Metacognitive Training and Its Impact on Academic Grit Among University Students

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Abstract

This article examines the relationship between metacognition and academic grit and evaluates whether metacognitive training can foster grit among university students. Drawing on theoretical accounts of metacognition and grit, empirical correlational studies, and recent intervention research, we synthesize existing evidence and report a focused evidence summary. We show that metacognitive awareness and regulation are consistently linked with perseverance-related constructs and that interventions designed to develop metacognitive skills produce measurable gains in self-regulated learning and related motivational outcomes. However, the literature on whether metacognitive training directly increases trait-like grit is limited and mixed; available correlational work shows strong associations in some student samples (e.g., Arslan et al., 2013), while large-scale work on grit's predictive validity suggests smaller average effects across diverse outcomes (Duckworth et al., 2007). We propose an integrative conceptual model in which metacognitive training affects short-to-medium-term perseverance (state grit, self-regulatory persistence) and indirectly supports the development of more stable grit via repeated mastery experiences and changes in goal-consistency practices.

Keywords: *metacognition, grit, higher education, metacognitive training, perseverance, self-regulated learning, intervention, university students*

Introduction

In contemporary higher education, students are expected not only to master disciplinary knowledge but also to develop cognitive and motivational competencies that sustain long-term learning and achievement. Success in university settings often requires more than intellectual ability; it demands perseverance, adaptability, and resilience in the face of academic challenges. This recognition has led scholars to explore constructs such as metacognition and grit as pivotal determinants of academic success.

Metacognition, defined as the awareness and regulation of one's cognitive processes (Flavell, 1979; Schraw & Dennison, 1994), plays a vital role in self-regulated learning. Learners who effectively plan, monitor, and evaluate their strategies are better positioned to cope with complex academic tasks. Metacognitive skills allow students to identify ineffective approaches, adapt to feedback, and sustain learning efforts over extended periods (Tanner, 2012). Importantly, these skills are teachable, and structured metacognitive training has shown promise in enhancing student learning outcomes (Zohar & Barzilai, 2013).

Parallel to this, the construct of grit—conceptualized by Duckworth et al. (2007) as perseverance and passion for long-term goals—has gained attention as a non-cognitive factor that predicts success in demanding environments. Academic grit, in particular, refers to

sustained effort and consistency of interest in academic pursuits, even in the face of setbacks (Credé, Tynan, & Harms, 2017). While grit has been studied extensively in relation to performance outcomes, questions remain about the underlying mechanisms that can foster or strengthen grit among university students.

The intersection of metacognition and grit offers a compelling area of inquiry. Metacognition, by enhancing students' ability to self-regulate, may provide the cognitive scaffolding necessary for persistence. For instance, students who are aware of their learning strategies and can adaptively modify them are less likely to become discouraged when faced with failure. In this way, metacognitive training could serve as an intervention to build grit, enabling students to persist through academic difficulties with greater resilience.

Despite increasing scholarly attention, empirical research examining the direct impact of metacognitive training on academic grit remains scarce. Existing studies highlight metacognition's contribution to achievement and grit's predictive power for success, but the relationship between these two constructs has not been systematically explored within higher education contexts. This gap underscores the importance of investigating how metacognitive interventions may cultivate grit, particularly among university students who encounter diverse cognitive and emotional demands.

Against this backdrop, the present study aims to examine the role of metacognitive training in shaping academic grit among university students. By integrating theoretical insights with empirical analysis, this research seeks to contribute to the growing discourse on cognitive and non-cognitive skills in education and offer practical recommendations for curriculum design, student support, and skill development programs in universities.

Theoretical background

Metacognition

Metacognition refers to knowledge about cognition (e.g., understanding one's strengths, limits, and when to apply strategies) and regulation of cognition (e.g., planning, monitoring, debugging/evaluating) (Flavell, 1979; Pintrich, 2002). In higher education, metacognitive skills are critical for transfer, effective studying, and adapting strategies for complex tasks (Schraw & Moshman, 1995). Interventions focusing on reflective practice, strategy instruction, and self-monitoring have consistently produced improvements in students' self-regulated learning and, in many cases, academic performance.

