

When students neither prepare nor participate: Readiness for autonomy and collaboration in stu- dent-centred learning

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ABSTRACT

Student-centred, flipped and collaborative pedagogies transfer substantial responsibility for foundational learning to students before class and reserve contact time for application, discussion and peer learning. Their effectiveness therefore depends on readiness for both self-regulation and collaboration, yet these capacities are often presumed rather than demonstrated. This systematic critical integrative review examined how undergraduate preparation and meaningful participation are conceptualised, what predicts them, how they relate to learning, how learner diversity is represented, and which design principles can address persistent disengagement. Searches conducted on 30 July 2026 covered empirical studies published from January 2015 to December 2025. OpenAlex, ERIC and SciSpace discovery systems were supplemented by backward and forward citation searching. The reported selection process produced 35 included studies from 154 unique screened records. Evidence was synthesised through framework analysis informed by self-regulated learning, self-determination and social interdependence theories. Preparation was better represented by regularity, timeliness and productive strategy use than by access alone. In-class participation was frequently unequal, with unstructured group work permitting silence, domination, social loafing and compensatory labour. Evidence was predominantly observational and context-specific, while subgroup analyses by age, nationality, personality, disability or neurodiversity, socioeconomic circumstances and competing work or care responsibilities were rare. The review develops an Autonomy-Collaboration Readiness Framework and a Progressive Autonomy Model. These conceptual models treat readiness as relational, developmental and differentially distributed, and position concise resources, readiness assurance, individual accountability, structured collaboration, inclusive participation options, timely feedback and gradual transfer of responsibility as design priorities. The models require prospective validation.

Keywords: flipped learning; student-centred learning; self-regulated learning; collaborative learning; student engagement; learner diversity

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1. Introduction

1.1 The promise and hidden prerequisites of student-centred pedagogy

Flipped learning has become one of the most recognisable expressions of the shift from lecturer-centred transmission toward student-centred higher education. Its basic sequence appears straightforward: students encounter explanatory content before class, while scheduled contact time is used for active application, problem solving, peer instruction and feedback. This rearrangement is attractive because it promises to replace passive listening with purposeful intellectual work, permit students to control the pace of initial exposure, and release instructors to diagnose misconceptions and support higher-order learning (Abeysekera & Dawson, 2015; Al-Samarraie et al., 2020). Yet the apparent simplicity of the sequence conceals demanding behavioural and motivational prerequisites. The model presupposes that students will begin assigned work without direct supervision, regulate attention, persist when content is difficult, judge whether they understand it, and arrive prepared to expose their reasoning to peers.

These prerequisites are not incidental. Pre-class work is the epistemic foundation on which in-class activity rests. If foundational concepts have not been encountered, collaborative tasks can become exchanges of unsupported opinion, improvised answer-seeking or passive dependence on a better-prepared peer. Instructors then face an unattractive choice: continue with activities that many students cannot use productively, or reteach the assigned content and thereby reward non-preparation. The latter response may preserve short-term comprehension but teaches students that preparation is optional because the lecturer will eventually supply the missing explanation. The former protects the formal model while risking exclusion of students who lack prior knowledge, confidence, time or effective study strategies.

A parallel assumption concerns collaboration. Placing students in groups does not itself create collaborative learning. Productive collaboration requires sufficient individual preparation, positive interdependence, individual accountability, communicative confidence, reciprocal listening and a task that cannot be completed by one dominant member. When these conditions are absent, group work can distribute grades without distributing thought. A small number of students may perform most of the interpretation, explanation and reporting, while others remain silent, defer to perceived experts, use phones for unrelated activity or wait for a final answer. Such classrooms can look active while remaining cognitively unequal.

1.2 Double disengagement: before class and within class

The central problem addressed in this review is therefore double disengagement. Pre-class disengagement includes non-completion, late access, superficial skimming, fragmented viewing, reliance on summaries, or the use of generative artificial intelligence to produce answers without adequate engagement with source material. In-class collaborative disengagement includes silence, social loafing, domination, procedural compliance, off-task behaviour and contributions that are verbally present but conceptually empty. These forms of disengagement are connected, but they may not have the same meaning for all students. Age, academic stage, prior schooling, language background, personality-linked preferences, disability or neurodiversity, employment, care responsibilities and material access can alter how the same pedagogical demand is experienced. These forms of disengagement are connected. Students who have not prepared may remain silent because they have little substantive knowledge to contribute; students who expect discussion to be dominated by others may decide that preparation has low value. Repeated experiences of low-quality collaboration can thus weaken motivation to prepare,

while weak preparation makes collaboration less credible and less educationally rewarding.

This problem has acquired additional urgency in a digital environment structured around continuous attention capture. Social media, entertainment platforms, employment, family obligations and overlapping course deadlines compete with deliberate reading. Generative AI adds a more ambiguous challenge. It can explain difficult concepts, generate practice questions and support feedback, but it can also separate visible task completion from genuine learning. A pre-class response may now be produced quickly without the intellectual struggle through which conceptual understanding is formed. The appropriate question is not whether technology is beneficial or harmful in itself, but whether course design makes productive cognition more valuable than symbolic compliance.

1.3 Limitations of the existing evidence base

Prior reviews have generally asked whether flipped classrooms improve achievement, satisfaction or engagement relative to conventional lectures. Meta-analytic evidence tends to show small to moderate average benefits, but effects vary by discipline, implementation fidelity, assessment design and comparison condition (Shi et al., 2020; Turan, 2023). Broad reviews also show that the label flipped classroom covers highly heterogeneous arrangements, from short videos followed by quizzes to elaborate team-based and inquiry-oriented designs (Al-Samarraie et al., 2020; Divjak et al., 2022). The average effect of this heterogeneous category is consequently less informative than the mechanisms through which particular designs succeed or fail.

Preparation and participation have often been treated as intermediate implementation details rather than as the central causal architecture of the model. Engagement reviews increasingly distinguish behavioural, cognitive, emotional and agentic dimensions, but the relationship between unsupervised preparation and the distribution of intellectual participation within

groups remains insufficiently theorised. Likewise, scholarship on social loafing and group work has developed largely outside the flipped-learning literature, even though the classroom phase of flipped learning commonly depends on small-group activity. The two evidence streams need to be brought together.

1.4 Purpose and research questions

This review critically synthesises evidence on the readiness conditions underlying flipped and collaborative undergraduate learning. It does not begin from the premise that students are deficient or that direct instruction is inherently superior. It examines a relational and developmental problem: whether the autonomy and collaboration demanded by a pedagogical design are aligned with students' demonstrated capabilities, motivations, circumstances and academic stage, and whether instructors and institutions provide adequate structures for those capabilities to develop. It also examines whether the literature adequately represents learner heterogeneity or conceals differential experiences within average effects. Four questions guide the review:

RQ1. How extensively and in what ways do undergraduate students complete pre-class learning and participate meaningfully in in-class group activity?

RQ2. Which learner-level, diversity-related, instructional and contextual factors explain variation in preparation and meaningful participation?

RQ3. What relationships are reported among preparation, participation and learning outcomes?

RQ4. Which design principles can support equitable, guided, partially flipped and progressively autonomous undergraduate learning?

