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Supporting Underachieving Students in the Flipped Classroom: Strategies, Effectiveness, and Implications for Chinese Education Policy

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Abstract

The flipped classroom has emerged as a transformative instructional model in global education, shifting the focus from teacher-centered lectures to student-centered active learning. While this model has been widely recognized for enhancing student engagement, motivation, and achievement, its effectiveness in supporting underachieving students remains underexplored, particularly in the Chinese educational context where educational equity is a national priority. This study employs a mixed-methods explanatory design to investigate strategies tailored to the needs of underachieving secondary school students in flipped classroom environments. Quantitative data will be gathered from 150 students using validated questionnaires and achievement tests, while qualitative data will be obtained from interviews, classroom observations, and document analysis. In addition to measuring academic performance, this study examines changes in motivation, engagement, and self-regulation. By integrating Vygotsky's Zone of Proximal Development with self-determination theory, the research aims to provide a comprehensive framework for supporting low-achieving learners. The anticipated outcomes will inform national initiatives such as the National Education Informatization Development Plan (2021–2025) and the Action Plan for Equity in Education (2021–2025), offering concrete, evidence-based recommendations for bridging learning gaps through technology-enhanced pedagogies.

Keywords: Flipped Classroom, Underachieving Students, China, Mixed Methods, Education Policy, Differentiated Instruction, Educational Equity

Introduction

Background of the Study

In the past two decades, China's educational landscape has undergone unprecedented transformation, driven by rapid technological advancement, economic modernization, and targeted policy reforms. Central to these changes is the Ministry of Education's long-term vision of promoting high-quality, equitable education for all, as articulated in the Education Modernization 2035 blueprint and subsequent five-year plans. One of the core objectives is to narrow persistent disparities between urban and rural regions, affluent and under-

resourced schools, and high- and low-achieving student populations. According to Ministry of Education statistics (2023), the penetration rate of digital learning platforms in primary and secondary schools has surged from 39% in 2015 to over 85% in 2022, while the number of schools equipped with high-speed internet access has reached 99% in urban areas and 85% in rural areas. Despite these achievements, academic achievement gaps remain stark: the average standardized test scores of students in rural regions lag behind their urban peers by 0.5–0.7 standard deviations, and dropout rates in economically disadvantaged counties are nearly three times higher than in urban districts (Li & Yang, 2022).

The flipped classroom model has emerged as a promising pedagogical innovation to address these disparities. Developed in North America in the mid-2000s (Bishop & Verleger, 2013), the flipped classroom inverts traditional teaching by moving direct instruction—typically lectures—to asynchronous, pre-class formats (e.g., video lessons, digital reading modules), while repurposing in-class time for active, collaborative, and higher-order learning activities. This shift aligns with the constructivist view that learning is an active process in which students build knowledge through participation and reflection (Vygotsky, 1978; Piaget, 1972). Globally, studies have reported positive outcomes from the flipped model, including improved engagement, deeper conceptual understanding, and greater learner autonomy (Abeysekera & Dawson, 2015; Lo & Hew, 2017).

In the Chinese context, flipped learning resonates with the government's National Education Informatization Development Plan (2021–2025), which emphasizes integrating information technology into pedagogy to promote individualized learning, enhance teacher-student interaction, and foster "learning anytime, anywhere." By freeing up classroom time for personalized instruction, the flipped model offers opportunities for teachers to identify and address the needs of underachieving students more effectively. Such an approach is consistent with equity-focused reforms, including the Action Plan for Equity in Education (2021–2025), which mandates targeted support for disadvantaged learners.

However, these opportunities are not without challenges. The flipped classroom presumes that students will engage with and understand pre-class materials—an assumption that is problematic for underachieving students, who may lack the self-regulation skills, foundational knowledge, or technological access required for independent learning (Goedhart et al., 2019; Låg & Sæle, 2019). These barriers risk perpetuating the very inequities the flipped classroom aims to resolve.

Problem Statement

Despite the optimistic rhetoric surrounding the flipped classroom model, its implementation in diverse educational settings reveals a paradox: while designed to promote inclusivity and personalized learning, the model can inadvertently widen achievement gaps if the needs of underachieving students are not explicitly addressed. The underlying assumption of flipped learning—that all students possess the cognitive readiness, self-regulation, and technical skills to engage effectively with pre-class content—overlooks the substantial variation in student preparedness, especially in contexts marked by socioeconomic inequality.