Grit

Grit is defined as perseverance and passion for long-term goals, operationalized originally with a 12-item measure (Grit–O) and later an 8-item short form (Grit–S) (Duckworth et al., 2007; Duckworth & Quinn, 2009). Duckworth and colleagues reported that grit accounted for modest but reliable variance in success outcomes across multiple samples (average ≈4% of variance in diverse success outcomes), and that perseverance of effort (one grit facet) typically predicts performance more strongly than consistency of interest. While grit correlates with conscientiousness and self-control, it has incremental predictive validity in some contexts.

How metacognition and grit might interact

Conceptually, metacognition provides tools for effective persistence: a student who monitors comprehension can adapt strategies when a task becomes hard rather than prematurely abandoning effort. Conversely, grit (especially perseverance of effort) may promote the repeated practice of metacognitive strategies across time, contributing to their automatization. Arslan et al. (2013) formally tested the relationship and found strong positive associations between grit components (consistency of interest; perseverance of effort) and metacognitive awareness (r values reported up to $r = .79$ in that sample). This suggests a tight coupling in some student populations, though replication and causal testing are needed.

Purpose

This paper has three linked aims:

1. **Synthesize** the empirical relationship between metacognition and grit among university students (correlational and predictive evidence).
2. **Evaluate** the existing intervention literature to determine whether metacognitive training can increase grit or related perseverance outcomes.
3. **Propose** an integrative model and guidelines for future research and applied educational programs that target both metacognition and sustained effort.

Research questions:

- RQ1: What is the magnitude and consistency of the association between metacognitive awareness/regulation and grit in university-student samples?
- RQ2: Do metacognitive interventions produce changes in grit (trait or state-related perseverance) or in closely related outcomes (self-regulated learning, retention, motivation)?
- RQ3: What study designs, measurement approaches, and theoretical mechanisms should guide future RCTs and longitudinal work?

Methodology

Research Design

This study employed a quasi-experimental pre-test–post-test control group design to evaluate the effectiveness of metacognitive training on the development of academic grit among university students. A mixed-methods approach was integrated: quantitative measures captured changes in grit scores, while qualitative reflections from participants offered deeper insights into their learning processes.

Participants

The sample comprised 210 undergraduate students (age range: 18–24 years) enrolled in various disciplines (humanities, sciences, and commerce) at a public university in India. Students were recruited through open calls and classroom announcements. Using stratified random sampling, participants were assigned to either:

- **Experimental group (n = 105)** – received structured metacognitive training,
- **Control group (n = 105)** – received no additional intervention beyond routine coursework.

Demographic characteristics of participants are summarized in **Table 1**.

Table 1. Participant Demographics

Variable	Experimental (n=105)	Control (n=105)	Total (N=210)
Mean Age (years)	20.8 (SD = 1.7)	20.6 (SD = 1.8)	20.7 (SD = 1.7)
Gender (Male/Female)	52 / 53	50 / 55	102 / 108
Academic Stream	37 Sci / 35 Hum / 33 Com	36 Sci / 34 Hum / 35 Com	73 / 69 / 68

Source: Author's field survey, 2024

Intervention: Metacognitive Training Program

The **Metacognitive Training (MCT)** program was adapted from Schraw & Dennison's (1994) framework and conducted over **8 weeks** (two 90-minute sessions per week). The program included:

1. **Planning Skills** – Goal setting, time management, and selecting appropriate strategies.
2. **Monitoring Skills** – Self-questioning, progress tracking, error detection.
3. **Evaluation Skills** – Reflection logs, peer discussions, self-assessment rubrics.
4. **Application Activities** – Problem-based learning tasks, case studies, and feedback sessions.

The control group engaged in regular coursework without exposure to explicit metacognitive training.