2. Theoretical and Conceptual Framework

2.1 Self-regulated learning and the demands of pre-class study

Self-regulated learning explains how students translate intentions into sustained academic action. It encompasses forethought, strategic performance and self-reflection, including goal setting, planning, time management, monitoring, help seeking and adaptation (Zimmerman, 2002). Flipped learning externalises many regulatory decisions that a lecture ordinarily structures. Students must decide when to begin, how long to persist, whether to revisit a resource and how to respond to confusion. Online access increases temporal flexibility, but flexibility expands the number of decisions that learners must regulate. Students with weak planning or high susceptibility to distraction can therefore experience flexibility as postponement rather than agency.

This perspective cautions against interpreting non-preparation solely as lack of care. A student may value learning but lack strategies for converting that value into regular action. Conversely, a student may demonstrate procedural completion while avoiding monitoring and elaboration. Learning-management-system traces are useful precisely because they reveal temporal and sequential patterns that self-report cannot capture, although opening a file or playing a video remains an imperfect proxy for cognition (Jovanović et al., 2017, 2019). Readiness is thus behavioural and metacognitive, not merely attitudinal.

2.2 Self-determination, task value and minimum-compliance behaviour

Self-determination theory distinguishes autonomous motivation from controlled regulation and amotivation. Students may prepare because they find the material interesting, recognise its importance, seek competence, fear sanctions, want marks, or merely wish to complete a

credential (Ryan & Deci, 2020). These motives can produce similar visible behaviours while differing in depth and durability. Low-stakes accountability may be necessary to establish routines, but external incentives alone can produce minimum-compliance behaviour when students see no credible relationship between preparation and success in class.

Task value is therefore central. Preparation is more likely when materials are concise, accessible and visibly necessary for an intellectually worthwhile classroom task. It is less likely when readings are excessive, videos repeat textbook content, group discussions merely ask students to restate definitions, or assessment rewards memorisation that can be achieved without preparation. The pedagogical problem is not simply how to compel work, but how to make effort intelligible and consequential.

2.3 Social interdependence and the conditions of collaboration

Social interdependence theory distinguishes cooperative structures, in which participants perceive that they can attain their goals together, from arrangements in which outcomes are independent or competitive (Johnson & Johnson, 2009). Effective collaborative learning requires positive interdependence and individual accountability. Without the first, students can divide a task into isolated fragments and avoid genuine intellectual exchange. Without the second, students can benefit from a group product without contributing proportionately. Psychological safety also matters because students are unlikely to test uncertain reasoning when disagreement is experienced as humiliation or when more fluent peers monopolise discussion (Edmondson, 1999).

Social loafing research shows that reduced identifiability, large groups, low task significance and the expectation that others will compensate can weaken individual effort (Karau & Williams, 1993). In educational groups, the burden often shifts to conscientious members who protect the collective grade by completing missing work.

This compensation can conceal dysfunctional participation because the group still produces a plausible output. Group performance is therefore an unreliable indicator of distributed learning.

2.4 Learner heterogeneity and differential readiness

Readiness is unlikely to be evenly distributed or stable across tasks. Student engagement emerges at an educational interface where individual histories and psychosocial conditions meet institutional expectations and curriculum design (Kahu & Nelson, 2018). Academic level, age, prior schooling, language background, nationality and cultural context, personality-linked preferences, disability or neurodiversity, employment and care obligations, and material access may therefore influence how students experience pre-class autonomy and public collaboration. These characteristics should not be treated as deterministic labels. Nationality, for example, is not itself a learning mechanism, and personality does not fix a student's capacity to participate; their relevance lies in how they interact with language, belonging, prior academic socialisation, task structure and available participation modes.

The review consequently treats learner diversity as a cross-cutting analytic condition and an evidential question. It distinguishes factors directly examined in included studies from plausible but under-tested sources of variation. Academic stage, prior knowledge, self-regulation, language confidence and access appeared more often in the corpus. Differential effects by age, personality, disability or neurodiversity, socioeconomic position, employment, care

responsibilities and nationality were rarely tested. Absence of subgroup evidence should not be mistaken for evidence of uniform effects.

2.5 The provisional Autonomy-Collaboration Readiness Framework

The review integrates these traditions through the Autonomy-Collaboration Readiness Framework shown in Figure 1. Independent-learning readiness includes self-regulation, motivation, prior knowledge, academic literacy, workload management, attentional control and the ability to use digital tools without outsourcing the core cognitive task. Collaborative-learning readiness includes preparation, language confidence, psychological safety, listening, explanation, respectful disagreement, peer trust, positive interdependence and resistance to social loafing. Learner heterogeneity and academic stage operate across both domains. Neither domain should be understood as a fixed personal trait: both are shaped by task design, assessment, feedback, group composition, instructional scaffolding, accessibility and the broader curriculum.

The framework proposes a reciprocal relationship. Preparation equips students to contribute evidence and reasoning; high-quality collaboration can make preparation valuable by creating a context in which knowledge is used, questioned and extended. Conversely, low-quality collaboration may undermine preparation, and non-preparation can empty collaboration of substance. Readiness is therefore an emergent alignment among learner capabilities, heterogeneous circumstances, design conditions and social relations. The framework is a conceptual synthesis rather than a validated measurement model.

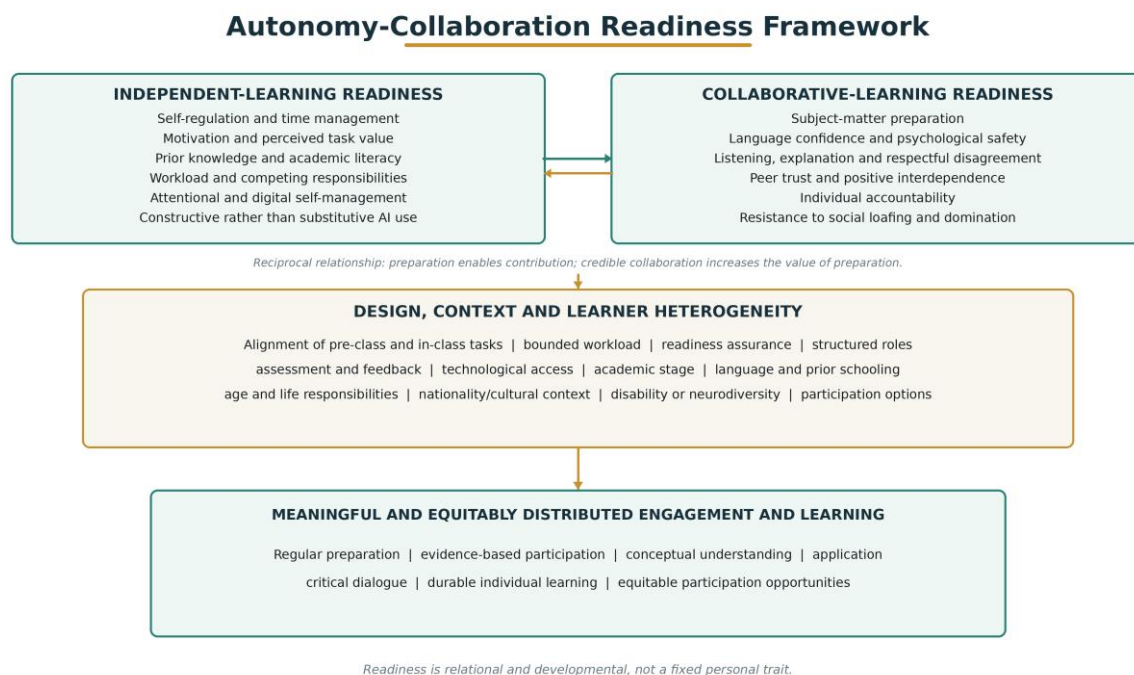


Figure 1. Autonomy-Collaboration Readiness Framework. Readiness is shaped by learner capabilities, heterogeneity and design/context conditions. The framework is a conceptual product of the review and requires prospective validation.

