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Facilitation as Epistemic Bridge: A Comparative Documentary Analysis of Convergence Education at Three Korean Universities

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Abstract. Engineering programmes continue to grapple with the gap between technical training and the communicative, ethical, and interdisciplinary capacities that contemporary practice requires. This paper offers an interpretive comparative documentary analysis of facilitation practices reported in publicly available materials from three South Korean universities – KAIST, POSTECH, and Seoul National University – and develops a conceptual model of the facilitator as an epistemic bridge. Drawing on peer-reviewed studies (2019–2025), Korean Ministry of Education policy texts, and institutional course documentation, the study (i) proposes a tripartite functional taxonomy of facilitator roles (mediator, translator, catalyst) grounded in Carlile’s (2004) syntactic / semantic / pragmatic boundary framework, (ii) sketches two conceptual heuristics – the Epistemic Bridge Index and the Disciplinary Integration Efficiency indicator – as targets for future psychometric development rather than as measured quantities, with candidate validated instruments specified for each construct, and (iii) identifies a candidate cross-case pattern, the *hierarchy-protocol convergence*, in which structured facilitative protocols appear, across the documentary record, to coexist with rather than be displaced by high-hierarchy academic culture. The paper closes with four operational propositions for adaptation in Russian polytechnic settings under Russia’s Federal State Educational Standards (FSES 3++), mapped to specific universal competencies. The contribution is conceptual and interpretive: the article does not claim to measure facilitator effectiveness or to generalise to the Korean higher-education population, and it foregrounds the limitations imposed by reliance on secondary documentary sources.

Keywords: Convergence Education, Epistemic Bridge, Facilitation Taxonomy, Boundary Spanning, Engineering Pedagogy, Korean Higher Education, Humanitarian-Technical Collaboration, Documentary Case Study.

1 Introduction

1.1 The Disciplinary Divide and What Facilitation Might Add

The persistent gap between technical proficiency and the communicative, ethical, and integrative capacities expected of contemporary engineers is well documented across OECD employer surveys and engineering-education scholarship [1, 2]. The gap is not incidental but structural: engineering pedagogy has historically privileged convergent

problem-solving and downplayed the dialogic, ambiguity-tolerant reasoning more typical of the humanities [3]. Disciplinary socialisation reinforces the boundary, leaving graduates technically capable but, in the language of boundary-spanning research, epistemically narrow [12].

Facilitation has been proposed as a pedagogical response. Unlike conventional instruction, facilitation positions the educator as a process architect who structures conditions for collaborative meaning-making without prescribing its content [4]. Boundary-spanning theory – in the form developed by Carlile [27] and taken up in education by Zheng, Jiang and Fu [16] and Smith and colleagues [25] (see also the systematic review of boundary spanning in education [18]) – extends this account by treating the facilitator as an agent operating at the interface of distinct epistemic communities. The question this paper addresses is conceptual: what does a facilitator do, functionally, when she or he operates at the boundary between technical and humanistic knowledge traditions in an engineering programme? I propose that the most parsimonious description of the facilitator’s epistemic work distinguishes three functions – mediation, translation, and catalysis – that may be enacted sequentially or in combination. This is the epistemic-bridge model, illustrated schematically in Fig. 1.

Definition 1 (Epistemic Bridge). *A facilitator functioning as an epistemic bridge is a pedagogical agent who, operating independently of exclusive disciplinary allegiance, structures the conditions under which participants from technically and humanistically oriented knowledge traditions engage in joint meaning-making. The role is characterised by three functional modes – **mediation** (process regulation at syntactic boundaries), **translation** (semantic conversion between disciplinary registers), and **catalysis** (pragmatic disruption of entrenched disciplinary assumptions) – each enacted sequentially or simultaneously in response to collaborative demands.*

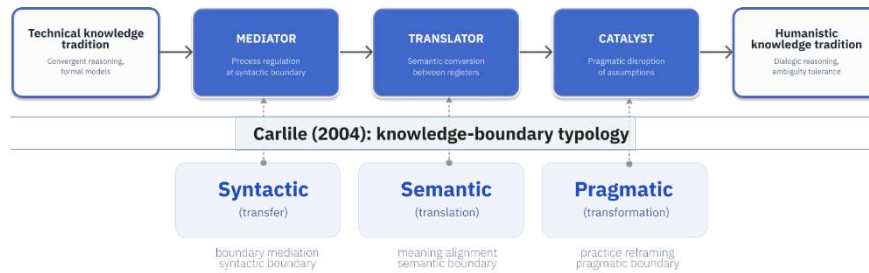


Fig. 1. The facilitator as epistemic bridge. The three functional modes (mediator, translator, catalyst) align with the syntactic, semantic, and pragmatic boundary types in Carlile’s [27] integrative framework. Functions may be enacted sequentially within a single learning episode or distributed across institutional roles. Adapted from Carlile [27] with pedagogical extensions developed for this paper.