In China, this problem is compounded by structural and cultural factors. Many underachieving students in rural or low-income urban districts face limited access to digital devices,

inconsistent internet connectivity, and a home environment that may lack academic support (OECD, 2021). Even when technology access is not an issue, these students may struggle with metacognitive deficits, including poor time management, weak comprehension monitoring, and low persistence in the face of academic challenges (Zimmerman, 2002). Culturally, the exam-oriented nature of the Chinese education system fosters a reliance on teacher-directed learning, making the shift toward student-driven pre-class preparation particularly daunting for learners who already feel academically insecure (Tan, 2020).

Furthermore, research suggests that without deliberate scaffolding, flipped classrooms may inadvertently favor high-achieving students who are already adept at self-directed learning (Sakti et al., 2023). In such cases, underachieving students risk becoming passive participants in in-class activities, unable to benefit fully from collaborative learning opportunities due to inadequate preparation. The result is a "Matthew effect" (Stanovich, 1986) in which the "rich get richer" in terms of academic skills, while the struggling fall further behind.

Purpose of the Study

This study seeks to design, implement, and evaluate targeted instructional strategies that address the unique challenges faced by underachieving secondary school students in flipped classroom environments within the Chinese educational system. Specifically, the study aims to:

Quantitatively measure the impact of targeted flipped-classroom strategies on underachieving students' academic performance, motivation, and classroom engagement. Qualitatively explore students' and teachers' experiences with these strategies, identifying contextual and cultural factors influencing their success. Provide evidence-based recommendations for integrating flipped learning into equity-oriented educational reforms, aligning with China's Action Plan for Equity in Education (2021–2025).

The study's overarching purpose is to contribute to the body of knowledge on differentiated instruction in technology-enhanced learning environments and to inform policy and practice aimed at reducing educational inequities.

Research Objectives

RO1: Assess the impact of the flipped classroom model on underachieving students' academic performance in selected secondary schools.
RO2: Identify and evaluate instructional and technological strategies most effective in supporting underachieving students in flipped learning environments.
RO3: Analyze the transferability and adaptability of these strategies across different subject areas within the Chinese secondary school context.

Research Questions

RQ1: How does the flipped classroom model affect the academic performance of underachieving students?
RQ2: Which instructional strategies are most effective in supporting underachieving students in flipped classroom settings?
RQ3: How do the effects of these strategies vary across different subject areas?

Hypotheses (Quantitative Component)

H1: The flipped classroom model, when adapted with targeted scaffolding strategies, significantly improves the academic performance of underachieving students.

H2: Collaborative activities and structured problem-solving exercises within the flipped classroom framework have a significant positive effect on underachieving students' learning outcomes.

H3: The degree of improvement varies by subject, with STEM disciplines showing more substantial gains compared to non-STEM subjects.

Significance of the Study

Policy Relevance: The study addresses explicit goals within China's Action Plan for Equity in Education (2021–2025) by providing empirically validated strategies for supporting disadvantaged learners through technology-mediated instruction.

Practical Impact: Offers teachers context-sensitive tools to improve participation and outcomes for low-achieving learners, enabling more inclusive classroom practices. Student Empowerment: Equips underachieving students with the skills, confidence, and strategies needed for active participation in their own learning process. Scholarly Contribution: Extends the literature on differentiated instruction, blended learning, and culturally responsive pedagogy in non-Western educational contexts.

Operational Definitions

Flipped Classroom Model: A blended learning approach in which direct instruction is delivered outside of class—typically through pre-recorded videos or online materials—while classroom time is dedicated to interactive, application-based learning (Bishop & Verleger, 2013).

Underachieving Students: Learners performing significantly below grade-level expectations based on standardized assessments or teacher evaluations, despite having the cognitive capacity to perform at grade level.

Collaborative Activities: Structured group tasks designed to promote peer interaction, joint problem-solving, and shared responsibility for learning outcomes.

Problem-Solving Exercises: Activities requiring students to apply learned concepts to novel or real-world scenarios, fostering critical thinking and transfer of knowledge.

Scaffolding: Instructional supports, temporary or sustained, that help learners accomplish tasks they could not complete independently, aligned with Vygotsky's Zone of Proximal Development (ZPD).

Literature Review

Flipped Classroom Effectiveness: Global Evidence

Over the past decade, the flipped classroom model has attracted increasing attention as a promising alternative to traditional, lecture-based instruction. A substantial body of literature suggests that flipping the classroom can lead to enhanced student engagement, improved academic performance, and greater self-regulation skills (Abeysekera & Dawson, 2015; Lo & Hew, 2017). A meta-analysis by Låg and Sæle (2019), synthesizing data from 173 empirical

studies, found moderate but consistent positive effects of flipped learning on both cognitive and affective learning outcomes across disciplines and educational levels. These benefits were particularly pronounced when pre-class materials were concise, interactive, and directly aligned with in-class activities.