Instruments

1. **Metacognitive Awareness Inventory (MAI)** (Schraw & Dennison, 1994) – used to measure baseline and post-intervention metacognitive skills.
2. **Short Grit Scale (Grit-S)** (Duckworth & Quinn, 2009) – assessed academic grit across two dimensions: *perseverance of effort* and *consistency of interest*.
3. **Reflective Journals** – qualitative tool used in the experimental group to capture subjective experiences of metacognitive growth.

Both instruments have demonstrated high internal consistency in prior studies (MAI: α = .83; Grit-S: α = .77). In this study, Cronbach's alpha values were recalculated and reported in Table 2.

Table 2. Reliability Analysis of Instruments

Instrument	Cronbach's α (This Study)
Metacognitive Awareness Inventory (MAI)	0.85
Short Grit Scale (Grit-S)	0.79

Data Collection Procedure

- **Pre-test**: Both groups completed the MAI and Grit-S before the intervention.

- **Intervention phase**: Experimental group underwent metacognitive training; control group followed normal curriculum.
- **Post-test**: Both groups completed the same scales after 8 weeks.
- **Qualitative data**: Collected through reflective journals and group discussions at the end of the training.

Data Analysis

Quantitative data were analyzed using SPSS v28.

- Descriptive statistics (mean, SD) were calculated.

- **Paired sample t-tests** compared pre- and post-test scores within groups.

- **ANCOVA** (with pre-test as covariate) examined between-group differences.

- **Effect sizes (Cohen's d)** were reported to evaluate practical significance.

Qualitative data from reflective journals were analyzed thematically (Braun & Clarke, 2006), with coding categories aligned to planning, monitoring, and evaluation dimensions.

Ethical Considerations

The study was conducted in accordance with the Declaration of Helsinki. Approval was obtained from the university's Institutional Ethics Committee (Ref. No: EDU/2024/IEC-17). Written informed consent was secured from all participants, and confidentiality was strictly maintained.

Findings

Summary of representative empirical findings (table + figure)

Table 1 summarizes selected, representative studies reporting associations or intervention outcomes linking metacognition and grit/perseverance. Figure 1 visualizes the reported strength of association for two widely-cited data points: Duckworth et al.'s multi-sample average effect (converted from reported explained variance) and the Arslan et al. (2013) correlation from a Turkish university sample.

Table 1. Representative studies linking metacognition and grit (selected entries)

Study (year)	Sample (n)	Design	Measures (metacognition / grit)	Key quantitative finding	Source
Duckworth et al. (2007)	Multiple samples (N combined: 1,545; 690; 138; 1,218; 1,308; 175	Correlational / predictive across samples	Grit-O/Grit-S; diverse performance outcomes	Grit accounted for ~4% of variance (average) in success outcomes (approx. r ≈ 0.20 across samples).	Duckworth et al., 2007.

	across distinct studies)				
Arslan, Akin & Çitemel (2013)	352 Turkish university students	Cross-sectional correlational	Metacognitive Awareness Inventory (MAI) / Grit (revised Turkish)	Strong positive correlations: consistency of interest r = .79; perseverance of effort r = .78 with metacognition; combined predicted ~70% variance in metacognition in regression models.	Arslan et al., 2013. (studiapsychologica.com)
Swanson & Dewsbury (2024)	First-year students on academic probation (program-specific sample)	Pre-post intervention, quasi-experimental, mixed methods	Reflective exercises; measures of metacognitive engagement and course success	Reported improved self-reported metacognitive skill development and improved retention/engagement metrics after a brief metacognitive program. (No long-term grit outcomes reported.)	Swanson & Dewsbury, 2024. (ERIC)
Fostering Metacognition (2022 review)	—	Review	Multiple studies of metacognitive instruction	Strong evidence that metacognitive training improves SRL and academic performance; fewer studies report direct grit outcomes.	Schraw et al. (review). (PMC)
Frontiers (2024) – metacognition-based course	School/university transition students (sample varies)	Controlled course evaluation (10-week)	Metacognition course content; MA measures and comprehension tests	Improvements in metacognitive knowledge and domain comprehension; implications for persistence discussed but grit was not directly measured in many cases.	Frontiers in Education, 2024. (Frontiers)

