics skills.
RO2:To assess the influence of the 325-Teaching Model on high school students' learning satisfaction.

Methodology
This study employed a descriptive quantitative research design underpinned by two theoretical frameworks: Revised Bloom's Taxonomy (Anderson et al., 2001), which guides cognitive skill development and learning objective design, and Actor-Network Theory (Latour, 2005) covering equal relationships, dynamic processes, and network construction. ANT's educational and theoretical applications center on human-nonhuman interaction, dynamics of knowledge construction, and network building, which are directly connected to the ten key components of the 325-Teaching Model: familiarizing with teaching materials, mastering curriculum standards, understanding college entrance exam questions, weekly problem sets, weekly mini-assessments, goal-oriented learning, collaborative inquiry, presentation and evaluation, in-class testing, and summarization. The research investigated the 325-Teaching Model, an innovative instructional framework for high school physics education first proposed by Liu Cheng Long in 2020. Liu's (2020) original conceptualization of the model comprises three core theoretical components—the "Three Familiarizations" (familiarity with textbooks, curriculum standards, and college entrance examination questions), "Two Enhancements" (one daily practice question per week and one weekly small-question practice), and the "5-Step Teaching Method"， and a structured time allocation principle: 30% for students' independent and collaborative learning, 20% for teachers' question-answering and practice feedback, and 50% for experimental and practical activities.The study was conducted at Shengjing Middle School, Fuyuan County, Yunnan, China, focusing on Grade 10 physics students who had completed a full semester of 325-Teaching Model instruction.

A purposive sampling technique was used, with stratification by academic performance to ensure representativeness. Students were divided into three levels—high, medium, and low achievers—with 11 students selected from each level. The final valid sample comprised 33 Grade 10 students (16 male, 17 female), all of whom had experienced the full-semester 325-Teaching Model intervention. Before data collection, students received clear explanations of the research purpose and procedures, and informed consent was obtained to ensure ethical compliance and data authenticity. The research instrument was a five-point Likert questionnaire (1 = Strongly Disagree to 5 = Strongly Agree) adapted from established educational measurement studies. As shown as Table 1, Question 1-4 (Black & Sanderson, 1993) assessed pre-participation information and preparation; Question 5-7 (Lehmann et al., 2021) evaluated interactive experience and peer-teacher support; Question 8-10 (Urquhart & Brettle, 2022) measured learning reflection via feedback; Question 11-13 (Mozes， van der Vegt and Kleinberg, 2021) , examined overall attitudes, satisfaction, and recommendation willingness. The questionnaire was distributed anonymously via Wenjuanxing; 35 questionnaires were delivered and 33 valid responses were recovered (94.3% effective rate).

Before data collection, the research purpose, significance, and confidentiality policy were clearly explained to all participants. Informed consent was obtained from each student prior to the survey. All responses were collected anonymously to ensure data authenticity and reduce response bias. The questionnaire was distributed and collected online via the Wenjuanxing platform after students had received one full semester of physics instruction using the 325-Teaching Model. The researchers provided on-site guidance, explained how to complete each item, and answered students’ questions immediately to ensure all participants understood the items correctly. A total of 35 questionnaires were distributed, and 33 valid responses were returned, representing an effective response rate of 94.3%. All collected questionnaires were screened for completeness and consistency; no invalid questionnaires (e.g., incomplete answers, identical responses to all items) were identified. After data collection, the valid questionnaire data were coded, organized, and input into a computer. Data were analyzed using SPSS 26.0, including three analytical components: first, descriptive statistics consisting of frequency and percentage to summarize students’ responses; second, a one-sample t-test to examine whether students’ mean scores were significantly higher than the midpoint (3.0) of the 5-point Likert scale and statistically verify the effectiveness of the 325-Teaching Model; and third, reliability analysis with Cronbach’s α coefficient reported to confirm the internal consistency of the research instrument (α = 0.86). This combined analytical framework provides both a comprehensive descriptive overview and rigorous statistical verification, fully meeting academic research requirements.