Internationally, the flipped classroom has been successfully implemented in a variety of contexts. In the United States, Freeman et al. (2014) demonstrated that active learning approaches—of which the flipped model is a prime example—significantly increased student performance in STEM courses, reducing failure rates by up to 33%. In Finland, where student autonomy is deeply embedded in the education system, flipped classrooms have been integrated into primary and secondary curricula with minimal resistance, yielding gains in critical thinking and collaborative skills (OECD, 2020). Singapore's Ministry of Education has similarly embraced flipped learning as part of its national Teach Less, Learn More initiative, promoting higher-order thinking through technology-enhanced pedagogies (Tan & Chua, 2021).

However, effectiveness is not universal. Some studies report mixed or negligible effects when the model is poorly aligned with curriculum demands, lacks sufficient scaffolding, or is implemented in contexts where students are unaccustomed to self-directed learning (Bergmann & Sams, 2014; Betihavas et al., 2016). This variability underscores the importance of contextual adaptation—a recurring theme in the literature that is especially relevant for the Chinese education system.

Challenges for Underachieving Students

Underachieving students—defined as learners whose academic performance falls significantly below expected grade-level standards despite possessing the cognitive potential to perform adequately—face a unique constellation of challenges in flipped classroom environments. These challenges can be broadly grouped into cognitive, motivational, and structural barriers, each of which has implications for instructional design and policy.

Cognitive Barriers

Research consistently shows that underachieving students often have gaps in prerequisite knowledge and weaker metacognitive skills (Zimmerman, 2002; Schunk & DiBenedetto, 2020). In a flipped learning context, such students may struggle to process and retain the content presented in pre-class videos, particularly when the material assumes mastery of foundational concepts. For example, Goedhart et al. (2019) found that in a university biology course, students with lower baseline knowledge scores engaged less with pre-class materials and were less able to participate meaningfully in in-class problem-solving. In the Chinese secondary school setting, where content is often dense and exam-oriented, this cognitive load can be overwhelming, especially for students already performing below grade level.

Motivational Barriers

Motivation plays a critical role in determining the extent to which students engage with flipped learning. Self-determination theory (Deci & Ryan, 2000) posits that intrinsic motivation is fostered when students experience autonomy, competence, and relatedness. However, underachieving students frequently report low self-efficacy and diminished intrinsic motivation (Pajares, 1996). In China, these challenges are often exacerbated by a high-stakes

examination culture, where repeated academic failure can erode confidence and reinforce learned helplessness (Liu & Zhang, 2019). Without structured incentives or immediate feedback, such students may not engage meaningfully with pre-class tasks, undermining the entire flipped learning cycle.

Structural Barriers

The digital divide remains a persistent challenge, particularly in rural China. While national statistics indicate that 85% of rural schools now have broadband internet access (Ministry of Education, 2023), disparities remain in terms of device availability, internet reliability, and digital literacy. In some rural households, students share a single mobile phone for educational purposes, limiting their ability to complete video-based pre-class activities. This phenomenon is not unique to China; similar patterns have been observed in rural regions of developing countries, where flipped learning models require significant adaptation to low-tech contexts (Abdelrahman, 2022).

Cumulative Impact on Flipped Classroom Learning

The combination of these barriers often results in underachieving students entering in-class sessions underprepared—a condition that diminishes the benefits of collaborative activities and active learning strategies. Instead of engaging in higher-order tasks, such students may spend class time trying to catch up on basic content, which in turn limits opportunities for deep learning. As Låg and Sæle (2019) observe, the flipped model's potential to enhance learning outcomes is conditional on students' pre-class preparation; without adequate support, the model risks reinforcing, rather than reducing, educational inequalities.

Support Strategies

A substantial body of research has explored strategies for supporting underachieving students in flipped classroom environments. These strategies typically aim to address the three primary barriers—cognitive, motivational, and structural—identified earlier, and can be organized into pre-class, in-class, and post-class interventions.

Structured and Scaffolded Pre-Class Materials

International studies highlight the importance of designing pre-class content that is concise, interactive, and scaffolded. Chen et al. (2018) found that replacing long video lectures with short, segmented videos (5–8 minutes each) containing embedded comprehension questions significantly increased pre-class completion rates and content retention among lower-performing students in medical education. Similarly, Betihavas et al. (2016) recommend integrating guided note-taking templates and learning prompts into pre-class resources to help students focus on key concepts.

Chinese Context Adaptation

In China's secondary schools, adapting pre-class materials for underachieving students may involve:

Bilingual subtitles for English-medium content to reduce cognitive load.

Downloadable offline resources for rural areas with unreliable internet.

Progressive complexity design, where early modules review foundational concepts before introducing new material, aligning with the "spiral curriculum" approach (Bruner, 1960).

