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Activity-Based Learning, Grit, and Growth Mindset among School Students: A Systematic Review

Saloni[1], Dr. Indu Bala[2]

[1]Research Scholar, Department of Psychology Faculty of Behavioural and Social Sciences Shree Guru Gobind Singh Tricentenary University, Gurugram, Haryana, India
[2]Assistant Professor, Department of Psychology Faculty of Behavioural and Social Sciences Shree Guru Gobind Singh Tricentenary University, Gurugram, Haryana, India
Corresponding Author: Dr. Indu Bala
https://orcid.org/0009-0003-8458-2019

ABSTRACT: Activity-based learning places students at the centre of learning: they inquire, test ideas, discuss progress, develop plans, build, and reflect. In this review, activity-based learning (ABL) is used as an umbrella term for active, experiential, inquiry-, project-, problem-, and hands-on learning. Although these approaches differ, each requires students to construct, apply, test, or revise knowledge rather than primarily receive it passively.

1. INTRODUCTION

1.1 Background

Activity-based learning places students at the centre of learning: they inquire, test ideas, discuss progress, develop plans, build, and reflect. In this review, activity-based learning (ABL) is used as an umbrella term for active, experiential, inquiry-, project-, problem-, and hands-on learning. Although these approaches differ, each requires students to construct, apply, test, or revise knowledge rather than primarily receive it passively.

The concept of active learning in particular has been widely discussed, as participation can improve academic learning when meaningfully aligned with pedagogical objectives. Prince (2004), for instance, noted broad, though uneven, support for pedagogical practices based on active, collaborative, cooperative, and problem-based learning. Freeman et al. (2014) later reported evidence that academic performance under active learning was improved across a large body of science, technology, engineering, and mathematics research. The bulk of this evidence, however, has tended to focus on academic achievement and has been gathered in higher education. It has therefore offered little insight into whether active pedagogies influence the psychological dispositions through which school-going students interpret and approach challenge, difficulty, failure, and extended learning.

Activity per se does not therefore guarantee learning or adaptive psychological development. Tasks can be cognitively demanding without being aligned with the aims of learning, poorly aligned with learning objectives, or overly focused on product completion rather than understanding (Skulmowski, 2024). ABL's value therefore depends on how challenges are framed and feedback, reflection, and revision are structured.

The concept of growth mindset is related to, but not interchangeable with, grit. Growth mindset refers to beliefs about malleability of ability, while grit concerns the sustained application of effort towards long-term goals. Neither is interchangeable with motivation, engagement, resilience, or persistence in general.

Growth mindset

Growth mindset refers to beliefs about whether intelligence or ability is developable. A growth or incremental view treats difficulty as a signal to learn, adapt strategy, or increase effort, while a fixed or entity perspective treats ability as relatively stable.

The educational utility of these beliefs is most clearly demonstrated in situations where students encounter increasingly demanding academic tasks. Blackwell et al. (2007) noted that adolescents' implicit beliefs about the nature of intelligence were associated with distinct patterns of mathematics achievement, and a changeable explanation or incremental theory of intelligence taught via an intervention was associated with more adaptive motivational and achievement patterns. Subsequent research has, however, established that growth mindset effects should not be assumed to be large or uniform. Meta-analytic studies have found modest overall associations between mindset and achievement and similarly modest effect sizes of mindset interventions with meaningful variation between students and contexts (Sisk et al., 2018). Yeager and Dweck (2020) likewise highlighted the heterogeneity of mindset effects and the importance of considering classroom and social contexts in which beliefs about ability operate.

ABL is therefore theoretically relevant because it often requires students to perform unfamiliar tasks, receive feedback, identify errors, and revise strategy. Such experiences may offer opportunities to demonstrate that competence develops through practice. Challenge alone without support, however, may be interpreted as evidence of inability. The presence of activity is therefore distinguishable from a learning environment that supports growth-oriented beliefs.

Research examining school-based activities illustrates this distinction. Growth-mindset outcomes have been explored in makerspace and project-based activities (Doss & Bloom, 2023), inquiry-oriented mathematics classroom environments (Pedersen & Haavold, 2023), project-based computer programming activities (Loksa et al., 2016), outdoor experiential education activities (O'Brien & Lomas, 2017), and project-based computing and design environments (Morales-Navarro et al., 2023, 2024, 2025). The diversity of these contexts suggests that there is substantial interest in the potential link between active pedagogy and students' beliefs about ability. At the same time, variation in instructional content, intensity, measurement, and research design makes the evidence difficult to interpret as a single homogeneous body of work.

Grit

Grit was defined as perseverance and passion in pursuit of long-term goals (Duckworth et al., 2007). It may be compatible with ABL because extended projects, complex problems, and sustained tasks often require students to repeatedly apply effort after setback.

However, grit overlaps substantially with conscientiousness, and perseverance of effort may be more predictive of outcomes than consistency of interests (Credé et al., 2017). Persistence of effort during a single activity should therefore not be described as increased grit. Engagement, resilience, and task persistence are also insufficient without grit or academic grit directly measured.

This distinction is particularly relevant to the present review because claims that active learning develops perseverance are common at the level of pedagogical practice, but direct evaluations of grit appear more scattered. Studies have explored grit in project-based STEAM (science, technology, engineering, and mathematics) activities (Boyle, 2021), student-centred and inquiry-oriented pedagogical strategies, and sustained active instructional programmes such as culturally relevant classroom interventions (Gallardo-Estrada et al., 2024). These studies raise an important empirical question about whether repeated participation in an active-learning environment is actually associated with measurable differences in grit rather than only conceptually adjacent outcomes.

1.2 Theoretical Framework

The review is framed by an integrative conceptual framework that connects active pedagogy with students' interpretations of challenge and responses to sustained difficulty. It draws on experiential and constructivist theories of learning as well as theories of growth mindset and grit.