3. Method

3.1 Review design and reporting

A systematic critical integrative review was conducted to combine heterogeneous quantitative, qualitative and mixed-methods evidence and to develop a theoretically informed account of preparation, collaborative participation and learner heterogeneity. Integrative review was selected because the questions concern mechanisms, meanings, differential conditions and design responses rather than a single intervention-outcome estimate (Whittemore & Knafl, 2005). Reporting was informed by PRISMA 2020 and PRISMA-S (Page et al., 2021; Rethlefsen et al., 2021). A review plan specifying the questions, eligibility criteria, search concepts, extraction fields and synthesis framework was finalised before full-text synthesis and is reproduced in Appendix A. The plan was not prospectively time-stamped or registered; it should therefore not be interpreted as a registered protocol. No primary human-participant data were collected.

3.2 Eligibility criteria

Studies were eligible when they: (a) reported peer-reviewed empirical research; (b) involved undergraduate or mixed higher-education populations from which undergraduate evidence could be interpreted; (c) examined a flipped, blended, active or collaborative design in which pre-class preparation or in-class group participation was a material component; (d) reported behavioural, perceptual, interactional or learning-outcome evidence relevant to preparation or meaningful participation; (e) were published in English between January 2015 and December 2025; and (f) provided sufficient methodological information for design-sensitive appraisal. Studies focused exclusively on school pupils, staff development, purely technical systems, opinion pieces and reviews were excluded from the empirical synthesis. Earlier theoretical and foundational sources were retained for conceptual framing but did not enter the PRISMA count. The end date was fixed at the last complete publication year before the search; studies published in 2026 were not eligible.

Table 1. Eligibility criteria

Domain	Included	Excluded
Population	Undergraduate or mixed higher-education students	School-only populations; staff-only professional development
Phenomenon	Pre-class preparation, flipped learning engagement, group discussion, collaborative participation or social loafing	Technology use without preparation or participation evidence
Evidence	Peer-reviewed empirical quantitative, qualitative or mixed-methods research	Reviews, editorials, conceptual papers and conference abstracts without sufficient data
Outcomes	Behavioural traces, readiness, motivation, interaction quality, participation distribution or learning outcomes	Satisfaction alone where it could not illuminate preparation or participation
Period and language	January 2015 to December 2025; English	Outside period; non-English full text

3.3 Information sources and search strategy

Searches were conducted on 30 July 2026. OpenAlex records were retrieved through the Sider Scholar interface; ERIC was searched through its public record interface; and SciSpace semantic discovery was used as a supplementary route for studies whose titles or abstracts did not use the exact phrases pre-class preparation or group participation. Search concepts combined flipped classroom or flipped learning with preparation, self-regulation, engagement, participation, group discussion, collaborative learning, social loafing, psychological safety, higher education and undergraduate. A separate concept block combined generative AI or ChatGPT with flipped learning and student engagement. Backward

and forward citation searching was conducted from directly relevant empirical studies and prior reviews. Complete reported strings are reproduced in Appendix A.

The public OpenAlex interface returned 2,358 broad matches for the principal query but permitted export of only 100 relevance-ranked records. All 100 exported records were screened. Supplementary ERIC and SciSpace searches and citation chasing broadened coverage, but neither relevance-ranked export nor semantic discovery is fully reproducible because results can change with indexing and proprietary ranking. The review is therefore systematic in its documented procedures and critical in its synthesis, but it does not claim exhaustive database coverage. This boundary is central to interpretation.

Table 2. Search sources, reported search logic and operational constraints

Source	Date	Core search logic	Records entering identification
OpenAlex via Sider Scholar	30 July 2026	"flipped classroom" AND higher education AND ("pre-class" OR preparation OR engagement OR "self-regulated learning"); 2015-2025; article	100 exported from 2,358 broadly matched records
ERIC	30 July 2026	("flipped classroom" AND (pre-class OR self-regulated OR engagement)) OR ("group work" AND "social loafing"); higher education	20
SciSpace	30 July 2026	Four semantic searches covering preparation; collaborative participation; motivation/distraction/AI; African higher education	40
Citation searching	30 July 2026	Backward and forward citation searching from sentinel studies and reviews	12

Note. Search strings and PRISMA counts are reported in Appendix A. Semantic-search results are supplementary and ranking-dependent.

3.4 Selection process

One reviewer conducted title-and-abstract screening, full-text assessment, extraction and appraisal. No independent duplicate screening, calibration exercise or inter-rater agreement statistic was available. Records were merged by

DOI and, where no DOI was available, by normalised title and first author. After removal of 18 duplicates, 154 unique records were screened; 103 were excluded because they did not address the eligible population, phenomenon, period, language or empirical scope. Fifty-one reports were sought for full-text assessment,

four could not be retrieved, and 47 were assessed. Twelve were excluded: five did not directly measure or substantively interpret preparation or participation, three focused on school populations, two were reviews or

commentaries, and two provided insufficient methodological information. Thirty-five studies entered the synthesis. Figure 2 reports the selection process. The single-reviewer process is addressed as a limitation.

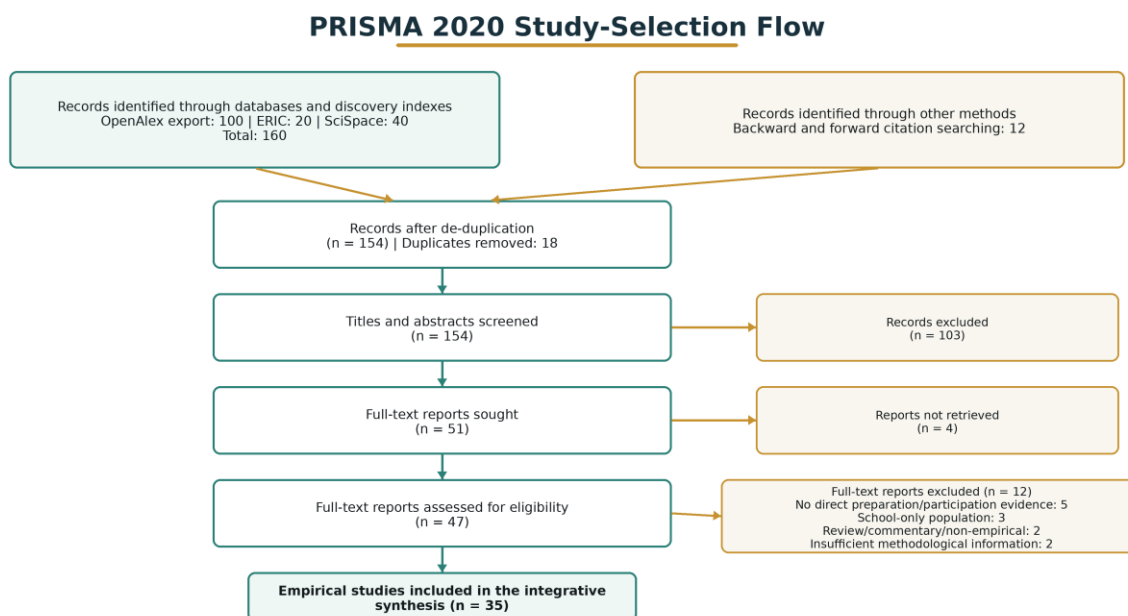


Figure 2. PRISMA 2020 flow diagram for study identification and selection.