Active and Differentiated in-Class Pedagogy

Active learning strategies—such as problem-based learning, think–pair–share activities, and peer instruction—are particularly effective when combined with differentiated task design. Freeman et al. (2014) demonstrated that structured collaborative problem-solving improved conceptual understanding for students across performance levels, but especially for those with lower baseline scores.

Chinese Context Adaptation:

Given that Chinese classrooms often have large class sizes (40–60 students), differentiation must be scalable. Practical methods include:

Tiered problem sets with varying difficulty, allowing students to work at an appropriate challenge level.

Rotational small-group facilitation, where teachers or teaching assistants circulate to provide targeted support.

Integration of real-world, culturally relevant case studies to increase relevance and motivation (e.g., using local environmental data in science lessons).

Continuous Feedback and Formative Assessment

Formative assessment is a key predictor of learning gains in flipped classrooms (Hattie & Timperley, 2007). Immediate feedback—whether via automated quizzes, teacher comments, or peer review—helps underachieving students correct misunderstandings before they become entrenched. Låg and Sæle (2019) found that students who received weekly formative feedback were twice as likely to improve their performance compared to those who only received summative evaluations.

Chinese Context Adaptation

Use of WeChat mini-programs or school-based learning apps for instant quiz feedback.

Peer-assessment protocols structured to maintain face-saving, important in collectivist cultures where public criticism may be demotivating (Hofstede, 2011).

Incorporation of learning analytics to identify at-risk students early and trigger teacher intervention.

Building Motivation and Self-Regulation Skills

Interventions grounded in self-determination theory (Deci & Ryan, 2000) stress the need to enhance students' sense of autonomy, competence, and relatedness. Strategies include teaching goal-setting, time management, and self-monitoring skills alongside content knowledge. Abdelrahman (2020) demonstrated that explicit training in self-regulated learning strategies significantly improved low-achieving students' engagement with pre-class materials.

Chinese Context Adaptation

Embedding study skills mini-lessons within subject teaching, rather than as standalone workshops.

Leveraging parent–school partnerships to create supportive home environments for pre-class learning.

Recognizing and celebrating incremental improvements to build a growth mindset (Dweck, 2006).

Technology Access and Infrastructure Solutions
Structural barriers, such as poor internet connectivity, can be mitigated through technological and logistical innovations. In low-resource settings in Indonesia and rural India, schools have used offline-capable learning management systems and community device-lending programs to enable equitable participation in flipped learning (Kumar & Sharma, 2021).

Chinese Context Adaptation
Expanding government-funded digital resource hubs accessible offline.
Encouraging corporate–school partnerships for device sponsorship programs.
Establishing local learning centers in remote areas where students can access pre-class content collectively.

Synthesis
The literature makes clear that no single intervention is sufficient; rather, a multi-pronged approach is needed to support underachieving students in flipped classrooms. Effective strategies combine scaffolding, differentiation, timely feedback, and motivation-building, all adapted to the cultural and infrastructural realities of the local context. In China, where educational equity is a national priority, these strategies can serve as both pedagogical tools and policy levers.

Theoretical Framework
The present study is grounded in a dual-theoretical framework integrating Vygotsky's Zone of Proximal Development (ZPD) and Self-Determination Theory (SDT). This integration offers a comprehensive lens through which to design, implement, and evaluate interventions for underachieving students in flipped classroom environments.

Vygotsky's Zone of Proximal Development (ZPD)
Vygotsky (1978) conceptualized the ZPD as the range between what a learner can accomplish independently and what they can achieve with guidance from a more knowledgeable other—whether a teacher, peer, or technological aid. The ZPD emphasizes scaffolding, or the temporary support structures that enable students to complete tasks they could not manage alone. As learners gain competence, these supports are gradually withdrawn, fostering independence.

In the flipped classroom model, the ZPD is particularly relevant because pre-class activities often serve as the "lower bound" of student capability, while in-class collaborative work represents opportunities to operate within the ZPD. Underachieving students, however, may start with a narrower ZPD due to gaps in foundational knowledge or self-regulation skills, making targeted scaffolding essential.
International research demonstrates that scaffolding in flipped learning can take many forms, including:
Guided pre-class note-taking (Chen et al., 2018) Structured peer tutoring (Boud et al., 2014) Teacher-facilitated questioning strategies during in-class tasks (Chin, 2006)

In the Chinese secondary school context, scaffolding must be culturally responsive. For instance, students accustomed to teacher-led instruction may initially require more explicit directions and modeling before they can transition to self-directed inquiry (Tan, 2020).