Experiential approaches conceptualize learning as a process in which students' experience becomes educationally significant in response to reflection, conceptualization, and further action (Kolb, 1984). Viewed from this perspective, the potential psychological value of ABL lies not in activity per se. It lies instead in the recurring cycle in which students encounter a task, act upon it, evaluate the consequences of their actions, receive or seek feedback, revise their understanding, and attempt subsequent action. Project-based, inquiry-based, problem-based, and design-based learning can all generate such cycles when properly structured.

These cycles may influence growth mindset when students can correct errors, adapt strategies, and observe improvement. Feedback and reflection provide links between effort and strategy and progress. In contrast, repeated failure without scaffolding or opportunities to revise may reinforce perceptions of inability.

Grit involves a longer-term process. Extended projects, iterative design, inquiry, and authentic problem solving may require students to sustain effort and tolerate delay in resolution. They may provide opportunities to exercise perseverance, but whether they change grit as a comparatively stable individual difference remains an empirical question.

The framework does not assume that ABL inevitably causes either outcome. It identifies challenge, recoverable failure, feedback, revision, reflection, co-operation, agency, and sustained engagement as possible pathways. Their presence varies across interventions, however, and pedagogical design is therefore important when interpreting positive, negative, or mixed findings.

1.3 Rationale and Research Gap

Although active learning, growth mindset, and grit each have substantial bodies of work, they also intersect in a fragmented way. Reviews of active learning mainly focus on achievement, understanding, performance, or engagement. Research on growth mindset and grit more frequently examines individual differences, direct psychological interventions, or academic outcomes rather than everyday pedagogy.

The school-based studies that connect these domains are scattered across different disciplinary literatures, including mathematics, computer science, STEAM education, outdoor education, entrepreneurship, language learning, and social-emotional learning. They also employ markedly different forms of active pedagogy and research design. Some compare structured interventions with control or comparison conditions, some observe changes within a single active-learning environment, and some examine cross-sectional associations between students' reported exposure to active teaching and their mindset or grit. Qualitative studies provide further evidence about such processes as failure, feedback, peer interaction, and revision but cannot be interpreted as estimates of intervention effectiveness.

The resulting body of research presents two issues for synthesis. First, the broad claim that active learning fosters persistence or adaptive beliefs may obscure the extent to which grit or growth mindset was actually measured. Second, findings obtained from correlational studies, longitudinal or quasi-experimental research, experiments, and qualitative studies cannot be given equivalent causal interpretations. A review therefore needs to preserve the conceptual boundaries of the target outcomes while distinguishing evidence according to the strength and purpose of the research designs upon which they are based.

A systematic review is therefore needed to determine what can and cannot be concluded about ABL in relation to grit and growth mindset among school students. It must also examine the pedagogical features associated with different findings, the contribution of explicit reflective or mindset components, and the quality and context of the evidence.

1.4 Objectives of the Review

The present systematic literature review aims to synthesize empirical evidence on the relationship between activity-based learning and grit and/or growth mindset among school-going children and adolescents, with Grades 6–12 representing the principal population of interest.

Specifically, the review seeks to:

1. Identify and characterize the forms of activity-based and aligned active pedagogies that have been studied in relation to directly measured grit, academic grit, growth mindset, or implicit theories of intelligence among school students.
2. Synthesize the direction and consistency of evidence linking these pedagogies with grit and growth mindset while distinguishing intervention evidence from observational associations.
3. Examine pedagogical and contextual features that may help explain variation in findings, including challenge, reflection, feedback, iteration, collaboration, scaffolding, and intervention intensity.
4. Evaluate the methodological characteristics and limitations of the available literature to identify priorities for future research.

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1.5 Research Questions

The review addresses the following research questions:

1. **RQ1.** What activity-based learning approaches have been empirically examined in relation to grit and/or growth mindset among school students?
2. **RQ2.** What is the direction and consistency of the evidence regarding the relationship between activity-based learning and grit and/or growth mindset?
3. **RQ3.** Which pedagogical, contextual, and implementation characteristics appear to accompany positive, null, or mixed findings?
4. **RQ4.** What methodological limitations and evidence gaps characterize the existing literature on activity-based learning, grit, and growth mindset among school students?

2. METHODOLOGY

2.1 Review Design and Reporting Framework

This review systematically searched the literature on activity-based learning (ABL) and two narrowly defined psychological outcomes, grit and growth mindset, among school-going learners. A priori decisions were made before full-text synthesis regarding population, qualifying pedagogical exposure, target outcomes, eligible designs, screening rules, and synthesis. Reporting followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA 2020) guidance (Page et al., 2021).

The included evidence spanned randomized and non-randomized interventions, longitudinal and cross-sectional studies, mixed methods, and qualitative research. Evidence was therefore organized by target outcome and inferential strength rather than treated as a common intervention effect.

Growth-mindset and grit evidence were treated as separate lines of evidence. Intervention effects and observational associations were also treated separately, and causal language was limited to designs capable of supporting causal inference.

2.2 Eligibility Criteria

Eligibility criteria were applied to both database and supplementary records. The principal target population was students in Grades 6–12, although younger school learners were eligible when all other criteria were satisfied. University, adult, professional-training, and teacher-only samples were excluded.

For the purposes of the review, ABL was operationalized in a way that was sufficiently broad to include other related forms of active pedagogy, while maintaining a clear conceptual boundary. A study involving a qualifying active pedagogy was one in which learning explicitly required learners to actively inquire, investigate, solve, make, design, experiment, collaborate, or acquire knowledge through direct experience. Qualifying approaches to pedagogy therefore included activity-based learning as well as active learning, experiential learning, learning by doing, hands-on learning, inquiry-based learning, project-based learning, and problem-based learning, when in each case these approaches involved substantive participation of students in the process of learning.

The outcome criterion was intentionally narrow. Specifically, a study was eligible only when it directly measured grit, academic grit, growth mindset, or implicit theories of intelligence or ability. Motivation, engagement, resilience, self-efficacy, academic persistence, perseverance, or related constructs were not treated as proxies for either one of these target outcomes. When growth mindset or grit was observed only as one aspect of a broader composite score, then the study was eligible only when the score could be separately extracted or interpreted.