This conceptualisation extends prior accounts that treat the facilitator as a managerial or motivational agent [4, 24] by specifying the facilitator’s epistemic function. The

tripartite taxonomy, made operational through behavioural indicators in Table 3 (Section 4.1), is the article’s primary theoretical contribution.

1.2 Why Look at Korea, and What Is and Is Not Claimed

South Korea offers an unusually well-documented case for studying convergence pedagogy at the higher-education level. The STEAM (Science, Technology, Engineering, Arts, and Mathematics) reform launched in 2011 and the 2022 Revised National Curriculum, although directed primarily at K–12 schooling, set a policy frame within which Korean universities have developed convergence (융합) programmes [7, 8], supported by sustained professional development that builds teachers’ self-efficacy for convergence and STEAM instruction [17]. Among Korean higher education institutions (HEIs), KAIST, POSTECH, and Seoul National University (SNU) have the most substantial English-language documentation of their convergence offerings, including peer-reviewed course studies [26], instrument-validation work on convergence competencies [15], and accreditation-aligned curriculum descriptions under the Accreditation Board for Engineering Education of Korea (ABEEK).

Three caveats are required at the outset. First, the three institutions are elite, internationally networked, and atypical of the Korean HEI population: South Korea has more than two hundred four-year universities and over one hundred junior colleges, and the great majority are regional and private institutions whose facilitation practice is not represented in the international literature. Nothing in this paper supports inference to Korean engineering education as a whole. Second, the primary policy mandate naming the instructor as a “learning facilitator” (학습 서포터) sits in the K–12 curriculum, not in undergraduate engineering accreditation, which is governed by ABEEK under criteria emphasising communication, social impact, and professional ethics. The transfer of facilitative language from K–12 policy to HEI practice is therefore a hypothesis to investigate, not a premise. Third, the research design is documentary; no student or instructor was interviewed, observed, or surveyed for this study.

The contribution is conceptual: a tripartite functional taxonomy of facilitator roles operationalised through behavioural indicators; two heuristic indicators with named candidate instruments for future psychometric development; a candidate cross-case pattern; and four propositions for empirical testing in Russian polytechnic settings under Russia’s Federal State Educational Standards (FSES 3++), the national standards that specify the competencies higher-education programmes must deliver.

2 Methodology

2.1 Research Design

This is an interpretive comparative documentary analysis. The design draws on documentary case-study methodology [10, 11] but does not claim the evidentiary status of a multi-case study built on primary fieldwork. The unit of analysis is the institutionally documented facilitation practice as represented in peer-reviewed and policy texts; the

analytical move is to read these documents through a constructed three-axis heuristic and ask what pattern emerges. The genre of the study is therefore interpretive: the heuristic is a reading tool, not a validated instrument, and the patterns reported are interpretive claims about the documentary corpus, not claims about classroom practice as it is actually enacted.

2.2 Source Selection

Fig. 2 summarises a PRISMA-style (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) four-phase flow. Search and screening parameters are detailed below.

Search. Web of Science, Scopus, KCI (Korea Citation Index), and ERIC were searched between January 2019 and February 2026 using combinations of: (“convergence education” OR “융합교육” OR “boundary spanning” OR “facilitation” OR “design thinking” OR “PBL” OR “Scrum”) AND (“KAIST” OR “POSTECH” OR “Seoul National University” OR “Korean engineering education”). Reference lists of the identified meta-analyses [9, 28] were hand-searched.

Inclusion criteria. (i) Peer-reviewed journal article, validated instrument paper, or official ministerial or institutional policy document; (ii) substantive engagement with facilitation, convergence pedagogy, or interdisciplinary integration in engineering or science higher education; (iii) language English, Korean (with translation support), or Russian (for the transferability discussion).

Exclusion criteria. Opinion pieces; institutional marketing materials with no analytical content; studies of secondary or primary schooling unless cited specifically for the policy frame.