3.5 Data extraction and methodological appraisal

A structured extraction matrix captured publication details, country, discipline, sample, academic level, design, operationalisation of preparation, operationalisation of participation, learner and diversity factors, design factors, outcomes and limitations. Preparation was coded as access, completion, timeliness, regularity, productive strategy use or demonstrated readiness. Participation was coded as attendance, speaking frequency, contribution distribution, evidence use, explanation, questioning, constructive disagreement, peer support or social loafing. Diversity fields recorded whether age, nationality or cultural context, language, personality, disability or neurodiversity, socioeconomic circumstances, employment or care responsibilities, prior preparation and academic stage were reported or analysed. This distinction prevented visible activity from being treated automatically as meaningful

engagement and prevented unmeasured diversity from being inferred.

Methodological quality was appraised with design-appropriate domains informed by the Mixed Methods Appraisal Tool: clarity of the research question; appropriateness of sampling and measurement; completeness of outcome data; alignment between analysis and design; integration in mixed-methods studies; and adequacy of qualitative substantiation (Hong et al., 2018). Appraisal qualified interpretation rather than generating a numerical score or excluding studies solely for imperfect reporting. Overall confidence was classified as higher when no critical weakness materially threatened the study's contribution, moderate when identifiable limitations constrained but did not invalidate interpretation, and lower when evidence relied heavily on weak or indirect measurement. Fourteen studies were classified as higher confidence, 20 as moderate and one as lower. Appendix B reports study-level judgments. Because appraisal was conducted by one reviewer and the full domain-by-domain matrix is not

publicly archived, these judgments should be treated as transparent interpretive assessments rather than externally replicated ratings.

3.6 Synthesis

The synthesis combined deductive and inductive framework analysis (Gale et al., 2013). The reviewer first familiarised themselves with the studies and charted extracted evidence in a matrix. Initial deductive categories came from self-regulated learning, self-determination and social interdependence theories. Inductive coding then identified explanations and design responses not adequately represented by those categories, including curriculum-level workload, performative group work, compensatory labour, learner heterogeneity and the distinction between constructive AI support and cognitive substitution. Evidence was compared across methods, disciplines and confidence levels. Contradictory findings were retained rather than resolved through vote counting, and lower-confidence studies did not alone support major conclusions.

4. Results

4.1 Characteristics and distribution of the evidence

The 35 included studies were published between 2015 and 2025 and spanned multiple national

and disciplinary settings. Most evidence came from Europe, East and Southeast Asia, North America or Australasia. Four studies provided direct evidence from African higher education, including South African and Ethiopian settings. Health-professions education and STEM were strongly represented, followed by language learning, teacher education and cross-disciplinary general education. Business and social-science contexts were comparatively sparse despite their frequent dependence on case discussion and group work.

The corpus combined learning analytics, surveys, quasi-experiments, structural models, mixed-methods studies and qualitative case evidence. Objective traces of preparation were less common than self-report, and direct observation or analysis of contribution quality was rarer still. Many studies measured engagement through satisfaction, attendance or perceived usefulness. These indicators are informative but cannot establish whether students engaged deeply with content, whether participation was equitably distributed or whether average outcomes concealed subgroup differences.

Table 3. *Selected characteristics of the included evidence*

Study	Context	Design	Primary focus	Contribution to synthesis
Bouwmeester et al. (2016)	Medical education	Mixed methods	How students prepared	Students used heterogeneous preparation strategies; time and guidance mattered.
Boevé et al. (2017)	Psychology/statistics	Diaries and outcomes	Study behaviour and performance	Some students resisted changing study routines; flipping was not a quick behavioural fix.
Jovanović et al. (2017)	Engineering	LMS sequence analytics	Pre-class strategies	Distinct strategy profiles differed in examination performance and changed over time.
White et al. (2017)	Pharmacy	Engagement and assessment data	Engagement-performance relationship	Engagement related differently to examination question types.
Jensen et al. (2018)	Science education	Comparative intervention	Pre-class learning strategy	Structured pre-class approaches affected preparation and classroom readiness.
Le Roux & Nagel (2018)	South African higher education	Qualitative/mixed	Perceived deep learning	Teaching, social and cognitive presence depended on a coherent blend, not technology alone.
Jovanović et al. (2019)	Engineering	Longitudinal LMS analytics	Regularity and performance	Regular and timely pre-class activity was more predictive than aggregate access.
Shih et al. (2019)	Cross-disciplinary university	Structural equation modelling	Online SRL and intention	Self-regulation and interaction predicted perceived usefulness and continued participation.

Study	Context	Design	Primary focus	Contribution to synthesis
Doo & Bonk (2020)	Large general-education class	Survey modelling	Engagement predictors	Self-efficacy, self-regulation and social presence were associated with engagement.
Tosuntaş (2020)	Undergraduate group work	Structural model, n=846	Social and cyberloafing	Larger groups and diffusion of responsibility were associated with loafing.
Rajaguru et al. (2020)	Business education	PLS modelling	Social loafing and work quality	Apathy, disruption and compensatory effort operated differently by group formation.
Jung et al. (2022)	Higher education	Regulation-supported intervention	Guided regulation	Explicit regulation support strengthened higher-order engagement.
Chen et al. (2023)	University flipped courses	Behavioural analytics	Pre- and in-class behaviour	Pre-class and in-class behaviours jointly predicted performance and experience.
Li (2023)	Teacher education	ChatGPT-guided intervention	AI-supported flipped learning	Guided AI use improved project performance and perceptions in the studied design.
Deng & Gao (2024)	University course	Quasi-experiment	Embedded pre-class questions	Embedded questions increased observable video engagement and supported learning measures.
Diningrat et al. (2024)	First-year language students	Survey/regression	Online SRL	Goal setting, environmental structuring and help seeking were prominent strategies.
Mengesha et al. (2024)	Ethiopian medical education	Interventional study	Learning and perceptions	Contextual feasibility was demonstrated, while infrastructure and implementation remained salient.

Note. Table 3 presents analytically influential studies rather than a complete evidence inventory. Appendix B lists all 35 included studies and confidence judgments.

4.2 RQ1: Preparation and participation were uneven and poorly captured by simple completion metrics

The clearest finding is heterogeneity. Students did not respond uniformly to the same flipped design. McNally et al. (2017) identified students who broadly endorsed the model and others who resisted pre-learning. Boevé et al. (2017) similarly found that introducing a flipped structure did not automatically transform study behaviour. Some students experienced the design as supportive, while others retained prior routines even when those routines were misaligned with the course. This evidence contradicts an implicit developmental assumption that university status is sufficient proof of independent-learning readiness.