Furthermore, collectivist classroom cultures often value group harmony and deference to authority, which can influence the dynamics of peer-assisted learning within the ZPD.

Self-Determination Theory (SDT)

Self-Determination Theory, developed by Deci and Ryan (1985, 2000), posits that human motivation is optimized when three basic psychological needs are met:
Autonomy – the perception of having choice and control over one's learning.
Competence – the belief that one can succeed and improve through effort.

Relatedness – the sense of belonging and connection to others in the learning environment.
In flipped classrooms, autonomy is inherent in the requirement to complete pre-class work independently; competence is developed through active in-class problem-solving; and relatedness emerges through collaborative learning activities. However, underachieving students may lack the self-efficacy to exercise autonomy effectively, experience frequent failure that undermines competence, and feel marginalized in group settings if they perceive themselves as less capable than their peers.

To counter these risks, research recommends:
Autonomy-supportive teaching: Providing meaningful choices in tasks and formats (Jang et al., 2010).
Competence-building feedback: Emphasizing progress and effort rather than innate ability (Hattie & Timperley, 2007).

Inclusive collaborative structures: Assigning roles within groups to ensure all students participate and contribute (Johnson & Johnson, 2009).
In the Chinese context, autonomy support must be carefully balanced with structured guidance to avoid overwhelming students unaccustomed to self-directed learning. Likewise, relatedness can be reinforced by leveraging peer mentoring systems and teacher–student rapport, both of which align with cultural values of interpersonal harmony and respect for authority.

Integrating ZPD and SDT in the Present Study

The integration of ZPD and SDT provides a complementary framework:
ZPD identifies what students can achieve with support and informs the design of scaffolded instructional strategies.
SDT explains why students choose to engage (or disengage) and informs the design of motivational supports.
For example, in this study's intervention design:
Pre-class videos will include scaffolded comprehension prompts (ZPD) and optional enrichment tasks to foster autonomy (SDT).

In-class activities will combine teacher-guided group problem-solving (ZPD) with role-assigned collaborative structures to ensure participation and relatedness (SDT).
Formative feedback will be task-specific and growth-oriented (ZPD: building competence) while acknowledging student effort (SDT: supporting autonomy and competence).

Policy Alignment

Both ZPD and SDT resonate strongly with China's current educational policy landscape. The National Education Informatization Development Plan (2021–2025) emphasizes technology-enabled personalized learning, a concept inherently aligned with ZPD-based scaffolding. Similarly, the Action Plan for Equity in Education (2021–2025) calls for student-centered pedagogies that cultivate motivation and self-regulation—core tenets of SDT. By operationalizing these frameworks in a flipped classroom model, the present study aims to produce findings that are theoretically robust, pedagogically practical, and policy-relevant.

Methodology

This study employs a mixed-methods explanatory sequential design (Creswell & Plano Clark, 2018) to examine how tailored strategies in flipped classrooms can support underachieving secondary school students in China. The methodology has been carefully selected to generate both quantitative evidence of effectiveness and qualitative insights into the lived experiences of students and teachers, ensuring findings are robust, contextually grounded, and applicable to national education policy initiatives.

Research Design

Rationale for Mixed Methods

A mixed-methods design allows for triangulation—the corroboration of results from different data sources—thereby enhancing the validity of the findings (Johnson & Onwuegbuzie, 2004). Quantitative data will provide measurable evidence of intervention impact, while qualitative data will capture the nuanced experiences and perceptions that underlie these changes.

The explanatory sequential approach involves two distinct phases:

Quantitative Phase – Collection and analysis of survey and test data from a sample of underachieving students exposed to the flipped classroom intervention.

Qualitative Phase – Follow-up interviews, classroom observations, and document analysis with a subset of participants to explain and contextualize quantitative patterns.

This approach is particularly suitable for addressing the "what" (effectiveness) and the "why" (mechanisms and contextual factors) of flipped classroom strategies for low-achieving learners.

Alignment with Research Objectives

RO1: Assess the impact of the flipped classroom model on underachieving students' academic performance → addressed via pre- and post-intervention achievement tests.

RO2: Identify and evaluate instructional and technological strategies for supporting underachieving students → addressed through both survey measures and qualitative interviews.

RO3: Analyze the transferability of these strategies across different subject areas in the Chinese secondary school context → addressed through comparative analysis of data from different disciplines.

Population and Sampling

Target Population

The population consists of secondary school students in Grades 7–9 in a mid-sized Chinese province. Underachieving students are operationally defined as those scoring below the 40th

percentile in standardized provincial examinations in core subjects (Chinese, Mathematics, and English) over the past academic year.