Resulting corpus. Twenty-eight peer-reviewed sources, four Korean Ministry of Education policy documents, three institutional curriculum documents, and two Russian-context empirical sources for the transferability analysis. The full corpus list is available on request.

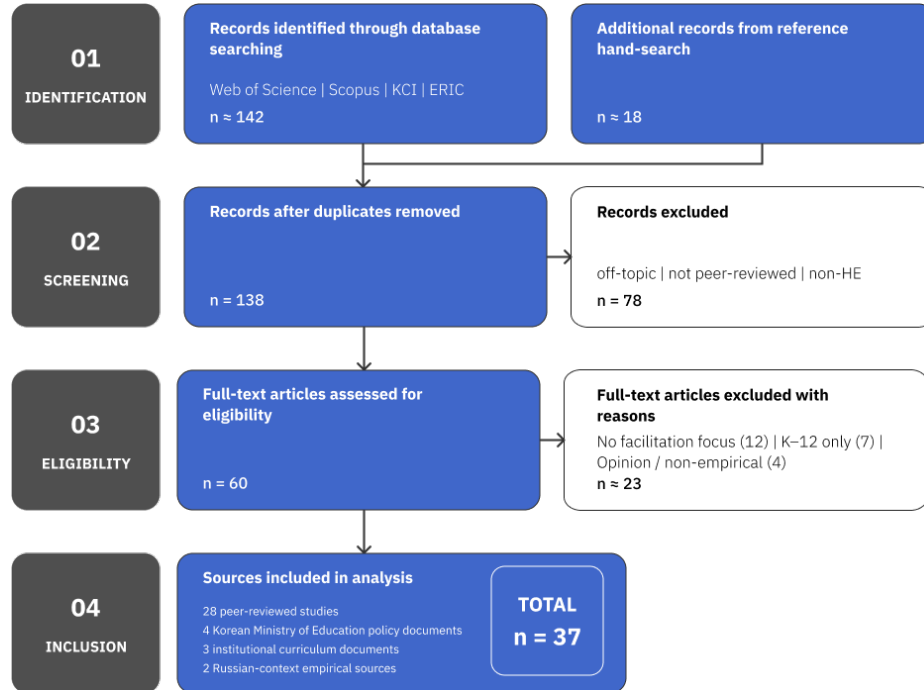


Fig. 2. Source selection flow (PRISMA-style). Counts are approximate ($\approx$) because the review is interpretive and unregistered, but the four-phase structure is preserved to maximise auditability. Exclusion reasons for full-text records are categorised: no facilitation focus (12), K-12 setting only (7), opinion-only (4).

2.3 Analytical Framework

A three-axis reading heuristic was constructed from the boundary-spanning [27], transformative-learning [22, 29] and communities-of-practice [19] literatures: (1) pedagogical method, the specific facilitative protocol described (design thinking, Agile/Scrum, structured dialogue); (2) facilitator role structure, the formal institutional positioning of the facilitator function (co-teacher, external Product Owner, dialogue moderator); and (3) disciplinary integration depth on the multidisciplinary–interdisciplinary–transdisciplinary continuum. The heuristic is constructed, not validated; it is a reading tool, not an instrument. Two sensitising lenses guided interpretation: Mezirow’s transformative learning [22] for the catalyst function, and Lave and Wenger’s communities of practice [19] for the mediator function.

2.4 Proposed Conceptual Heuristics: EB-Index and DIE

The Epistemic Bridge Index (EB-Index) and the Disciplinary Integration Efficiency (DIE) indicator are presented here as conceptual heuristics targeted at future empirical operationalisation, not as measured quantities. The notation

$$\text{EB-Index}(i) = \alpha \cdot \text{M}(i) + \beta \cdot \text{T}(i) + \gamma \cdot \text{C}(i), \quad \alpha + \beta + \gamma = 1 \quad (1)$$

signals the structure of a future composite measure in which M, T, and C would be operationalised through observational coding or self-report items. Analogously, the programme-level DIE indicator

$$\text{DIE} = (1/N) \cdot \sum_i \text{EB-Index}(i) \cdot \text{D}(i), \quad \text{D}(i) \in \{1, 2, 3\} \quad (2)$$

structures a future aggregate weighted by documented integration depth (1 = multidisciplinary, 2 = interdisciplinary, 3 = transdisciplinary). Rather than leave these heuristics free-floating, Table 1 specifies, for each construct, a peer-reviewed validated instrument that could provide the measurement basis in a subsequent empirical study. The numerical values previously assigned to POSTECH, KAIST, and SNU in the working draft have been removed; the documentary corpus does not contain the per-interaction observational data those values would require.