Eligibility criteria

Criterion	Included	Excluded
Population	School-going children and adolescents; Grades 6–12 were the principal population of interest	University students, adult learners, professional trainees, and teacher-only samples

Criterion	Included	Excluded
Exposure	Activity-based, active, experiential, inquiry-, project-, problem-, hands-on, design-, or learning-by-doing approaches involving substantive learner activity	Predominantly passive instruction or programmes without an identifiable active-learning component
Outcome	Direct measures of grit, academic grit, growth mindset, or implicit theories of intelligence	Motivation, engagement, resilience, self-efficacy, generic persistence, or non-extractable composite outcomes
Study type	Quantitative, qualitative, mixed-methods, randomized, quasi-experimental, longitudinal, cohort, cross-sectional, and other empirical designs	Reviews, protocols, conceptual papers, editorials, commentaries, and non-empirical reports
Publication status	Peer-reviewed research reports, including eligible peer-reviewed conference proceedings	Non-peer-reviewed descriptive material without identifiable empirical methods and results
Language	English	Non-English
Publication period	January 2000 through September 2026	Published before 2000

2.3 Information Sources and Search Strategy

Searches in Scopus, ERIC, and PubMed/MEDLINE were conducted through September 1, 2026. Backward and forward citation searching and targeted web searching supplemented the database corpus.

Three blocks of concepts were joined with the Boolean operator AND, with terms within each block joined by OR:

Population: student*, schoolchild*, adolescent*, "middle school," "high school," "secondary school"

Active pedagogy: "active learning," "activity-based learning," "experiential learning," "learning by doing," hands-on, "inquiry-based learning," "project-based learning," "problem-based learning"

Outcome: grit, "academic grit," "growth mindset," "implicit theories of intelligence," "theories of intelligence," "intelligence mindset"

Syntax and field restrictions were adapted to each database. PubMed/MEDLINE searched title and abstract fields, and records were restricted to English-language sources published from January 1, 2000, through September 1, 2026. Scopus and ERIC used the same conceptual structure with database-specific syntax.

Citation searching was conducted from provisionally eligible database studies. One generation of backward and forward citations was examined. Candidate records identified via citation searching were required to satisfy the same set of criteria with respect to population, pedagogy, and outcome as those of database records, but citation proximity of records to an included study was not considered to be sufficient for inclusion. Targeted supplementary web searching involved combinations of school-population terms, qualifying pedagogical terms, and grit and/or growth-mindset terms, with bibliographic details subsequently verified. Search sources were entered separately to retain record provenance.

2.4 Record Management, Deduplication, and Screening

Records were compiled into a master screening dataset. Duplicates were identified primarily by exact DOI and normalized-title matching, with one canonical record retained and its source as well as basis for matching recorded.

We proceeded with screening in two rounds. In the first round, titles and available abstracts were reviewed against the predefined eligibility criteria. Each record was assigned to one of three decisions: Include, Maybe, or Exclude. Include signified that the record should proceed to full-text assessment. Maybe was used when available bibliographic information was insufficient to resolve one or more of the eligibility criteria. Neither was treated as a designation for final inclusion.

Excluded records were assigned one standardized primary reason such as wrong population, wrong outcome, non-qualifying pedagogy, or publication type.

All records coded Include or Maybe were sought in full text. Eligibility was reassessed using the complete report. A study was not assumed eligible when full text could not be retrieved despite the relevance of the abstract. Full-text exclusions were likewise assigned one primary exclusion reason. Particular attention was devoted to three recurring boundary problems across the literature: studies involving higher-education populations; studies that reported conceptually adjacent psychological outcomes, rather than grit or growth mindset; and studies in which the target construct was part of a composite score but the constituent could not be separately extracted. The selection process was documented in a PRISMA 2020 flow diagram.

2.5 Identification and Management of Multiple Reports

The independent study, rather than the publication, was the unit of synthesis because one dataset or intervention may yield multiple reports.

Potential overlaps were assessed by setting, sample, recruitment and data-collection periods, intervention, authorship, and analyses. Reports representing the same dataset were grouped into one study family.

Where multiple publications represented the same study, the report that provided information that was most complete with respect to the review question was treated as the primary report. Companion publications were used where possible to supplement information about measures, methods, analyses, or mechanisms and were not treated as independent evidence. This procedure avoided double counting while preserving useful information that was spread across multiple reports.

2.6 Data Extraction

A standardized framework captured:

- Bibliographic Information And Country;
- Sample Size, Age Or Grade, And School Context;
- Study Design;
- Type Of Activity-Based Or Aligned Active Pedagogy;
- Intervention Or Exposure Duration;
- Comparator, Where Applicable;
- Grit Or Growth-Mindset Measure;
- Reported Reliability Of The Outcome Measure;
- Covariates And Adjustment Procedures;
- Statistical Analyses;
- Effect Estimates;
- Confidence Intervals And/Or p Values;
- Direction Of Findings;
- Whether Estimates Were Adjusted Or Unadjusted;
- Methodological Limitations;
- Information Required For Risk-Of-Bias Assessment; And
- Contextual Or Qualitative Evidence Relevant To Possible Mechanisms.

Extraction focused on reported estimates, rather than on authors' overall descriptions. Where possible, positive, null, and mixed findings were retained and interpreted in relation to design, sample size, measurement, and statistical precision.

Extracted information was verified against full texts and organized in an evidence map that links each synthesis statement to its report, and then its study family.

2.7 Risk-of-Bias and Methodological Appraisal

Design-appropriate appraisal tools were used because the review included heterogeneous methods. Numeric quality scores were not calculated because they can obscure distinct sources of bias.