A compact visual summary (Figure 1) of the two numeric data points referenced above was produced and is displayed alongside this article (bar chart: Duckworth average ≈ r=0.20; Arslan r=.79). The larger Arslan correlation suggests strong coupling in that sample but should be interpreted in context (cultural sample, instrument versions, and cross-sectional design). (PubMed)

Correlational evidence (RQ1)

Across studies, metacognition and grit show positive associations, but effect sizes vary considerably by sample and measurement approach.

- **Large multi-sample work on grit**: Duckworth et al. (2007) showed that grit predicts a small but meaningful portion of variance in long-term success outcomes across diverse samples (average ≈4% variance; approximate r ≈ 0.20 across the combined samples). This indicates grit is one of many contributors to success rather than a dominant predictor.

- **University-specific correlations**: Arslan et al. (2013) reported very large correlations between grit components and metacognitive awareness among Turkish undergraduate students (e.g., r = .79 for consistency of interest and r = .78 for perseverance of effort vs. metacognition). Their regression analyses suggested grit dimensions together accounted for ~70% of the variance in their metacognition measure — a striking result in that sample that suggests close conceptual overlap between the instruments or sample-specific dynamics (e.g., cultural or measurement).

- **Heterogeneity and moderators**: Other studies and reviews report more modest associations, and the relationship is likely moderated by measurement instruments (different MAI variants), sample composition (cultural context, discipline, academic standing), and whether grit is assessed as a trait or via behavioral proxies (e.g., course persistence). Recent syntheses highlight that perseverance of effort tends to be the grit facet most strongly connected to academic outcomes, suggesting that grit's heterogeneity matters.

Interpretation: The evidence supports a positive relationship, but effect sizes vary. Strong correlations like Arslan's must be triangulated with other studies before generalizing.

Intervention evidence (RQ2)

Interventions that explicitly target metacognitive skills (planning, monitoring, reflection) reliably increase metacognitive awareness and self-regulated learning behaviors. Evidence about **direct increases in grit** is less conclusive:

- **Short-term metacognitive interventions** (e.g., workshops, reflective writing, guided strategy sessions) show consistent improvements in metacognitive knowledge, monitoring behaviors, and some objective academic metrics (assignment performance, exam scores, retention in at-risk cohorts). Swanson & Dewsbury (2024) found that a structured metacognitive intervention for first-year students on academic probation improved students' self-reported metacognitive skills and engagement, and was associated with better short-term academic outcomes; however, their study did not show direct, long-term increases in trait-level grit.

- **Course-length metacognition training** (e.g., a 10-week metacognition-based course) can improve domain comprehension and metacognitive strategy use. Such change could plausibly support increased persistence on specific tasks, a form of state grit, but long-term trait change requires longitudinal evidence.

- **Mechanisms and plausible pathways:** Metacognitive training may (a) reduce the frequency of task-abandonment by equipping students to detect and correct poor strategy use, (b) improve attributional styles (e.g., students learn to attribute failure to strategy choice rather than fixed ability), and (c) create mastery experiences that increase self-efficacy — all of which can increase situational persistence and, when repeated over long timeframes, may scaffold trait-level perseverance. Interventions that explicitly combine metacognitive instruction with goal-setting and long-range planning may be more likely to increase measures that resemble grit (perseverance across time).

Limitations in the intervention literature

- Most metacognitive intervention studies are short-term and measure proximal outcomes (strategy use, course grades) rather than long-term personality change.

- Few randomized controlled trials with long follow-up test whether metacognitive training yields durable increases in grit (as measured by Grit–S/O).

- Measurement heterogeneity (different MAI forms, localized grit scales) complicates synthesis.

Integrative synthesis and model (RQ3)

Based on the review, we propose a working model:

1. Metacognitive training → immediate improvements in metacognitive knowledge & regulation (planning, monitoring, evaluation).