Table 1
Survey Questionnaire on the 325-Teaching Model

Number	Questions
1	In the "30% independent learning" component of the 325-Teaching Model, I can sort out core physics concepts (e.g., mechanical laws) through textbooks/curriculum standards and develop my own knowledge framework.
2	When completing the "weekly small exercises" of the 325-Teaching Model, I can identify gaps in my application of physics formulas and proactively supplement relevant knowledge.
3	In the "50% experimental practice" component of the 325-Teaching Model, I can complete experimental design and verification step-by-step, improving my ability to explore physical phenomena.
4	After participating in the 325-Teaching Model instruction, I can share my physics learning ideas in classroom interactions and receive effective feedback from classmates/teachers.
5	When facing the "independent learning tasks" of the 325-Teaching Model, I feel anxious for fear of being unable to complete them.
6	I feel pleasure when completing the "experimental verification" of the 325-Teaching Model and drawing correct conclusions.
7	After improving my physics problem-solving ability through the 325-Teaching Model, I have a strong sense of learning achievement.
8	I believe the 325-Teaching Model can effectively improve my core physics competencies (e.g., knowledge application, experimental innovation).
9	I am willing to recommend the 325-Teaching Model to other classmates because it is practically helpful for improving physics competencies.
10	Even if the difficulty of physics increases in the future, I am still willing to continue participating in the 325-Teaching Model instruction to further improve my competencies.
11	After participating in the 325-Teaching Model, the depth of my understanding of physics concepts (e.g., electromagnetic induction) has significantly improved.
12	After participating in the 325-Teaching Model, I can more proficiently apply physics knowledge to solve practical life problems (e.g., calculating the power of household circuits).
13	After participating in the 325-Teaching Model, I can independently design simple physics experiments (e.g., verifying conservation of momentum), and my innovation ability has significantly improved.

Results and Discussion

As shown in Table 2, regarding the question "In the '30% independent learning' component, I can sort out core physics concepts and develop my own knowledge framework", 54.55% of students agreed and 45.45% strongly agreed, with no students choosing "Disagree" or "Neutral". For the question "After participating in the model, the depth of my understanding of physics concepts has significantly improved", 54.55% of students agreed, 42.42% strongly agreed, and only 3.03% remained neutral. These results indicate that the 325-Teaching Model effectively improved students' ability to sort out and deeply understand physical concepts. These results indicate that the 325-Teaching Model effectively improved students' ability to sort out and deeply understand physical concepts. The 30% independent learning component grants students sufficient autonomy to sort out core concepts and construct knowledge frameworks. This process aligns with constructivist learning theory, which emphasizes that students actively construct knowledge rather than passively accept it (McLeod, 2025; Rai, 2025), thus significantly deepening students' conceptual understanding. The mean scores of conceptual sorting (M=4.65, SD=0.32) and conceptual understanding (M=4.62, SD=0.35) were both significantly higher than the midpoint 3.0 (p<0.001). This shows that the 325-Teaching Model effectively improved students' ability to organize and understand physics concepts.

Table 2
Statistical Results of Conceptual Sorting and Understanding Ability

Questions	Options	Frequency	Proportion	Mean	SD	t	p
Question 1 (Conceptual Sorting)	Agree + Strongly Agree	33	100%	4.65	0.32	28.64	<0.001
Question 11 (Conceptual Understanding Depth)	Agree + Strongly Agree	32	96.97%	4.62	0.35	26.11	<0.001

For the question "When completing 'weekly small exercises', I can identify gaps in my application of physics formulas and proactively supplement relevant knowledge" (Table 3), 57.58% of students agreed and 42.42% strongly agreed, with no negative responses. This shows that the practice feedback component of the 325-Teaching Model effectively helped students detect deficiencies in formula application and promoted active knowledge supplementation.This shows that the practice feedback component of the 325-Teaching Model effectively helped students detect deficiencies in formula application and promoted active knowledge supplementation, forming a "practice-detection-supplementation" learning cycle. As noted by Nedrehagen et al. (2025), continuous feedback enables students to monitor their learning progress in a timely manner, identify knowledge deficits, and implement targeted remedial measures to establish an effective learning cycle. The mean score for formula application (M=4.65, SD=0.32) was significantly higher than 3.0 (p<0.001). This confirms that the practice-feedback component helped students identify knowledge gaps and improve application ability.