Randomized intervention studies were appraised with the revised Cochrane risk-of-bias tool (RoB 2), covering randomization, deviations from intended interventions, missing outcome data, outcome measurement, and selection of reported results (Sterne et al., 2019). Non-randomized and quasi-experimental intervention studies were appraised with ROBINS-I, with attention to

confounding, participant selection, intervention classification, deviations, missing data, outcome measurement, and selective reporting (Sterne et al., 2016).

Longitudinal observational studies were appraised with the revised JBI cohort criteria, including exposure measurement, confounding, outcome measurement, follow-up, and analytical appropriateness (Barker et al., 2025). Analytical cross-sectional studies were appraised with the revised JBI criteria, emphasizing exposure and outcome measurement, confounding, and ambiguous temporality (Barker et al., 2026). Qualitative evidence was appraised with the Critical Appraisal Skills Programme checklist, covering methodological fit, recruitment, data collection, reflexivity, analysis, and credibility (Critical Appraisal Skills Programme, 2024).

When studies included quantitative and qualitative components, the components were appraised separately. Their integration was also considered using MMAT principles (Hong et al., 2018).

Appraisal informed the weight and wording of conclusions. Studies were not excluded solely because appraisal identified limitations.

2.8 Data Synthesis

Meta-analysis was infeasible because pedagogies, outcomes, measures, duration, comparators, designs, effect metrics, and assessment points differed. Many interventions also combined ABL with mindset teaching, reflection, technology, cultural adaptation, or other components, preventing definition of a common intervention effect.

A design-stratified synthesis without meta-analysis was therefore conducted following SWiM principles (Campbell et al., 2020), with growth-mindset and grit evidence synthesized separately.

Within each outcome stream, quantitative evidence was grouped as follows:

1. Comparative intervention studies, including randomized and non-randomized comparative designs.
2. Longitudinal studies lacking an external comparison group.
3. Cross-sectional or contextual association studies.

Qualitative studies were synthesized separately as mechanism evidence rather than estimates of effectiveness.

Quantitative findings were coded as positive, null, negative, or mixed where possible. These categories organized the evidence but were not used for vote counting. Interpretation considered direction, design, magnitude, precision, risk of bias, directness, and consistency.

Cross-sectional relationships were not treated as causal, and within-group change in uncontrolled studies was distinguished from comparative intervention effects.

A complementary thematic synthesis examined recurring processes involving challenge and failure, feedback and reflection, revision, peer interaction, agency, and sustained engagement. Framework categories sensitized the analysis without excluding additional evidence-supported patterns.

The synthesis therefore addressed the direction and strength of evidence and the pedagogical conditions accompanying positive, null, or mixed findings.

3. RESULTS

3.1 Study Selection

The search identified 202 records: 141 from databases, 51 from citation searching, and 10 from supplementary web searching. After 36 duplicates were removed, 166 unique records were screened by title and abstract.

Of the 166 records screened, 141 were excluded and 25 reports were sought for retrieval. Four reports could not be retrieved, leaving 21 full-text reports for eligibility assessment.

Six full-text reports were excluded: three for an ineligible population, two because the required outcome was absent or not separately extractable, and one because it duplicated or accompanied an already represented study without adding an independent study family. Fifteen eligible reports representing 14 independent study families were included.

The difference between reports and families arose because the 2024 computer-science self-beliefs report and a 2023 companion e-textiles report used the same Spring 2021 dataset. They were retained for complementary information but counted once (Morales-Navarro et al., 2023, 2024). A separate qualitative e-textiles study by Morales-Navarro et al. (2025) represented a different study family.

Of the 14 independent study families, 10 examined growth mindset and four examined grit; none measured both outcomes in the same sample. Figure 1 summarizes study selection.