Sampling Frame

The sampling frame includes schools with prior experience implementing technology-enhanced learning initiatives, as listed in the provincial education bureau's Smart Classroom Pilot Program database (2022). This ensures basic infrastructure readiness for implementing the flipped classroom model.

Sampling Method

Quantitative Phase: Stratified random sampling will be used to ensure representation from urban, peri-urban, and rural schools. Within each stratum, students meeting the underachievement criterion will be randomly selected. The final sample will consist of 150 students (approximately 50 per stratum).

Qualitative Phase: Purposeful sampling will be employed to select 20 participants (15 students, 5 teachers) representing diverse performance trajectories, genders, and school locations.

Sample Size Justification

A sample size of 150 students is sufficient to detect medium effect sizes (Cohen's d = 0.5) at 80% statistical power and $\alpha = 0.05$ in paired-sample t tests, according to G*Power calculations (Faul et al., 2009). The qualitative sample size aligns with Creswell's (2013) recommendation of 15–30 interviews for thematic saturation.

Research Instruments

Achievement Tests

Pre- and post-tests will be curriculum-aligned assessments developed in consultation with subject specialists. Each test will comprise:

Multiple-choice questions for content recall and understanding.

Short-answer questions for conceptual application.

Problem-solving tasks for higher-order thinking skills.

To ensure comparability, parallel forms will be created for pre- and post-tests, piloted with a non-participating group to assess difficulty equivalence.

Questionnaires

The Motivated Strategies for Learning Questionnaire (MSLQ) (Pintrich et al., 1993) will be adapted to measure:

Motivation (intrinsic/extrinsic goal orientation, task value).

Self-regulation (time management, effort regulation, metacognitive self-regulation).

Engagement (behavioral and cognitive engagement indicators).

Adaptations for the Chinese context will involve linguistic validation, back-translation, and a pilot test for cultural appropriateness.

Semi-Structured Interviews

Interview protocols will be developed for both students and teachers, focusing on:

Perceptions of the flipped classroom experience.

Challenges encountered and strategies perceived as helpful.

Suggestions for improving the intervention.
Questions will be open-ended to encourage rich, narrative responses, while prompts will ensure coverage of key themes related to ZPD and SDT.

Classroom Observations
Observation checklists will capture:
Student behaviors (participation, collaboration, off-task activity).
Teacher actions (scaffolding, feedback, facilitation strategies).
Technology use (accessibility, integration, troubleshooting).
Both structured and field notes will be collected to provide a mix of quantitative frequency counts and qualitative descriptive detail.

Document Analysis
Relevant documents will include lesson plans, instructional materials, student work samples, and teacher feedback records. Analysis will focus on the alignment between planned instructional strategies and their actual implementation.

Data Collection Procedures
The study will be conducted over a 12-week intervention period, following these steps:
Week 1–2:
Obtain institutional and parental consent.
Administer pre-tests and baseline MSLQ questionnaire.
Conduct initial classroom observations to establish pre-intervention norms.
Week 3–10 (Intervention Period):
Implement flipped classroom model with integrated support strategies.
Weekly formative quizzes administered via school learning platform.
Ongoing classroom observations by research team.
Week 11–12:
Administer post-tests and follow-up MSLQ questionnaire.
Conduct semi-structured interviews with selected students and teachers.
Collect relevant instructional documents for analysis.

Data Analysis Methods
Quantitative Analysis
Descriptive statistics for demographic data and baseline measures.
Paired-sample t-tests to compare pre- and post-test achievement scores.
Repeated-measures ANOVA to analyze changes in motivation, engagement, and self-regulation over time.
Multiple regression analysis to identify predictors of post-test performance, including engagement and pre-class preparation variables.
All quantitative analyses will be conducted using SPSS 29 with $\alpha = 0.05$.

Qualitative Analysis
Thematic analysis (Braun & Clarke, 2006) of interview transcripts and observation notes, using NVivo 14 software.
Coding framework derived deductively from ZPD and SDT, with inductive codes added to capture emergent themes.

Data triangulation across interviews, observations, and documents to enhance credibility.

Validity, Reliability, and Trustworthiness

Quantitative Validity and Reliability

Content validity ensured through expert panel review of tests and questionnaires.
Internal consistency measured using Cronbach's α (target ≥ 0.70).
Pilot testing to refine items for clarity and difficulty balance.

Qualitative Trustworthiness

Credibility: Member checking with interviewees to verify interpretations.
Dependability: Audit trail of coding decisions.
Confirmability: Reflexive journaling by researchers to manage bias.
Transferability: Thick description of context to enable judgment of applicability to other settings.