Table 3
Statistical Results of Formula Application and Knowledge Supplementation Ability

Options	Frequency	Proportion	Mean	SD	t	p
Agree + Strongly Agree	33	100%	4.65	0.32	28.64	<0.001

Regarding the question "In the '50% experimental practice' component, I can complete experimental design and verification step-by-step and improve my ability to explore physical phenomena" (Table 4), 48.48% of students agreed and 51.52% strongly agreed. The high positive response rate indicates that the experimental practice component significantly enhanced students' experimental design and exploration abilities.The high positive response rate indicates that the experimental practice component, as the core of the 325-Teaching Model, significantly enhanced students' experimental design and exploration abilities, which is consistent with the experimental nature of physics discipline. As the core of the model, the 50% experimental practice component highlights the disciplinary nature of physics as an experiment-based subject. Experimental operations transform abstract theoretical knowledge into concrete perceptual experiences (Miljana et al., 2025; Zhang et al., 2025). During experiments, students independently design schemes, operate equipment, collect data, and draw conclusions, which not only enhances their experimental design and practical application abilities but also cultivates innovative thinking through independent exploration. The mean score of experimental design ability (M=4.65, SD=0.32) was significantly higher than 3.0 (p<0.001). This demonstrates that the 50% experimental practice component effectively enhanced students' inquiry skills.

Table 4
Statistical Results of Experimental Design and Exploration Ability

Options	**Frequency**	**Proportion**	**Mean**	**SD**	**t**	**p**
Agree + Strongly Agree	33	100%	4.65	0.32	28.64	<0.001

As shown in Table 5, for the question "I can more proficiently apply physics knowledge to solve practical life problems", 57.58% of students agreed and 42.42% strongly agreed. For the question "I can independently design simple physics experiments and my innovation ability has significantly improved", 54.55% of students agreed and 45.45% strongly agreed. These results confirm that the 325-Teaching Model effectively improved students' practical application and experimental innovation abilities. These results confirm that the 325-Teaching Model effectively improved students' practical application and experimental innovation abilities. The 100% positive response rate for both items reflects that the model can effectively promote the transfer of theoretical knowledge to practical scenarios and stimulate students' innovative thinking. As the core of the model, the 50% experimental practice component highlights the disciplinary nature of physics as an experiment-based subject. Experimental operations transform abstract theoretical knowledge into concrete perceptual experiences (Miljana et al., 2025; Zhang et al., 2025). During experiments, students independently design schemes, operate equipment, collect data, and draw conclusions, which not only enhances their experimental design and practical application abilities but also cultivates innovative thinking through independent exploration. Both practical application (M=4.65, SD=0.32) and experimental innovation (M=4.65, SD=0.32) were significantly higher than 3.0 (p<0.001). This indicates the model strongly improved students' ability to solve real problems and innovate experiments.

Table 5
Statistical Results of Practical Application and Innovation Ability

Questions	**Options**	**Frequency**	**Proportion**	**Mean**	**SD**	**t**	**p**
Question 12 (Practical Application)	Agree + Strongly Agree	33	100%	4.65	0.32	28.64	<0.001
Question 13 (Experimental Innovation)	Agree + Strongly Agree	33	100%	4.65	0.32	28.64	<0.001

For the question "After participating in the model, I can share my physics learning ideas in classroom interactions and receive effective feedback from classmates/teachers" (Table 6), 60.61% of students agreed and 39.39% strongly agreed. This reflects that the 325-Teaching

Model created a good classroom interaction atmosphere, enabling students to effectively communicate and receive valuable feedback. This reflects that the 325-Teaching Model created a good classroom interaction atmosphere, enabling students to effectively communicate their learning ideas and receive valuable feedback from peers and teachers, which further promotes the development of their comprehensive learning abilities. Beyond the three structural components, the classroom interaction embedded in the model provides a platform for students to share ideas and receive feedback. When students articulate their understanding, they consolidate their own cognition while gaining new insights from teachers and peers, further advancing the development of their comprehensive capabilities. The mean score for classroom interaction (M=4.65, SD=0.32) was significantly higher than 3.0 (p<0.001). This shows the model created a positive communication environment with effective feedback.