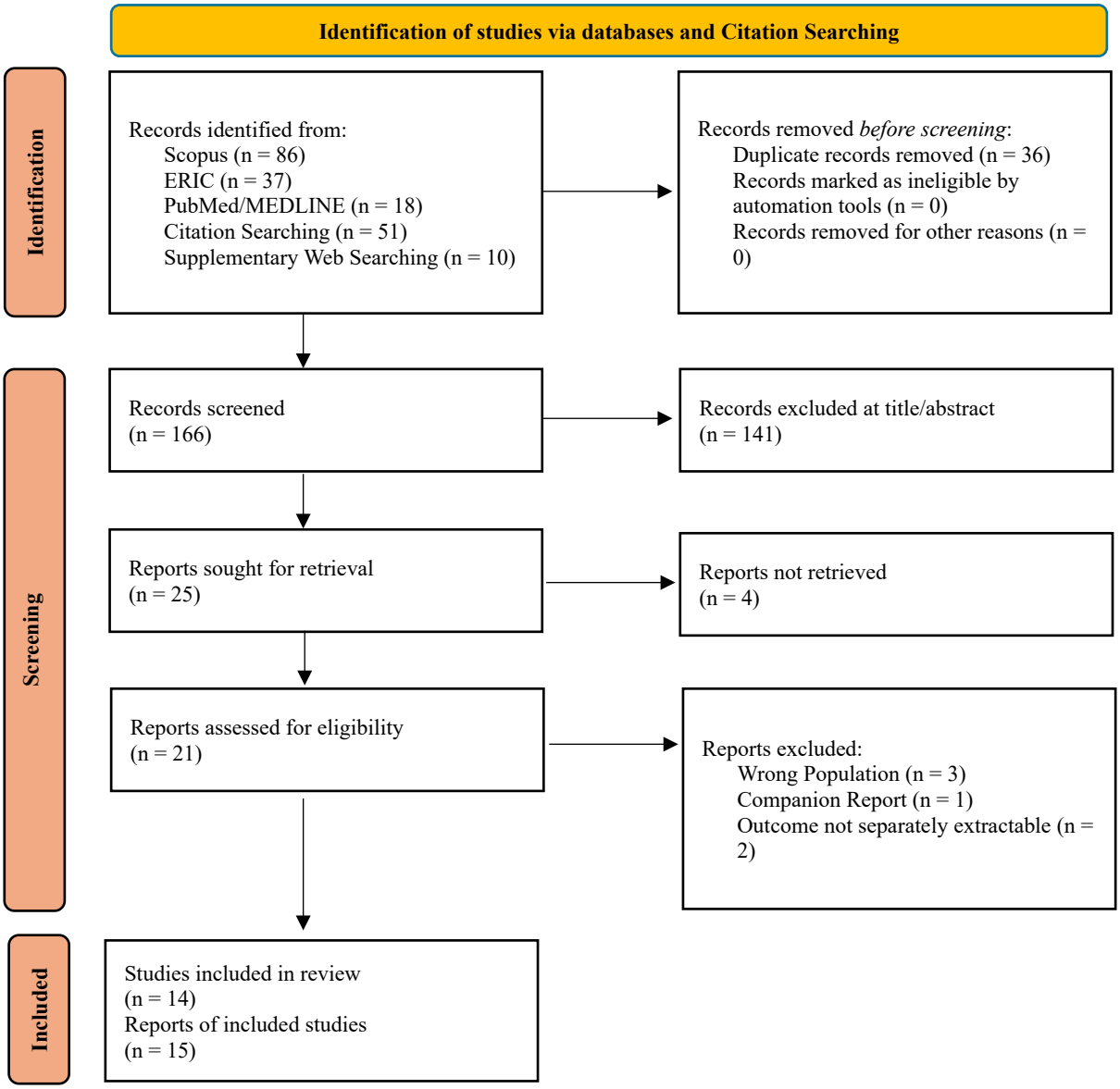


Figure 1: PRISMA 2020 Revised Flowchart

3.2 Characteristics of Included Study Families

The 14 study families were published between 2016 and 2026 and represented eight countries. Seven were conducted in the United States, with the remainder from Tanzania, Norway, Scotland, Indonesia, the United Kingdom, Chile, and the Philippines. Samples ranged from seven participants in an exploratory STEAM programme to 528 participants in a randomized study.

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Participants ranged from primary grades through the end of secondary school, although most families involved middle- or secondary-school populations.

Both study design and active pedagogy were heterogeneous. Six study families used comparative intervention designs, three examined change over time without an external comparison group, four provided cross-sectional or contextual associations between active learning and the target outcomes, and one was primarily qualitative. The qualitative family contributed mechanism evidence rather than a direct estimate of intervention effectiveness.

Active-learning contexts included inquiry mathematics, project-based learning, project-based computer programming, e-textiles design, makerspaces, STEAM projects, outdoor experiential education, experiential social-emotional learning, design thinking, student-centred pedagogy, and culturally relevant active language instruction. The literature did not represent one standardized ABL intervention. Instead, reports shared substantive student participation through inquiry, creation, problem solving, collaboration, experimentation, design, or hands-on activity.

Table 1 Overview of the independent study families included in the synthesis

Study family/report(s)	Pedagogical context	Design	Outcome	Main direction
Doss & Bloom (2023)	Makerspace/creative project-based camp	Cross-sectional mixed methods	Growth mindset	Mixed/positive association
Cherewick et al. (2021)	Experiential social-emotional learning	Randomized comparative	Growth mindset	Positive in intensive arm
Pedersen & Haavold (2023)	Inquiry mathematics	Cross-sectional	Growth mindset	Positive association
Morales-Navarro et al. (2024); companion report (2023)	Inquiry computing/e-textiles	Cross-sectional/contextual	Growth mindset	Positive association
Boyle (2021)	Ocean-based STEAM club	Descriptive pre–post	Grit	Positive, descriptive
Warsen & Vandermolen (2024)	Long-term project-based pathway	Prospective comparative	Grit	Null
Richmond & Sibthorp (2019)	Outdoor adventure education	Single-group pre–post	Growth mindset	Null
Wulandari et al. (2026)	Project-based entrepreneurship, chatbot, design thinking, mindset module	Non-randomized comparative	Growth mindset	Positive
Loksa et al. (2016)	Programming projects with scaffolding	Quasi-experimental	Growth mindset	Positive/protective
Morales-Navarro et al. (2025)	E-textiles debugging by design	Qualitative observational	Growth mindset	Mechanism evidence

Study family/report(s)	Pedagogical context	Design	Outcome	Main direction
O'Brien & Lomas (2017)	Outdoor experiential learning with mindset sessions	Randomized comparative	Growth mindset	Positive, sustained
Tawfik et al. (2025)	School-wide inquiry learning	Longitudinal	Growth mindset	Mixed
Gallardo-Estrada et al. (2024)	Active culturally relevant language instruction	Non-randomized comparative	Grit	Positive
Alfaras (2025)	Student-centred/inquiry pedagogy	Cross-sectional	Grit	Positive association

Note. The 2023 and 2024 Morales-Navarro reports used the same Spring 2021 dataset and were counted as one family; the 2025 qualitative report represented a separate family.

3.3 Activity-Based Learning and Growth Mindset

3.3.1 Comparative intervention evidence

Four independent study families reported comparative intervention evidence for growth mindset. Together, these studies produced largely positive results, though the intervention generally bundled active learning with additional reflective, scaffolding, or explicit mindset components.

Cherewick et al. (2021) conducted a three-arm randomized study of 528 young adolescents in Tanzania. The intervention used a combination of experiential social-emotional learning, peer reflection, technology-mediated activities, and community components at varying intensity levels. Growth mindset increased significantly only in the most intensive experimental condition, from 19.9 to 20.9, with the coefficient of intervention estimated to be $\beta = 1.00$, $p < .001$, and an overall effect size of $d = .20$. The less intensive conditions did not demonstrate significant increases. In other words, exposure to the broader programme was not simply associated with change across all conditions; the improvement was concentrated primarily within the condition featuring substantially greater experiential participation and repeated active engagement.

Wulandari et al. (2026) reported a larger effect in a non-randomized high-school intervention integrating project-based entrepreneurship, chatbot-based learning, design thinking, and an overt, explicit "mindset reset" activity. Compared with students who undertook a standard entrepreneurship project, intervention students exhibited greater increases in both their internally and externally oriented creative-growth-mindset dimensions. Between-group gain differences of $g = 1.20$ and $g = 1.39$, respectively, were both $p < .001$. These were large effects, although the intervention consisted of several components beyond activity-based instruction specifically.