Studies using learning analytics refined the meaning of preparation. Jovanović et al. (2017) identified distinct sequences of pre-class resource use associated with different performance profiles. Their later longitudinal analysis found that regularity and time management were predictive, indicating that aggregate counts conceal strategically important differences (Jovanović et al., 2019). A student who repeatedly returns to resources, attempts

questions and distributes effort across time is not equivalent to a student who opens the same resources immediately before class. Access is therefore a weak indicator; preparation should be operationalised through regularity, timeliness, completion, retrieval practice and evidence of comprehension.

Evidence about in-class participation was less mature. Many flipped studies assumed that small-group work represented engagement without measuring who contributed or the quality of contributions. Where collaborative processes were examined directly, participation was often unequal. Social-loafing studies showed that group size, reduced identifiability, apathy and disruptive behaviour can weaken effort, while conscientious students compensate to protect group outcomes (Rajaguru et al., 2020; Tosuntaş, 2020). The resulting product may look successful even though learning opportunities were distributed unevenly. Meaningful participation therefore requires evidence of reasoning, explanation, questioning or synthesis, not merely attendance or speech.

4.3 RQ2: Preparation and participation reflected interactions among learner readiness and design

4.3.1 Self-regulation and prior learning routines

Self-regulation was the most consistent learner-level explanation. Online goal setting, environmental structuring, time management and help seeking were associated with more positive engagement, while irregular last-minute patterns were associated with weaker outcomes (Dinigrat et al., 2024; Jovanović et al., 2019; Shih et al., 2019). Yet several studies also demonstrated that course design can strengthen regulation. Learning-analytics feedback, embedded questions and regulation prompts made the learning process more visible, although effects were not uniformly positive across all outcomes (Deng & Gao, 2024; Jung et al., 2022). The appropriate inference is not that self-regulation is a fixed entry requirement, but that flipped courses increase its importance and should therefore teach it explicitly.

4.3.2 Motivation, perceived value and resistance

Students were more willing to prepare when pre-class work was concise, accessible and clearly connected to classroom success. Conversely, resistance was associated with perceptions of additional workload, preference for direct explanation, uncertainty about expectations and weak alignment between preparation and assessment. Motivation was not reducible to whether students liked videos or group work. Students could appreciate flexibility while postponing work, or express satisfaction while contributing minimally. Autonomous motivation and task value offered a better account than positive attitude alone.

Credential-oriented or minimum-compliance behaviour was rarely measured directly, which is a notable gap. Nevertheless, the literature repeatedly showed sensitivity to assessment signals. Low-stakes quizzes, embedded questions and visible use of preparatory work increased completion or engagement in several studies. These mechanisms can establish accountability,

but they should not turn preparation into a series of easily outsourced answers. Tasks that require students to bring an example, uncertainty, interpretation or preliminary solution to class create a more authentic bridge between preparation and participation.

4.3.3 Workload, access and curriculum coherence

Preparation occurred within a curriculum rather than an isolated course. Excessive materials, overlapping deadlines and unreliable connectivity raised the cost of participation. African studies gave particular prominence to access, mobile compatibility and the need for inclusive design, but they also resisted technological determinism: the quality of interaction and alignment remained decisive even where access was available (Gerber & Eybers, 2021; Le Roux & Nagel, 2018). The evidence suggests that departments should audit total student workload across courses rather than interpreting non-completion course by course.

4.3.4 Psychological safety, language confidence and group structure

Silence in group discussion had multiple possible meanings. It could indicate non-preparation, low confidence, language difficulty, fear of public error, disagreement with the task, or a strategic decision to let dominant peers lead. Social presence and relational quality were associated with engagement in flipped settings, while social disconnectedness, apathy and dominance weakened the credibility of group work. Smaller groups, structured turn-taking, assigned intellectual roles and individual pre-discussion responses increased visibility and reduced the opportunity to disappear within a collective product.

Psychological safety does not mean removing challenge. It means enabling students to offer provisional reasoning, ask for clarification and disagree without interpersonal punishment. In multilingual classrooms, a rapid whole-group debate may privilege fluency over thought. Quiet individual writing followed by paired exchange and then group synthesis can preserve

intellectual demand while widening access to participation.

4.3.5 Learner diversity and differential effects

The evidence base rarely analysed preparation or participation through a sufficiently differentiated account of student diversity. Academic stage was the clearest recurring dimension: first-year and preparatory-year students often required more explicit regulation support, while several studies showed that established study routines did not change automatically when a course was flipped. Language confidence, social presence, prior academic preparation, connectivity and mobile access also appeared in international and African contexts. These findings support attention to transition, academic literacy and access, but not fixed assumptions about particular nationalities or demographic groups.

By contrast, age, personality, disability or neurodiversity, socioeconomic position, employment and care responsibilities were rarely modelled as moderators, and nationality was usually a study-location descriptor rather than an analysed mechanism. The corpus therefore cannot establish whether these attributes independently predict non-preparation or silence. Its more defensible contribution is to expose a reporting and design gap: average engagement scores may conceal who can access materials, who has time to prepare, who feels safe to speak, who is disproportionately asked to compensate for peers, and who benefits from the intervention.

4.3.6 Generative AI as scaffold and substitute

The evidence on generative AI within flipped learning remained emerging. A ChatGPT-guided flipped approach showed benefits when AI use was embedded within a structured pedagogical sequence (Li, 2023). This finding supports the possibility of AI as a tutor, question generator or feedback partner. It does not establish that unrestricted AI use promotes readiness. The core design distinction is whether AI expands the student's reasoning or replaces it. When a student asks for explanation, tests an argument and

verifies a source, AI may support regulation. When AI produces a summary or answer that the student cannot explain, visible completion becomes detached from cognition.

The review therefore introduces constructive and substitutive AI use as a readiness dimension. Courses should assess what students can explain, apply, critique and defend rather than whether they can submit a polished pre-class artefact. Oral justification, annotated reasoning, source comparison and transfer to a novel case make cognitive ownership more visible without assuming that AI use can be eliminated.

4.4 RQ3: Preparation and participation were associated with learning, but causal evidence remained limited

Across the stronger behavioural studies, preparation quality and regularity were positively associated with performance. Jovanović et al. (2017, 2019) found that strategy profiles and temporal regularity differentiated outcomes. White et al. (2017) showed that engagement related to assessment performance in ways that depended on question type, suggesting that preparation may support some forms of knowledge more than others. Chen et al. (2023) reported that pre-class and in-class behaviours jointly predicted performance and learning experience. These findings support a sequence in which preparation enables participation and participation supports application, but observational associations cannot establish that preparation alone caused achievement.

Intervention studies strengthened the inference that design matters. Jensen et al. (2018) demonstrated that pre-class learning strategy can be deliberately shaped. Embedded questions increased viewing behaviour and supported retention or transfer outcomes in a quasi-experimental design (Deng & Gao, 2024). Regulation-supported flipping promoted higher-order engagement (Jung et al., 2022). The convergence across these studies is more persuasive than a generic comparison of flipped and lecture formats: structured preparation and accountable

collaboration are active ingredients, while temporal rearrangement alone is insufficient.