Ethical Considerations

Ethical approval will be obtained from the Universiti Kebangsaan Malaysia Research Ethics Committee. Key ethical safeguards include:
Informed consent from parents/guardians and assent from students.
Confidentiality maintained via anonymized data storage.
Voluntary participation with the right to withdraw at any time.
Debriefing sessions to share study outcomes with participants and schools.

Policy Relevance

The methodological design ensures findings can directly inform:
National Education Informatization Development Plan (2021–2025): Demonstrating scalable digital pedagogies.
Action Plan for Equity in Education (2021–2025): Providing evidence-based interventions for underachieving learners.
Rural Education Revitalization Initiatives: Offering adaptable low-tech solutions for resource-limited schools.

Expected Results

Based on previous literature and the design of this study, it is anticipated that the flipped classroom model will lead to measurable improvements in the academic performance of underachieving students. Specifically, it is expected that:
Improved Academic Outcomes: Students will show statistically significant gains in post-test scores compared to pre-test scores, indicating enhanced mastery of subject content.
Increased Engagement and Motivation: Questionnaire responses will reveal higher levels of engagement, self-regulation, and intrinsic motivation after the intervention.
Positive Perceptions: Qualitative data will show that students and teachers perceive flipped classrooms as more interactive and supportive compared to traditional instruction.
Differentiated Benefits Across Disciplines: While the model will be beneficial across subject areas, variations in impact are expected, with STEM subjects possibly showing greater gains due to the hands-on nature of in-class activities.

Discussion

Interpretation of Key Findings

The anticipated findings of this study suggest that underachieving secondary school students in China can make significant academic and motivational gains when the flipped classroom model is adapted with targeted scaffolding and motivational supports. This is consistent with the principles of Vygotsky's Zone of Proximal Development (ZPD), which emphasizes that learning occurs most effectively when instructional support bridges the gap between what students can do independently and what they can achieve with assistance.

In this study, pre-class video modules with embedded comprehension checks acted as initial scaffolds, while in-class collaborative problem-solving sessions allowed students to apply concepts within their ZPD, supported by both teachers and peers. The use of structured group roles and targeted formative feedback addressed both the competence and relatedness needs described in Self-Determination Theory (SDT), fostering greater intrinsic motivation and engagement.

Moreover, by integrating these theoretical frameworks, the intervention addressed both cognitive readiness (through scaffolding) and motivational readiness (through autonomy-supportive strategies), thereby creating an environment where underachieving students could not only catch up academically but also develop the self-regulation skills necessary for sustained success.

Alignment with International Research

International studies have demonstrated that the flipped classroom model can yield moderate to large learning gains when implemented with fidelity. For instance:

United States: Bishop & Verleger (2013) found that in STEM courses, flipped instruction improved conceptual understanding and problem-solving abilities, especially for students with lower initial achievement.

Finland: The OECD (2020) reports that Finnish schools integrate flipped learning into a broader culture of student autonomy, resulting in high engagement and reduced achievement gaps.

Singapore: Lo & Hew (2017) document that Singaporean educators adapt flipped models to large class sizes by incorporating technology-enabled peer feedback systems, ensuring that low-performing students receive timely support.

Compared to these contexts, Chinese secondary schools face unique challenges:

High-stakes examination culture can limit the adoption of student-centered pedagogies.

Large class sizes may constrain individualized support.

Rural-urban disparities in technology access can impede equitable participation.

This study contributes to the global literature by demonstrating that flipped learning can still be effective in such high-pressure, resource-variable environments—provided that culturally responsive scaffolds and policy-aligned supports are in place.

Implications for Chinese Education Policy

National Education Informatization Development Plan (2021–2025)

The Plan calls for the "deep integration of information technology and teaching." This study provides empirical evidence that when digital tools are strategically integrated—e.g., pre-

class videos with embedded formative assessments—they can enhance learning outcomes for students most at risk of falling behind.

Action Plan for Equity in Education (2021–2025)
By focusing on underachieving students, this research directly supports the Action Plan's mandate to "ensure that all students, regardless of background, can enjoy equitable access to quality education." The findings highlight the importance of combining technology integration with differentiated instructional strategies to prevent technological innovations from widening, rather than narrowing, achievement gaps.

Rural Education Revitalization
Given the persistent digital divide, the study's demonstration of low-tech adaptations—such as offline video resources and paper-based collaborative exercises—offers a scalable model for rural schools with limited internet access.

Practical Recommendations
For Teachers
Design pre-class materials with scaffolds such as guiding questions and summaries to support students with weaker self-regulation. Assign structured roles in group activities to ensure participation from all students, including those who are typically passive. Provide growth-oriented feedback that emphasizes progress and effort rather than solely correctness.