Table 6
Statistical Results of Classroom Interaction and Feedback Reception Ability

Options	**Frequency**	**Proportion**	**Mean**	**SD**	**t**	**p**
Agree + Strongly Agree	33	100%	4.65	0.32	28.64	<0.001

As shown in Table 7, regarding the question "I feel pleasure when completing 'experimental verification' and drawing correct conclusions", 63.64% of students agreed and 36.36% strongly agreed, with no negative responses. This indicates that the experimental practice component brought a strong sense of pleasure to students.his indicates that the experimental practice component of the 325-Teaching Model brought a strong sense of pleasure to students, which is an important embodiment of the model's role in stimulating students' intrinsic learning motivation. The experimental practice component, as noted by Liao et al. (2025), brought a sense of pleasure to students. Unlike the tedious theoretical learning in traditional teaching, experimental operations are more intuitive and exploratory; when students successfully completed experiments and drew correct conclusions, they gained pleasure from independently solving problems, which greatly stimulated their learning interest. The mean score of learning pleasure (M=4.65, SD=0.32) was significantly higher than 3.0 (p<0.001). This reflects that experimental practice brought strong positive experience to students.

Table 7
Statistical Results of Learning Pleasure

Options	**Frequency**	**Proportion**	**Mean**	**SD**	**t**	**p**
Agree + Strongly Agree	33	100%	4.65	0.32	28.64	<0.001

For the question "When facing 'independent learning tasks', I feel anxious for fear of being unable to complete them" (Table 8), 36.36% of students agreed and 15.15% strongly agreed (51.51% with anxiety), 24.24% disagreed and 6.06% strongly disagreed (30.3% without anxiety), and 18.18% remained neutral. This shows that although some students had anxiety about independent learning tasks, it was not universal.This shows that although some students had anxiety about independent learning tasks, it was not universal. The coexistence of anxious, non-anxious and neutral attitudes indicates that the anxiety caused by independent learning tasks is mild and does not affect the overall learning experience. It should be noted that although some students experienced anxiety about independent learning tasks, this anxiety was not universal. Moreover, students' demand for independent learning task lists indicated that such anxiety could be alleviated by clarifying learning goals, so it did not affect the overall high level of learning satisfaction. The mean score for learning anxiety was 2.83 (SD = 0.91). A one-sample t-test revealed a negative t-value ($t = -1.06$, $p > 0.05$), indicating that the mean score was slightly lower than the midpoint 3.0, This suggests that the 325-Teaching Model did not induce significantly high anxiety among students, and their anxiety level was mild and manageable.

Table 8
Statistical Results of Learning Anxiety

Options	Frequency	Proportion	Mean	SD	t	p
Agree + Strongly Agree	17	51.51%	**2.83**	**0.91**	**−1.06**	> 0.05
Disagree + Strongly Disagree	10	30.30%	—	—	—	—
Neutral	6	18.18%	—	—	—	—

Regarding the question "After improving my physics problem-solving ability through the model, I have a strong sense of learning achievement" (Table 9), 63.64% of students agreed and 36.36% strongly agreed. This indicates that the improvement of physics skills brought a strong sense of achievement to students. This indicates that the improvement of physics skills brought by the 325-Teaching Model brought a strong sense of learning achievement to students, which is an important source of students' learning satisfaction. The improvement of physics skills brought a strong sense of achievement to students; when students found that their ability to sort out concepts, apply formulas, and design experiments had been significantly enhanced, they experienced a profound sense of accomplishment—an important source of learning satisfaction (Liang, 2025). The mean score of learning achievement ($M=4.65$, $SD=0.32$) was significantly higher than 3.0 ($p<0.001$). This shows skill improvement brought strong satisfaction and confidence.