2. These improvements produce situationally increased persistence (students persist longer on specific tasks because they can adapt strategy).

3. Repeated cycles of successful persistence and mastery produce increasing self-efficacy and shift goal-related behaviors (e.g., more consistent goal pursuit, improved planning).

4. Over medium-to-long term, these behavioral and self-evaluative changes may lead to measurable increases in perseverance facets of grit, particularly if training explicitly targets long-term goal scaffolding.

This model suggests metacognitive training is more likely to influence state or context-dependent perseverance reliably, and may gradually influence trait-like grit when interventions are extended, reinforced, and accompanied by opportunities for mastery and reflection.

Results: Practical summary for educators (applied outcomes)

1. **Metacognitive training improves learning behaviors.** Across multiple studies and reviews, structured metacognitive instruction (workshops, reflective writing, guided planning) increases students' metacognitive awareness and self-regulated learning behaviors, which often translate into improved academic performance.

2. **Direct changes in trait-level grit are not yet robustly demonstrated.** While correlational data indicate a relationship between metacognition and grit (sometimes large in specific samples), there is limited longitudinal experimental evidence showing that short-term

metacognitive training produces durable increases on standard grit scales. Educators should expect gains in task persistence and strategy use rather than immediate large shifts in trait grit.

3. **Design implications:** To target grit-like outcomes, programs should combine metacognitive skills instruction with:

- explicit long-term goal-setting and periodic review,
- opportunities for incremental mastery and feedback,
- motivational scaffolds (peer cohorts, mentoring) that sustain practice over months/semesters.

4. **Measurement recommendations for practitioners:** Use both (a) proximal measures (MAI, strategy-checklists, reflective journals) and (b) perseverance-focused measures (Grit–S or behavioral persistence indices such as assignment completion rates across semesters). Collect follow-up data at ≥ 6–12 months to detect potential trait shifts.

Related works

- **Duckworth et al. (2007)** introduced the grit construct and demonstrated modest but reliable predictive validity across diverse achievement outcomes. Their multi-sample analysis found that grit explained on average ~4% of variance in success outcomes—suggesting grit is one of several factors influencing achievement.

- **Arslan et al. (2013)**: In a large sample of Turkish undergraduates (n = 352), the authors found strong correlations between grit dimensions and metacognitive awareness (consistency of interest r = .79; perseverance r = .78), with both grit dimensions predicting metacognition in regression models that accounted for ~70% of the variance. This paper is frequently cited as evidence that grit and metacognition are tightly linked in student populations but also highlights that measurement and sample factors may inflate effect sizes.

- **Swanson & Dewsbury (2024)**: A recent applied quasi-experimental study found that a metacognitive intervention for academically at-risk first-year students improved metacognitive skill development and engagement and had positive short-term academic effects. The study highlights practical feasibility but did not provide long-term grit assessments.

- **Fostering metacognition reviews (e.g., LifeSciEd, 2022)**: Reviews emphasize that metacognitive instruction is a robust lever for improving student study behaviors, transfer, and academic outcomes, but note that grit-specific outcomes are understudied.

- **Recent course-level studies (Frontiers, 2024)**: Longer courses that integrate reflective practice across weeks yield improvements in metacognitive measures and domain comprehension; these designs provide a promising scaffold for attempts to influence longer-term perseverance.

Discussion

What the evidence supports

- Metacognitive training reliably improves students' metacognitive knowledge and regulation, which in turn supports improved academic behaviors.

- There is consistent correlational evidence that metacognition and grit/perseverance-related constructs are positively related; in some samples (e.g., Arslan et al., 2013), the association is very large, though this may be sample- or measure-specific

What remains uncertain

- Whether short-duration metacognitive interventions lead to durable changes in trait-level grit is unknown. Existing intervention studies often lack long-term follow-up or standardized grit measures.

- The causal direction between metacognition and grit is not firmly established: grit might encourage the development and maintenance of metacognitive strategies, or metacognition might enable perseverance by reducing strategy-related failure.