Loksa et al. (2016) examined the results of project-based web-development camps among high-school students. Students receiving explicit problem-solving cues, help-seeking scaffolding, and contextualised guidance did not change their programming growth-mindset scores during the programme, whereas the scores for comparison-group students declined. The difference in change between conditions was statistically significant, $H = 6.20$, $p = .012$. The finding was thus more suggestive of a protective influence on mindset when faced with difficult or complex project work rather than a large absolute increase.

O'Brien and Lomas (2017) similarly examined whether explicit mindset instruction could add value to an existing experiential-learning programme. Students participating in a five-day outdoor-development course, with four growth-mindset sessions embedded along the way, were compared with students who received the outdoor course alone. A significant condition-by-time interaction was detected, $F(2, 193) = 3.56$, $p = .03$, $\eta^2 = .04$. Growth-mindset scores changed from 9.28 at baseline to 11.90 following the intervention and were still elevated at one-month follow-up, at 11.00, while changes in the comparison condition were not significant.

Across these comparative studies the positive growth-mindset findings were therefore most evident when active learning was bundled with explicit psychological framing, with structured reflection, with problem-solving support, or with repeated guided practice.

3.3.2 Longitudinal evidence without external controls

Two study families examined longitudinal growth-mindset change without a concurrent externally comparative reference and their findings were more mixed.

Richmond and Sibthorp (2019) studied the outcomes of 165 adolescents participating in a week-long outdoor adventure programme. Despite a substantial degree of experiential challenge, no statistically significant changes were detected in either leadership- or emotion-regulation-related growth-mindset measures. The study thus did not provide any evidence of a broad-based change in growth mindset following only active outdoor experience.

Tawfik et al. (2025) traced a cohort of middle-school students across three measurement waves, within a school-wide inquiry-based curriculum. No significant overall time effect was detected across the sample. A grade-by-time interaction was detected, however, $p = .006$, $\eta p^2 = .16$, with Grade 6 students showing improvement on these measures by the third measurement occasion. The effect was not reproduced uniformly across older grades. The study thus provided evidence of possible group-specific changes rather than a generalized longitudinal growth-mindset increase.

The uncontrolled longitudinal studies as a group therefore did not demonstrate consistent growth-mindset gains simply by continuing to participate in active or experiential learning environments.

3.3.3 Cross-sectional and contextual evidence

Several studies reported positive associations between active-learning environments and growth-mindset-related beliefs but did not determine temporal or causal direction.

Pedersen and Haavold (2023), investigating 248 Norwegian students in Grades 5–10, found that greater reported frequency of inquiry-based mathematics activities was positively associated with a growth-oriented belief that mathematical ability was not innate, $\varrho = .27$, $p < .01$.

Within an inquiry-orientated secondary-school computer-science curriculum, Morales-Navarro et al. (2024) found programming growth mindset to be strongly related to several adaptive computer-science beliefs, including that of creative expression ($r = .739$) and perceived problem-solving competency ($r = .618$). A 2023 companion report from the same study family showed that completion of an iterative e-textiles design project was associated with programming growth mindset, $r = .313$, $p < .01$. Because the 2023 and 2024 reports were based on the same underlying dataset and lacked a prospective contrast in exposure to ABL, they were treated as one contextual study family rather than two independent demonstrations of the effect.

Doss and Bloom (2023) traced a group of children attending a one-week-long makerspace and project-based creativity camp. Fifty-five per cent were categorised as displaying a strong growth mindset. However, agreement between self-reported mindset and behaviour was limited. The association between the Dweck-based self-report measure and teacher rating was $r = .34$, $p = .008$. The study consequently contributed more strongly to an understanding of the measurement and behavioural expression of growth mindset in active-learning environments than to the estimation of an intervention effect.

As a group, the contextual studies indicated that growth-oriented beliefs were frequently co-occurring with inquiry, making, design, and related practice in active learning. Their cross-sectional nature, however, made it impossible to determine whether the pedagogical setting contributed to the mindsets, students with particular mindsets responded differently to active learning, or both processes were occurring simultaneously.

3.4 Activity-Based Learning and Grit

The evidence related to grit was much more limited, with only four independent study families.

The most compelling positive comparative finding was that of Gallardo-Estrada et al. (2024) who evaluated an 18-week-long culturally relevant active language intervention among 246 Grade 5 students in rural Chile. The programme included discussion, creative challenges, metacognitive reflection, and feedback. Post-intervention grit among students in the intervention schools

was higher after statistical adjustment, B = .542, SE = .060, 95% CI [.423, .661], p < .001. The model explained approximately 31% of the outcome's variance. Though promising, the comparison was not randomized and was conducted at the school level.

By contrast, Warsen and Vandermolen (2024) found no statistically significant evidence that participation in an extended project-based high-school curriculum increased grit. Mean grit levels of PBL students increased from 33.31 to 34.91 but this change was not significant, p = .518. Traditional pathway students decreased from 33.51 to 32.47, also not a significant change, p = .391. Severe attrition and unequal pre- and post-intervention groups severely limited inference, but the study nevertheless represented an important null finding within the sparse grit literature.

Boyle (2021) reported an increase in grit among students participating in an extracurricular ocean-based STEAM programme. However, only seven intervention students were available for the relevant pre-post assessment, and no inferential statistical test or precise effect estimate was reported. The result was therefore retained as descriptive exploratory rather than evidence for an intervention effect.

Finally, Alfaras (2025) reported a moderate positive association between perceived student-centred pedagogical practice and academic grit among 369 Grade 8 students in the Philippines, r = .531, p < .001. Pedagogical exposure contained elements of constructivist, collaborative, reflective, integrative, and inquiry-oriented practice. Because both exposure and grit were measured concurrently by self-report, the finding established an association but not a directional effect.