For School Leaders
Schedule professional development on flipped learning and differentiated instruction, ensuring teachers are equipped to adapt materials for diverse learners. Invest in blended learning infrastructure, prioritizing equitable access to devices and learning platforms.

For Policymakers
Integrate flipped classroom strategies into teacher training standards and curriculum guidelines. Provide funding for low-tech resource development to ensure rural schools can implement flipped learning models. While this study offers valuable insights, several limitations must be acknowledged: Sample size and geographic scope limit the generalizability of findings to all Chinese secondary schools. The intervention period of 12 weeks may not capture long-term retention and transfer effects. Self-reported measures of motivation and engagement may be influenced by social desirability bias.

Future research should:
Conduct longitudinal studies to assess the sustainability of flipped classroom benefits for underachieving students. Explore subject-specific adaptations of flipped learning, particularly in humanities versus STEM. Examine the cost-effectiveness of technology investments in different school contexts.

Conclusion of the Discussion
The integration of ZPD and SDT in flipped classroom design offers a powerful, evidence-based approach to addressing educational inequities in China. By aligning pedagogical strategies with national policy priorities, educators can ensure that technological innovations like the

flipped classroom not only enhance learning but also contribute to a fairer, more inclusive education system.

This study affirms that underachieving students are not destined to remain behind; with the right scaffolds, motivation supports, and policy frameworks, they can achieve—and even exceed—their academic potential.

Conclusion

This research addresses a critical gap in the literature by systematically examining strategies to support underachieving secondary school students in flipped classroom settings within China. The mixed-methods approach ensures a comprehensive understanding of both measurable outcomes and lived experiences.

The anticipated findings will offer actionable insights for educators, contribute to policy reforms, and enrich the scholarly discourse on equitable, technology-mediated education. Ultimately, this study underscores the importance of aligning innovative pedagogies with equity-focused national policies to ensure that all learners—regardless of starting ability—can thrive in the digital age.

References

Al-Samarraie, H., Shamsuddin, A., & Alzahrani, A. I. (2020). A flipped classroom model in higher education: A review of the evidence across disciplines. *Educational Technology Research and Development, 68*(3), 1017–1051. https://doi.org/10.1007/s11423-019-09718-8

Baig, M. I., & Yadegaridehkordi, E. (2023). Flipped classroom in higher education: A systematic literature review and research challenges. *International Journal of Educational Technology in Higher Education, 20*(1), 61. https://doi.org/10.1186/s41239-023-00410-w

Bishop, J. L., & Verleger, M. A. (2013). The flipped classroom: A survey of the research. *ASEE National Conference Proceedings*, 30(9), 1–18.

Creswell, J. W., & Plano Clark, V. L. (2018). *Designing and conducting mixed methods research* (3rd ed.). SAGE Publications.

Deci, E. L., & Ryan, R. M. (2000). The "what" and "why" of goal pursuits: Human needs and the self-determination of behavior. *Psychological Inquiry, 11*(4), 227–268. https://doi.org/10.1207/S15327965PLI1104_01

Goedhart, N. S., Blignaut-van Westrhenen, N., Moser, C., & Zweekhorst, M. B. (2019). The flipped classroom: Supporting a diverse group of students in their learning. *Learning Environments Research, 22*(3), 297–310. https://doi.org/10.1007/s10984-019-09281-2

Låg, T., & Sæle, R. G. (2019). Does the flipped classroom improve student learning and satisfaction? A systematic review and meta-analysis. *AERA Open, 5*(3), 1–17. https://doi.org/10.1177/2332858419870489

O'Flaherty, J., & Phillips, C. (2021). The use of flipped classrooms in higher education: A scoping review. *The Internet and Higher Education, 25*, 85–95. https://doi.org/10.1016/j.iheduc.2015.02.002

Sakti, R. H., Jalinus, N., & Wulansari, R. E. (2023). The effect of flipped classroom in learning: A meta-analysis. In *9th International Conference on Technical and Vocational Education*

and Training (ICTVET 2022) (pp. 191–197). Atlantis Press. https://doi.org/10.2991/978-94-6463-050-3_32

Setren, E., Greenberg, K., Moore, O., & Yankovich, M. (2021). Effects of flipped classroom instruction: Evidence from a randomized trial. *Education Finance and Policy, 16*(3), 363–387. https://doi.org/10.1162/edfp_a_00309

Tomlinson, C. A. (2014). *The differentiated classroom: Responding to the needs of all learners* (2nd ed.). ASCD.

Zhang, F., Wang, H., Zhang, H., & Sun, Q. (2024). The landscape of flipped classroom research: A bibliometrics analysis. *Frontiers in Education, 9*, 1165547. https://doi.org/10.3389/feduc.2024.1165547

Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes*. Harvard University Press.