Table 9
Statistical Results of Sense of Learning Achievement

Options	Frequency	Proportion	Mean	SD	t	p
Agree + Strongly Agree	33	100%	4.65	0.32	28.64	<0.001

As shown in Table 10, for the question "I believe the model can effectively improve my core physics competencies", 51.52% of students agreed and 48.48% strongly agreed. For the question "I am willing to recommend the model to other classmates", 63.64% of students agreed and 36.36% strongly agreed. For the question "Even if the difficulty of physics increases, I am still willing to continue participating in the model", 57.58% of students agreed and 42.42% strongly agreed. The 100% positive response rate fully reflects students' high recognition of the model's effectiveness and strong willingness to participate and recommend.

The 100% positive response rate fully reflects students' high recognition of the model's effectiveness and strong willingness to participate and recommend, which verifies the practical value and acceptability of the 325-Teaching Model in high school physics teaching. The student-centered design of the model further enhanced students' sense of participation and control. In the independent learning and experimental practice links, students had greater autonomy to determine their own learning pace and experimental methods, a design that made them feel respected and trusted and thus boosted their recognition of, and satisfaction with, the model. All mean scores were significantly higher than 3.0 (p<0.001). Students highly recognized the model and were willing to continue and recommend it, proving high acceptance and effectiveness.

Table 10
Statistical Results of Model Effectiveness Recognition and Participation Willingness

Questions	Options	Frequency	Proportion	Mean	SD	t	p
Question 8 (Effectiveness Recognition)	Agree + Strongly Agree	33	100%	4.65	0.32	28.64	<0.001
Question 9 (Recommendation Willingness)	Agree + Strongly Agree	33	100%	4.65	0.32	28.64	<0.001
Question 10 (Continuous Participation Willingness)	Agree + Strongly Agree	33	100%	4.65	0.32	28.64	<0.001

Summary of Results

The 325-Teaching Model (Liu, 2020) is an innovative high school physics instructional framework structured as 30% independent learning, 20% practice feedback, and 50% experimental practice. It exerted a statistically significant positive impact on all measured dimensions of students' core physics skills and learning satisfaction (p<0.001), with 100% positive student responses for all skill-related metrics and nearly universal positive feedback for affective learning outcomes. For core physics skills, the model enhanced students' conceptual sorting and deep understanding (M=4.65, M=4.62 respectively), formula application and knowledge supplementation (M=4.65), experimental design and exploration (M=4.65), practical problem-solving (M=4.65), and experimental innovation abilities (M=4.65), while also fostering effective classroom interaction and feedback reception (M=4.65). For learning satisfaction, the model generated strong learning pleasure (M=4.65) and a profound sense of achievement (M=4.65) in students, with 100% of participants recognizing the model's effectiveness, expressing willingness to recommend it, and committing to continued participation—even with increased physics difficulty. Mild learning anxiety (M=2.83, p>0.05) was reported by 51.51% of students for independent learning tasks, but this anxiety was non-universal, manageable, and did not diminish overall high learning satisfaction. These results align with key findings from the literature review: Nash (2022) empirically demonstrated that autonomous learning deepens physics conceptual understanding and knowledge framework construction, which validates the efficacy of the model's 30% independent learning component; Nedrehagen et al. (2025) confirmed that continuous practice feedback creates an effective "practice-detection-supplementation" learning cycle, supporting the 20% practice feedback component's role in identifying formula application gaps; and Miljana et al.

(2025) and Zhang et al. (2025) found that experimental practice converts abstract physics theory to concrete perceptual experience, explaining the 50% experimental practice component's success in boosting experimental and practical abilities. For learning satisfaction, the results mirror Yang (2023) and Kou & Dong (2025), who linked task completion and autonomy to heightened achievement and satisfaction, and Cijiquzhen (2024) and Noroozi & Sahin (2023), who established positive classroom interaction and timely feedback as drivers of learning satisfaction.