As a group, the grit literature contained one positive non-randomized comparative study, one null comparative study with substantial methodological limitations, one very small descriptive study, and one positive cross-sectional association. As a result, the evidence base was too limited and heterogeneous to establish a consistent effect of ABL on grit.

3.5 Pedagogical Processes Identified Across the Evidence

Both qualitative and quantitative results identified several recurring processes that were treated as potential mechanisms rather than independent effects of intervention.

The process of iterative challenge and recoverable failure in particular was highly visible across the evidence with regard to programming, e-textiles design, and outdoor experiential learning. Morales-Navarro et al. (2025), in a microgenetic observational study of e-textiles design, identified 231 instances of growth-mindset-related practices. Fifty-six per cent of these occurred while students were working with deliberately "buggy" or malfunctioning projects, indicating that difficulties requiring debugging and revision provided frequent opportunities for persistence, strategy adjustment, and related responses to failure.

Peer interaction was also particularly visible. Approximately 78% of the coded instances of growth-mindset practice in this study occurred through interaction with peers. Similar forms of structured assistance were present in the programming intervention evaluated by Loksa et al. (2016), where students were explicitly supported in identifying problem stages, requesting help, and selecting alternative strategies.

A second recurring pattern concerned guided reflection or explicit mindset-related framing. The positive comparative interventions reported by Cherewick et al. (2021), Wulandari et al. (2026), O'Brien and Lomas (2017), and Gallardo-Estrada et al. (2024) all included some combination of reflection, metacognitive discussion, feedback, mindset instruction, or guided interpretation of challenge. By contrast, the outdoor adventure programme examined by Richmond and Sibthorp (2019), which provided substantial challenge but not a comparable explicit mindset component, produced no significant change in the measured growth-mindset outcomes.

Finally, instances of agency and meaningful production appeared repeatedly within positive or contextually supportive studies. Students designed digital or physical products, explored authentic problems, engaged in culturally relevant activities, or exercised choice over aspects of the learning process. These features occurred across different subject domains, but the included studies did not permit their independent effects to be separated from one another.

3.6 Methodological Profile of the Evidence

The methodological strength of the evidence varied widely. Though the corpus contained randomized comparative studies, many were cross-sectional, uncontrolled longitudinal, non-randomized, or based on small sample sizes.

The strongest growth-mindset evidence came from randomized studies by Cherewick et al. (2021) and O'Brien and Lomas (2017), but both bundled active learning with greater intensity or explicit mindset instruction, limiting attribution to ABL specifically.

Non-randomized studies raised concern about baseline equivalencies, group allocation, clustering, and multi-component interventions. Cross-sectional designs faced temporal ambiguity and shared-source measurement while uncontrolled longitudinal studies could not control for maturation, history, novelty, or cohort effects.

Measurement also varied widely. Studies assessed general growth mindset, programming-specific mindset, creative mindset, mathematical beliefs, leadership or emotion-regulation mindsets, general grit, and academic grit. Some measures demonstrated good internal consistency, whereas reliability was unreported or comparatively low in other cases. This measurement heterogeneity further limited direct comparison across effect estimates.

The methodological limitations were especially prominent within the grit literature. Of the four grit study families, one involved only seven intervention participants, one experienced severe attrition, one was non-randomized at the school level, and one relied on a cross-sectional self-report correlation. The relative confidence that can presently be placed in findings concerning grit is therefore lower than for growth mindset.

As a group, growth-mindset findings were more consistently positive, particularly when ABL included reflection, scaffolding or feedback, or explicit content concerning mindset. Null findings within both streams together showed that activity alone was not consistently associated with change.

4. DISCUSSION

In relation to growth mindset, growth-mindset evidence was greater in volume and more consistent than grit evidence. Growth mindset beliefs were most likely to be enhanced when activity involved reflection, feedback, scaffolding, revision, or explicit interpretation of difficulty. Grit was measured in only four study families, and evidence was weaker and less consistent.

The findings suggest a distinction between student activity and a learning environment that shifts the interpretation of challenge. Growth-mindset-related evidence was generally observed when students were encouraged to interpret mistakes, revise unsuccessful strategies, seek help, and to link effort to improvement.

This view is consistent with a general conceptualization of active learning as a pedagogical process rather than a singular instructional strategy. Prince (2004) argued that active learning encompasses many different methods of learning that vary significantly in structure and intensity. Similar experiential learning theory suggests that experience becomes educationally relevant through cycles of action, reflection, conceptualization, and subsequent experimentation (Kolb, 1984). The current findings support this perspective further by suggesting that these processes may also shape how students interpret their own potential for improvement.

4.1 Activity-Based Learning and Growth Mindset

Comparative evidence for growth mindset was generally favourable, but positive interventions typically integrated active participation with reflection, scaffolding, or explicit growth mindset content.

In stronger studies, intensive experiential learning, mindset-oriented reflection, or explicit problem-solving and help-seeking support accompanied growth improvement or protected against decline (Cherewick et al., 2021; Loksa et al., 2016; O'Brien & Lomas, 2017; Wulandari et al., 2026). In contrast, challenging activity lacking equivalent interpretive support produced more inconsistent shifts (Richmond & Sibthorp, 2019; Tawfik et al., 2025).

Overall, these studies do not support the implication that ABL consistently results in a growth mindset. Rather, they suggest that how students are taught to interpret and address challenge may determine whether active participation translates to beliefs about ability.

From the growth-mindset perspective, the key issue is not whether a student faces difficulty but what the difficulty comes to symbolize. Dweck's theoretical framework distinguishes the interpretation in which difficulty represents an opportunity to learn and those in which it signals limited capacity. Active-learning environments can plausibly generate either experience. A student who repeatedly faces challenging tasks without adequate feedback or support may interpret failure as confirmation of incapacity.

Alternatively, an environment in which unsuccessful attempts are expected, strategies may be revised, and improvement is made visible may provide experiential support for the belief that competence is developable.