The relationship between participation and learning was less consistently measured. Speaking frequency can reflect confidence or dominance rather than conceptual quality. Group products can conceal individual learning. Studies that analysed dialogue, individual assessments or contribution patterns offered more defensible evidence than studies using participation marks or satisfaction. Future research should link individual preparation traces to observed contribution quality and authenticated individual outcomes within multilevel designs.

4.5 RQ4: Design principles for progressive autonomy

The synthesis generated eight design principles. First, preparation should be bounded: short, purposeful resources with explicit learning questions are more defensible than transferring a full lecture while retaining the previous homework load. Second, preparation should be consequential: students should need their preliminary thinking to succeed in class, and low-stakes readiness assurance should expose misconceptions without converting every activity into high-stakes surveillance. Third, individual cognition should precede group discussion. A brief written response, concept map or case judgment gives each student a position to contribute and makes unequal preparation visible.

Fourth, collaboration should be structured around intellectual roles and individual accountability. Roles such as evidence analyst, critic, application specialist and synthesiser distribute thinking more effectively than purely administrative roles. Fifth, participation should be multimodal and psychologically safe, allowing quiet writing, paired rehearsal, oral contribution, accessible digital input and sufficient wait time without reducing intellectual demand. Sixth, feedback should be rapid and diagnostic: pre-class responses should alter what the instructor does. Seventh, submitted work should require explanation, application, source verification and transfer so that AI-enabled fluency cannot substitute for understanding. Eighth, autonomy should be progressively transferred and support differentiated according to demonstrated readiness rather than assumed from age or university status.

These principles are represented in the Progressive Autonomy Model in Figure 3. The model rejects both permanent lecturer domination and premature withdrawal. Scaffolding is not the opposite of student-centred learning; it is the route through which students can become capable of increasingly independent and collaborative work. Movement across stages is non-linear and task-specific, and accessible design, feedback and assessment integrity remain instructor responsibilities throughout.

Progressive Autonomy Model for Undergraduate Learning

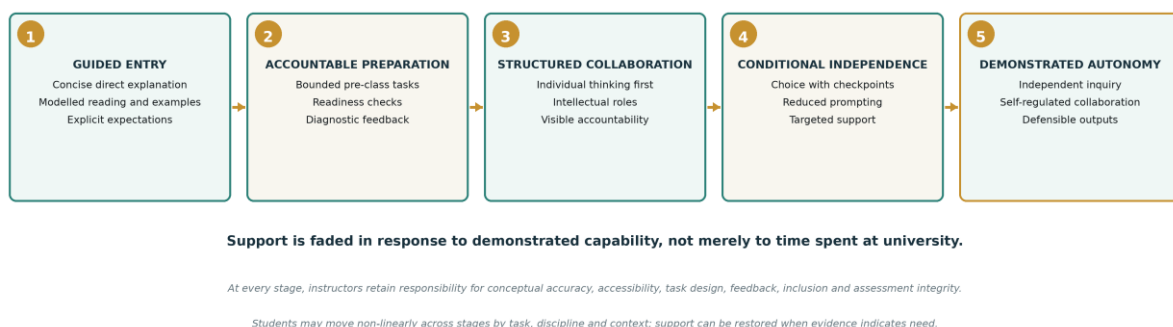


Figure 3. Progressive Autonomy Model for undergraduate learning. Support is faded in response to demonstrated capability and may be restored when evidence indicates need.

Table 4. Evidence-based design principles

Problem mechanism	Design response	Observable indicator
Late or superficial preparation	Chunked resources, clear time estimates, embedded retrieval and preparation prompts	Regular access, completed readiness checks, ability to explain key concepts
Preparation perceived as optional	Use pre-class responses directly in class; assign a small but meaningful assessment weight	Students bring evidence, examples or preliminary solutions that are required for the task
Silence or domination	Individual thinking before discussion; small groups; structured turn-taking and intellectual roles	Contribution distribution widens and more students provide reasons or evidence
Social loafing and compensatory labour	Visible individual outputs, peer accountability and differentiated individual/group grading	Group products can be traced to individual contributions; peer ratings show fewer persistent non-contributors
Fear of error or language insecurity	Psychologically safe protocols, wait time, paired rehearsal and multiple participation modes	More questions, provisional explanations and constructive disagreement
AI-enabled symbolic compliance	Require explanation, application, source verification and transfer to novel cases	Students can defend and adapt submitted work without relying on generated wording
Premature autonomy	Progressive reduction of guidance based on demonstrated readiness	Scaffolds are faded when behavioural and learning evidence shows capability
Diverse readiness profiles hidden by averages	Accessible resources, multiple participation modes, transparent workload, and ethical subgroup monitoring without stereotyping	Preparation, contribution and learning indicators improve across student groups; persistent gaps trigger redesign rather than deficit labelling

5. Discussion

5.1 The autonomy-readiness gap

The review shows why a debate framed as flipped versus traditional teaching is conceptually inadequate. The same design can support students who possess stable regulatory routines and frustrate students who do not. The relevant unit of analysis is alignment between demanded autonomy and demonstrated readiness. A university may describe its pedagogy as student-centred, yet impose a level of unsupervised responsibility that students have never been taught to manage. When students then fail to prepare, the failure is interpreted as personal irresponsibility rather than as evidence about the design's developmental assumptions.

This is not an argument for lowering expectations. It is an argument for distinguishing expectations from capabilities and for treating capability development as part of teaching. Independent learning is an educational outcome. It includes habits of attention, time management, epistemic monitoring and persistence that can be taught, practised and assessed. Presuming

these capacities can reproduce inequality because students with stronger prior academic socialisation are better positioned to benefit from autonomy, while others experience the same flexibility as ambiguity.

5.2 The collaboration-readiness gap

A corresponding collaboration-readiness gap arises when institutions equate group formation with collaborative learning. The literature shows that group outcomes can be maintained by a minority who absorb the work of less engaged peers. This compensatory labour is pedagogically troubling for both groups. Passive members receive credit without equivalent learning, while diligent members lose opportunities for dialogue because they must secure task completion. The visible success of the group conceals unequal cognitive participation.

Meaningful participation should therefore be defined qualitatively. It includes offering reasons, linking claims to evidence, asking questions, explaining concepts, challenging assumptions, integrating perspectives and helping peers advance. An instructor who measures only attendance, speaking turns or group submissions cannot determine whether these

processes occurred. The central evaluation question is not whether students talked, but who performed the reasoning and how widely that reasoning was distributed.

5.3 From student-centred appearance to cognitive engagement

The review supports a broader philosophical distinction between the appearance and substance of student-centred learning. Reduced lecturer talk, online materials and visible group activity are structural indicators. They do not guarantee agency, understanding or inclusion. A silent lecturer can preside over a classroom in which one student teaches the group, several copy an answer, and others wait. Conversely, a concise instructor explanation can be deeply student-centred when it resolves a common misconception identified through pre-class work and enables students to undertake a more demanding application.

Lecturer activity and student agency are not a zero-sum relationship. The appropriate amount of direct instruction depends on prior knowledge, task complexity, time and demonstrated readiness. The instructor's responsibility shifts from continuous exposition to deliberate orchestration, but it does not disappear. Student-centred pedagogy becomes performative when the institution values the format more than evidence of learning.