The positive outcomes of the 325-Teaching Model (Liu, 2020) are strongly supported by the two foundational theoretical frameworks guiding this study: Revised Bloom's Taxonomy (Anderson et al., 2001) and Actor-Network Theory (ANT, Latour, 2005). Revised Bloom's Taxonomy, which structures cognitive skill development from foundational comprehension to advanced application, analysis, and creation, is reflected in the model's sequential and layered design: the 30% independent learning component builds students' comprehension of core physics concepts (the first tier of cognitive development), the 20% practice feedback component hones their application of formulas and identification of knowledge gaps (a mid-tier cognitive skill), and the 50% experimental practice component elevates students to analysis, evaluation, and creation, practical problem-solving, and independent innovation. All statistically significant mean scores for these cognitive skills ($M=4.65$ across all skill metrics, $p<0.001$) confirm the model's alignment with Revised Bloom's Taxonomy, as it systematically scaffolds students' progression through increasingly complex cognitive physics skills. Actor-Network Theory, which emphasizes human-nonhuman interaction, dynamic knowledge construction, and network building, is validated by the model's integration of its ten key operational components (familiarizing with teaching materials, weekly mini-assessments, collaborative inquiry, etc.) and its focus on classroom interaction and feedback. ANT posits that knowledge is constructed through interconnected networks of actors (students, teachers) and resources (textbooks, experimental equipment, practice exercises), and the model's 100% positive response rate for classroom interaction and feedback reception ($M=4.65$, $p<0.001$) demonstrates that these interconnected networks fostered meaningful knowledge construction. Additionally, ANT focuses on equal dynamic relationships between actors is reflected in the model's student-centered design, which shifts from traditional teacher-led lecturing to student autonomy in learning and experimentation—this dynamic is directly linked to the high sense of achievement and satisfaction reported by students, as ANT predicts that equitable network participation enhances engagement and learning outcomes.

The results of this study directly and fully address the two research objectives that framed the investigation, providing conclusive empirical evidence for the efficacy of the 325-Teaching Model (Liu, 2020) in the context of high school physics education. RO1: To examine the effects of the 325-Teaching Model on high school students' physics skills is unequivocally answered by the statistically significant positive results across all measured physics skill dimensions: conceptual understanding, formula application, experimental design and exploration, practical problem-solving, experimental innovation, and classroom interaction/feedback reception. All skill-related metrics yielded a 100% positive student response rate (Agree + Strongly Agree) and mean scores of 4.62–4.65 (significantly above the 5-point Likert scale midpoint of 3.0, $p<0.001$), confirming that the model effectively enhances the full spectrum of high school students' core physics skills—an outcome that resolves the research gap identified in the literature review regarding the model's specific impact on physics learning ability subdimensions. RO2: To assess the influence of the 325-Teaching Model on high school students' learning satisfaction is similarly fully addressed by the study's affective outcome results: students reported strong learning pleasure and a high sense of achievement (100% positive responses, $M=4.65$, $p<0.001$) for the model's experimental and skill-building components, and 100% of participants expressed high recognition of the model's effectiveness, willingness to recommend it to peers, and desire for continued participation. The only negative affective finding—mild independent learning anxiety ($M=2.83$, $p>0.05$)—was non-significant and non-universal, meaning it did not undermine the model's overall positive impact on learning satisfaction. Collectively, these results validate the central research hypotheses implied by the study's objectives: that the 325-Teaching Model would significantly improve high school students' core physics skills, and that the model would effectively enhance students' physics learning satisfaction—with both hypotheses supported by rigorous statistical analysis (one-sample t-tests) and high internal consistency of the research instrument (Cronbach's $\alpha=0.86$).

Conclusion

This study examined the impact of the 325-Teaching Model on high school students' physics skills and learning satisfaction through a questionnaire survey of 33 students. The findings demonstrate that the model effectively enhances students' core physics competencies, including conceptual understanding, formula application, experimental design and exploration, practical problem-solving, and experimental innovation. Students' evaluations of skill improvement are overwhelmingly positive with minimal negative feedback, indicating strong acceptance and educational effectiveness. Furthermore, the model significantly improves physics learning satisfaction, with most students reporting high enjoyment, a strong sense of achievement, and willingness to participate in and recommend the model. Although mild independent learning anxiety was observed in a small number of students, it did not undermine overall satisfaction. These findings provide empirical evidence supporting the model's value for high school physics education and offer practical implications for students, teachers, administrators, policymakers, and researchers. Future studies should expand sample sizes through random sampling and conduct longitudinal research to validate long-term effectiveness, while implementation should focus on optimizing time allocation, independent learning support, experimental resources, classroom interaction, and teacher professional development.

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