This contextual account also agrees with Yeager and Dweck (2020). Mindset beliefs may matter most in contexts in which effort, strategy, feedback, and assistance can generate improvement; conversely, well-designed contexts may provide the experiences through which those beliefs come to hold meaning.

The qualitative evidence further suggested support for this interpretation. In the e-textiles study of Morales-Navarro et al. (2025), growth-mindset-related behaviours occurred particularly frequently when students encountered malfunctioning or partial projects and were required to debug, revise, and continue. Peer interactions contributed a substantial proportion of these practices. This is theoretically important because it places growth mindset within observable learning activity rather than treating it exclusively as an internal and questionnaire-measured belief.

Challenge may therefore create opportunity for mindset-relevant learning, while feedback, reflection, revision, and social support shape interpretation.

4.2 Activity-Based Learning and Grit

Evidence linking ABL to grit was sparse and inconsistent, consisting of positive comparative and cross-sectional findings, a very small descriptive study, and a comparative null study.

This pattern may relate to the construct itself. Growth mindset focuses on beliefs that can respond to discrete experience, whereas grit refers to long-term persistence and commitment to goal achievement (Duckworth et al., 2007) and may be less responsive to short- or locally focused interventions.

This distinction becomes particularly important when interpreting studies in which students demonstrate persistence in a single project or classroom activity. Persistence within a task does not necessarily imply an increase in grit. Credé et al. (2017) questioned the incremental validity and internal structure of the broader grit construct and suggested that perseverance of effort may account for much of its predictive value. Consequently, ABL studies should avoid inferring grit from observable engagement, effort, resilience, or persistence unless grit or academic grit is measured directly.

Active pedagogies generate opportunity to practice perseverance through complex problems, unsuccessful attempts, and long projects. Current evidence does not demonstrate that these experiences reliably change grit as a measured psychological construct.

Another possible explanation relates to duration. If grit reflects relatively stable patterns of goal-oriented behaviour, short interventions may be insufficient to meaningfully influence it. Longitudinal participation across repeated projects, school years, or sustained learning environments may be more relevant than exposure to an isolated activity-based programme. The null result reported by Warsen and Vandermolen (2024), however, also suggests that duration alone cannot be assumed to produce change. The quality of the learning environment, students' ownership of goals, nature of feedback, opportunity for revision, and consistency of implementation may all be relevant.

ABL may offer contexts for perseverance, but evidence remains insufficient to conclude that it consistently builds grit.

4.3 Pedagogical Processes Across the Evidence

Across both outcomes, the most plausible processes were manageable challenge, recoverable failure, reflection, feedback, revision, collaboration, scaffolding, and learner agency.

Challenge was common across included pedagogies but did not differentiate positive from null findings. A more useful distinction was whether failure remained recoverable through revision, alternative strategies, assistance, or repeated attempts. Such cycles make links among strategy, effort, and improvement visible.

Reflection may bridge experience with psychological meaning by helping students to explain why a strategy failed and what to try next. Peer interaction may normalize struggle and make adaptive responses visible, as suggested by the concentration of observed mindset practice in peer exchanges (Morales-Navarro et al., 2025).

Scaffolding keeps challenge within a recoverable range. When absent, difficulty may reinforce helplessness; when combined with problem-solving and help-seeking guidance, it can support strategy change (Loksa et al., 2016). Agency may further shape persistence when students make meaningful choices rather than merely comply with assigned tasks.

These features are recurring candidates, not established mediators, because few studies tested mechanisms directly.

4.4 Interpretation of the Overall Evidence

The practical implication is that schools should focus on pedagogical design rather than the activity label. Projects and collaborative exercises are unlikely to change beliefs or perseverance by themselves. Activities should make improvement visible, permit repeated attempts, encourage appropriate help-seeking, incorporate reflection, and frame errors as information for subsequent action.

5. LIMITATIONS

1. The evidence base was small, particularly for grit, which was examined in only four independent study families.
2. Considerable heterogeneity in pedagogies, intervention duration, study design, and outcome measurement prevented statistical pooling.
3. Multi-component interventions limited attribution of observed effects specifically to ABL.
4. Several studies used cross-sectional, uncontrolled, non-randomized, or small-sample designs, restricting causal inference.
5. Reliance on self-report measures introduced possible shared-method and response bias.
6. The geographic concentration of studies, particularly in the United States, limits generalizability across educational systems.
7. The review's deliberately narrow outcome criteria strengthened construct specificity but may have excluded relevant adjacent psychological outcomes.
8. Inconsistent terminology across disciplines means some eligible studies may not have been identified despite supplementary searching.

6. FUTURE DIRECTIONS

1. Use adequately powered randomized or well-controlled longitudinal designs with pre-, post-, and follow-up assessment.
2. Isolate active ingredients of ABL through multi-arm or dismantling designs comparing reflection, feedback, scaffolding, peer collaboration, and revision.
3. Test mechanisms such as interpretation of failure, help-seeking, learner agency, perceived competence, and feedback use.
4. Distinguish general growth mindset from domain-specific mindsets.
5. Expand grit research using validated measures and longer-term designs that separate grit from short-term persistence or engagement.
6. Combine self-report measures with behavioural, observational, and qualitative indicators of responses to challenge.
7. Examine developmental, cultural, socioeconomic, subject-specific, and school-level moderators.
8. Improve consistency in outcome measurement, intervention reporting, effect-size reporting, and implementation fidelity to support future meta-analysis.

7. CONCLUSION

Current evidence suggests that activity-based learning may support growth mindset when challenge is paired with reflection, feedback, scaffolding, revision, and explicit interpretation of difficulty. Evidence for grit remains limited and inconsistent. ABL should therefore not be treated as inherently capable of changing either construct. The findings instead indicate that pedagogical design, rather than activity alone, is likely to shape psychological outcomes. Stronger comparative, longitudinal, and mechanism-focused research is required before firm conclusions about causal effects can be drawn with confidence.

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