5.4 Theoretical contribution: readiness as relational and developmental

The Autonomy-Collaboration Readiness Framework extends self-regulated learning by locating regulation within a social and curricular ecology. Students regulate not only time and strategy, but also whether preparation is worth doing in light of assessment, group norms and instructor behaviour. It extends self-determination theory by showing how credible task design can convert externally required preparation into identified value. It extends social interdependence theory by treating individual preparation as a precondition for positive

interdependence: students cannot contribute distinct intellectual resources if they arrive without resources to exchange.

Readiness is consequently relational and developmental. It is relational because the same student may prepare diligently for a course where preparation is concise and consequential, yet disengage where materials are excessive and discussion is superficial. It is developmental because regulatory and collaborative capacities can strengthen through guided practice. This formulation avoids two errors: blaming students as inherently unmotivated, and absolving students of responsibility. Responsibility is shared but differentiated. Institutions design the environment; instructors structure the work; students remain accountable for engaging with reasonable and transparent expectations.

5.5 Learner diversity, equity and the limits of average effects

The review adds an equity qualification to the readiness argument. A course can improve mean achievement while widening participation inequalities or transferring hidden labour to a conscientious minority. Readiness data should therefore be disaggregated where ethically and statistically defensible, but demographic categories must not be treated as explanations in themselves. The relevant question is which mechanisms connect a student's circumstances to the task: time scarcity, language demand, sensory or attentional barriers, prior academic socialisation, access, psychological safety, group status or assessment incentives.

This position avoids both universalism and stereotyping. It rejects the assumption that one model is equally accessible to all students, but it also rejects deterministic claims that older, international, introverted, neurodivergent or early-stage students are inherently less capable of autonomy or collaboration. Equity-sensitive student-centred learning offers multiple legitimate routes into demanding cognitive work while retaining common standards for evidence, explanation and individual learning.

5.6 African higher education and the limits of transfer

The small African evidence base prevents confident regional generalisation. The included studies show that flipped designs can be feasible and valuable, but also foreground connectivity, mobile access, linguistic diversity and uneven academic preparation. Models developed in highly resourced settings cannot be transferred by copying their technological surface. Contextual adaptation requires attention to data costs, device compatibility, commuting, employment, language, class size and the cumulative workload created by several courses adopting pre-class requirements simultaneously. This contextual argument is consistent with recent work on African digital transition, which shows that credible online and blended provision depends on coordinated governance, quality assurance, infrastructure, assessment, staff capability and learner support rather than technological adoption alone (Sangwa et al., 2026).

The scarcity of African evidence is itself significant. It means that institutions may be importing strong pedagogical prescriptions from research conducted in different material and educational conditions. Local evaluation should therefore accompany implementation. Such evaluation should not merely ask whether students enjoyed the model, but should examine preparation traces, participation distribution, individual learning and differential effects across student groups.

6. Implications for Research, Practice and Policy

6.1 Course design

Course teams should specify the function of every pre-class activity. If a resource is not needed for a subsequent task, it should be reconsidered. Workload estimates should be tested with students rather than inferred from video duration or page count. Readiness checks should diagnose understanding and feed directly into

teaching. A useful sequence is individual preparation, individual commitment to a preliminary answer, peer explanation, revised individual judgment and instructor synthesis. This preserves both accountability and the learning benefits of discussion.

6.2 Group-discussion design

Unstructured prompts such as discuss the reading should be replaced by tasks that create intellectual interdependence. Each member can analyse a different source, assumption, stakeholder or dimension, but all must contribute to a shared decision. Group size should remain small enough for absence to be visible. Roles should rotate and should distribute reasoning rather than merely administration. Individual exit responses can determine whether students learned from the discussion rather than merely copied the group conclusion.

6.3 Curriculum and institutional policy

Institutions should avoid mandating a single percentage of student talk or treating minimal lecturing as a quality indicator. Teaching quality should be judged through alignment, inclusivity, intellectual challenge, feedback and evidence of learning. First-year curricula should explicitly teach academic reading, self-regulation, productive AI use, discussion and disagreement. Programme teams should coordinate preparation demands across courses. A pedagogy that is manageable in isolation can become unreasonable when every course transfers substantial content outside class. Related work in the Global South similarly argues that generative-AI-related academic integrity is better addressed through assessment redesign and transparent governance than through detection- or surveillance-led responses alone (Sangwa & Mutabazi, 2025).

6.4 Equity-sensitive implementation and evaluation

Course teams should examine not only average completion and satisfaction but the distribution

of preparation, participation and learning. Materials should be mobile-compatible and accessible, with captions or transcripts where relevant; time estimates should reflect actual student effort; and participation should not depend exclusively on rapid public speech. Quiet individual reasoning, paired rehearsal, rotating intellectual roles and accessible digital contribution can widen participation without lowering standards. Any subgroup monitoring should be proportionate, privacy-conscious and directed toward redesign rather than labelling students.

6.5 Future research

The next generation of studies should connect three data layers: objective pre-class behaviour, observed in-class contribution quality and authenticated individual learning outcomes. Multilevel longitudinal designs are needed because students are nested within groups and courses and because preparation habits change over time. Researchers should preregister theoretically justified moderation analyses and report whether effects vary by academic stage, age, language background, prior preparation, nationality or cultural context, disability or neurodiversity, personality-related preferences, socioeconomic circumstances, employment and care responsibilities. Such analyses require adequate power and careful mechanism-based interpretation rather than demographic fishing. Studies should also distinguish constructive AI support from cognitive outsourcing, compare structured and unstructured collaboration, and undertake multi-institutional African research across disciplines.

7. Limitations

This review has six principal limitations. First, the OpenAlex interface allowed export of only 100 relevance-ranked records from a much larger broad match, while SciSpace semantic discovery was ranking-dependent. Supplementary searches and citation chasing reduced but did not eliminate retrieval bias. Second, the search did not include subscription databases

such as Scopus or Web of Science and was restricted to English-language full texts. Third, the review plan was not prospectively registered or time-stamped. Fourth, screening, extraction and appraisal were conducted by one reviewer without independent duplicate checking, which increases the risk of selection and interpretive error. Fifth, methodological heterogeneity and inconsistent operationalisation prevented defensible meta-analysis. Sixth, demographic and contextual reporting was too sparse for strong claims about differential effects across diverse student groups. The framework should therefore be tested prospectively rather than treated as validated.

A further interpretive limitation concerns rapid technological change. Evidence on generative AI within flipped learning was emerging at the 2025 publication cutoff. The distinction between constructive and substitutive AI use is theoretically and pedagogically plausible but rests on a smaller empirical base than the claims concerning self-regulation, assessment signals and social loafing.

8. Conclusion

Flipped and collaborative learning do not fail simply because students are distracted, unmotivated or reluctant to discuss, and they do not succeed simply because lectures are moved online and students are seated in groups. Their effectiveness depends on alignment among demanded autonomy, collaborative structure, learner readiness, diverse circumstances, credible tasks, individual accountability, psychological safety, feedback and manageable workload.

Preparation is better understood through regularity, timeliness, productive strategy use and demonstrated comprehension than through access alone. Participation is better understood through the quality and distribution of reasoning than through attendance or speaking frequency. When students neither prepare nor participate, the defensible response is neither an automatic return to continuous lecturing nor

rigid adherence to a nominally student-centred format. Progressive autonomy offers a conditional middle path: guide, model, require, observe, include and gradually release

responsibility as students demonstrate the capacity to use it. Student-centred learning should be an educational achievement, not an untested assumption imposed at entry.