Recommendations for future research

1. **Randomized controlled trials (RCTs)** with adequate sample sizes (power analyses) that compare metacognitive training vs. active controls and measure grit pre-intervention, post-intervention, and at long-term follow-ups (6–12+ months).

2. **Measurement harmonization**: standardize the metacognition instruments (e.g., MAI variants) and grit scales (Grit–S or Grit–O) to enable comparison across studies.

3. **Multi-method outcomes**: combine self-report grit scales with behavioral indices of persistence (assignment completion across semesters, retention, time-on-task logs).

4. **Mechanism-focused studies**: include mediational analyses to test whether increases in metacognitive monitoring → improved attribution and self-efficacy → increased persistence.

5. **Diverse samples**: replicate in varied cultural and disciplinary contexts; Arslan's strong effects highlight the need for cross-cultural replication.

Practical implications for university programs

- **Short-term**: Implement metacognitive workshops focused on planning, monitoring, and reflective evaluation; expect gains in strategy use and task persistence.

- **Medium-term**: Embed metacognitive prompts in courses (reflective journals, confidence judgments, requirement to justify problem-solving steps) and pair these with structured long-term goal-setting exercises.

- **Long-term**: Sustainable increases in grit-like perseverance likely require repeated cycles of guided practice, mastery experiences, and supportive social structures (mentors, peer cohorts).

Limitations of this article

- This article is a narrative synthesis using representative primary sources rather than a full systematic review or formal meta-analysis. The heterogeneity of instruments, definitions, and sample characteristics in the literature limits generalizability.

- Quantitative summary in Table 1 focuses on selected high-impact / illustrative studies rather than an exhaustive extraction from all available studies.

Conclusion

Metacognitive training is a reliable method to improve students' self-awareness of learning and regulatory skills, and these improvements frequently translate into better academic behaviors and short-term persistence. The evidence that such training produces durable increases in trait-level grit is promising but insufficient. Interventions that explicitly combine metacognitive instruction with long-term goal scaffolding, frequent mastery experiences, and opportunities for reflection are most likely to support the development of sustained perseverance. Rigorous RCTs with long follow-up and harmonized measurement are needed to test whether metacognitive training can shape grit itself or primarily enhances state persistence that supports academic success.

References

1. Arslan, S., Akin, A., & Çitemel, N. (2013). *The predictive role of grit on metacognition in Turkish university students*. Studia Psychologica, 55, 311–320. (PDF). (studiapsychologica.com)
2. Duckworth, A. L., Peterson, C., Matthews, M. D., & Kelly, D. R. (2007). *Grit: Perseverance and passion for long-term goals.* Journal of Personality and Social Psychology, 92(6), 1087–1101. https://doi.org/10.1037/0022-3514.92.6.1087. (PubMed)
3. Duckworth, A. L., & Quinn, P. D. (2009). *Development and validation of the Short Grit Scale (Grit–S).* Journal of Personality Assessment, 91(2), 166–174. (ResearchGate)
4. Fostering Metacognition to Support Student Learning and Transfer. (2022). *CBE—Life Sciences Education* (review). (Open access review summarizing metacognition interventions and educational outcomes.) (PMC)
5. Swanson, H. J., & Dewsbury, B. (2024). *The Impact of a Metacognitive Intervention on Student Experiences and Success in an Academic Probation Program for First-Year Students.* Teaching & Learning Inquiry, 12. https://doi.org/10.20343/teachlearninqu.12.26. (Open access / ERIC PDF). (ERIC)
6. Frontiers in Education. (2024). *The impact of a metacognition-based course on school/university students* (10-week course evaluation). Frontiers in Education. (Frontiers)
7. Additional meta-analytic and critique references: Credé, M., Tynan, M. C., & Harms, P. D. (2017). Much ado about grit: A meta-analytic synthesis of the grit literature. *Journal of Personality and Social Psychology* (meta-analytic discussions). (ResearchGate)