Declarations

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CONFLICTS OF INTEREST	The author declares no competing interests.
ETHICS APPROVAL	Not applicable. This study synthesised published research and involved no primary human-participant data.
INFORMED CONSENT	Not applicable.
DATA AVAILABILITY	Search strings, PRISMA counts, exclusion reasons and the study-level evidence map are provided in Appendices A-B. The full screening and extraction workbook is not publicly deposited.
MATERIALS AND CODE AVAILABILITY	Not applicable.
USE OF GENERATIVE AI	OpenAI ChatGPT (GPT-5.6 Thinking, accessed July 2026) supported language refinement, structural and methodological consistency checking, and formatting only. It was not used for searching, screening, eligibility decisions, data extraction, appraisal, or generation of empirical findings. Figures were based on author-defined concepts and produced without generative image tools. The author verified all content, citations and interpretations and accepts full responsibility.
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Appendix A. Review Plan, Search Documentation and PRISMA Records

A1. Review questions and review-plan decisions

The review plan fixed the four questions reported in Section 1.4, the 2015–2025 publication window, the higher-education population, the empirical-design requirement and the distinction between preparation access and preparation quality. It also specified that group participation would be interpreted through contribution quality or distribution where evidence permitted. The plan was finalised before full-text synthesis but was not prospectively registered or time-stamped. Generative AI was added as an emergent subtheme after eligible post-2022 studies were identified. During synthesis, learner-diversity coding was refined to distinguish measured moderators from untested sources of heterogeneity; this was treated as an emergent analytic extension rather than a pre-specified outcome.

A2. Search strings

OpenAlex core string: "flipped classroom" AND ("higher education" OR university OR undergraduate) AND ("pre-class" OR preclass OR preparation OR engagement OR "self-regulated learning" OR participation). Filters: article; English where indexed; publication date 2015-01-01 to 2025-12-31.

ERIC strings: (1) "flipped classroom" AND ("pre-class" OR preparation OR self-regulated) AND higher education; (2) "flipped classroom" AND engagement AND university; (3) "group work" AND ("social loafing" OR participation OR "individual accountability") AND higher education.

SciSpace semantic questions: (1) What empirical higher-education studies examine completion of pre-class activities, preparation compliance and self-regulation in flipped classrooms? (2) What empirical higher-education studies examine unequal participation, social loafing, psychological safety or individual accountability in group discussion? (3) How do motivation, workload, social-media distraction and generative AI affect preparation and engagement? (4) What evidence addresses flipped or student-centred learning in African higher education?

A3. PRISMA counts

Stage	Count	Decision rule
Database and discovery-index records	160	OpenAlex export 100; ERIC 20; SciSpace 40
Other-method records	12	Backward and forward citation searching
Duplicates removed	18	DOI match; otherwise normalised title plus first author
Unique records screened	154	Title and abstract screening
Records excluded	103	Outside population, phenomenon, date, language or empirical scope
Full texts sought	51	Potentially met all eligibility criteria
Reports not retrieved	4	No accessible full text through public or author routes
Full texts assessed	47	Eligibility and methodological sufficiency assessed
Full texts excluded	12	Reasons reported below
Studies synthesised	35	Entered framework synthesis

A4. Full-text exclusion reasons

Reason	n	Interpretation
No direct measure or substantive interpretation of preparation/participation	5	Reported general effectiveness or satisfaction without evidence relevant to the review mechanism
Not higher education	3	School-only population

Reason	n	Interpretation
Review, commentary or non-empirical article	2	Used for contextual citation where relevant but excluded from empirical corpus
Insufficient methodological information	2	Could not appraise design, sample or analysis

Appendix B. Study-Level Evidence Map and Appraisal

The table below records the 35-study evidence corpus. Confidence categories are interpretive summaries based on design alignment, measurement quality, transparency and relevance to

the review questions; they are not numerical scores. Fourteen studies were judged higher confidence, 20 moderate and one lower. Because appraisal was undertaken by one reviewer, these categories should be interpreted cautiously and ideally accompanied by a deposited domain-level appraisal matrix.

Study	Evidence focus	Design	Confidence
Bouwmeester et al., 2016	Preparation strategies	Mixed methods	Moderate
Chen et al., 2015	Cooperative learning in flipped statistics	Mixed methods	Moderate
Long et al., 2016	Pre-class video perceptions	Survey	Lower
Butzler, 2016	SRL tools and flipping	Comparative	Moderate
McLaughlin et al., 2016	Implementation across institutions	Case comparison	Moderate
Boevé et al., 2017	Study behaviour and performance	Diary/mixed	Higher
Jovanović et al., 2017	Pre-class learning strategies	Learning analytics	Higher
White et al., 2017	Engagement and exam performance	Observational analytics	Higher
McNally et al., 2017	Student preferences and resistance	Survey/mixed	Moderate
McCollum et al., 2017	Relationships in flipped learning	Qualitative/mixed	Moderate
Jensen et al., 2018	Pre-class learning strategies	Comparative	Higher
Silva et al., 2018	Learning analytics feedback and SRL	Quasi-experimental	Moderate
Le Roux & Nagel, 2018	Deep learning and community of inquiry	Qualitative/mixed	Moderate
Shih et al., 2019	Online SRL and participation intention	SEM survey	Higher
Jovanović et al., 2019	Regularity and performance	Longitudinal analytics	Higher
Røe et al., 2019	Physiotherapy flipped design	Mixed methods	Moderate
Jdaitawi, 2019	Self-regulation and social connectedness	Quasi-experimental	Moderate
Doo & Bonk, 2020	Self-efficacy, SRL, social presence	Survey modelling	Higher
Hava, 2021	Deep learning and engagement	Quasi-experimental	Moderate
Xiu & Thompson, 2020	Motivation and learning	Mixed methods	Moderate
Tosuntaş, 2020	Social and cyberloafing	Structural modelling	Higher
Rajaguru et al., 2020	Loafing and group work quality	PLS modelling	Higher
Ahmed & Indurkha, 2020	Cognitive holding power and equity	Survey/quantitative	Moderate
Kim et al., 2021	Design fidelity and outcomes	Mixed/quantitative	Moderate
Cho et al., 2021	Active learning in engineering	Quasi-experimental	Moderate
Gerber & Eybers, 2021	Inclusive online flipped learning	Case study	Moderate
Jung et al., 2022	Regulation-supported flipping	Intervention	Higher
Yoo et al., 2022	LMS behaviours and success	Learning analytics	Higher
Li & Li, 2022	Language engagement	Mixed methods	Moderate
Fidan, 2023	Microlearning-supported flipping	Quasi-experimental	Higher
Chen et al., 2023	Pre/in-class behaviour and outcomes	Behavioural analytics	Higher
Li, 2023	ChatGPT-guided flipping	Quasi-experimental	Moderate
Deng & Gao, 2024	Embedded questions	Quasi-experimental	Higher
Diningrat et al., 2024	Online SRL strategies	Survey/regression	Moderate
Mengesha et al., 2024	African medical education intervention	Interventional	Moderate

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