Table 1. Candidate validated instruments for future operationalisation of the EB-Index and DIE constructs.

Construct	Candidate instrument	Validation context	Why suitable
M(i) — mediator function	Leader Inclusiveness Scale (Nembhard & Edmondson [31])	Cross-disciplinary healthcare teams (n = 1,440 across 23 hospitals)	Captures the process-regulation work — invitation to contribute, openness to input — that the mediator function performs at the syntactic boundary.
T(i) — translator function	HASS (Humanities, Arts, and Social Sciences) Convergence Competency Self-Assessment (Jung, Song & Noh [15])	Three-round Delphi validation; South Korean HASS undergraduates	Targets the semantic conversion work between disciplinary registers; instrument validated in Korean HEI context — direct transferability.
C(i) — catalyst function	Team Psychological Safety Scale, 7 items (Edmondson [30])	51 work teams, manufacturing firm; subsequently revalidated in interdisciplinary student teams	Captures the pre-condition for pragmatic disruption: perceived safety to take epistemic risks, voice dissent, and challenge assumptions.
D(i) — integration depth	Documented coding against Klein’s multidisciplinary / interdisciplinary / transdisciplinary continuum	Established in interdisciplinary studies literature; no single validated instrument	Coded from syllabus and outcome documentation; coding rubric should be piloted with two independent raters.

The structure in Table 1 makes the heuristic falsifiable: a future study could collect M, T, C, and D scores per instructional episode using these instruments, compute EB-Index(i) values, aggregate to a programme-level DIE, and test whether predicted patterns (mediator-dominated at multidisciplinary depth, catalyst-dominated at transdisciplinary depth) appear in observed data.

2.5 Reflexivity and Positionality

The author is an engineering-education researcher based at a Russian polytechnic university. This shapes both the choice of Russian transfer as the closing question and a likely sympathy toward structured-protocol pedagogies that resemble Conceive–Design–Implement–Operate (CDIO) and FSES 3++ frames. The framework’s three axes were derived during reading, not before it; the interpretive bias is acknowledged.

2.6 Limitations of the Design

The study reads documents about facilitation rather than observing facilitation. It cannot speak to moment-to-moment facilitator practice, to student experience, or to unsuccessful cases that are systematically under-published. Further limitations are revisited in Section 5.

3 Findings

3.1 The Three Cases, Read Through the Heuristic

Table 2 summarises the cross-case coding, indicating for each institution the documented pedagogical method, the formal facilitator role structure, the dominant facilitator function in the documentary record, the integration depth typology consistent with that record, and the strongest available primary empirical anchor.

Table 2. Cross-case coding matrix across the three documented Korean university cases.

Institution	Pedagogical method (documented)	Facilitator role structure	Dominant function / integration depth	Primary empirical anchor
KAIST (<i>K-School</i>)	Design-thinking pedagogy Iterative needfinding cycles; empathy-mapping, problem-reframing tasks	Humanities-trained co-facilitator with engineering instructor; studio-based critique replaces conventional exam	Translator <i>Interdisciplinary</i>	Koo [26] — qualitative case, n = 16
POSTECH	Agile / Scrum project-based learning Industry-linked capstone; sprint cycles; external Product Owner	External industry stakeholder as Product Owner; faculty as process facilitator and Scrum Master	Mediator <i>Multidisciplinary</i>	Korean PBL proxy: Lee & Jung [32] — no POSTECH-specific primary study located
SNU	Structured dialogue, Socratic questioning, appreciative inquiry Mandatory liberal-arts core (College of Liberal Studies)	Faculty dialogue moderator with sustained training; rotating student facilitators in upper-year seminars	Catalyst <i>Transdisciplinary</i>	Institutional / descriptive only

Two boundary conditions on Table 2 must be noted explicitly. First, the strength of the primary empirical anchoring is uneven: KAIST is anchored by a peer-reviewed qualitative study of K-School pedagogy [26]; POSTECH has no English-indexed peer-reviewed primary study of its undergraduate engineering pedagogy, and the Lee and Jung [32] entry serves as Korean PBL context only; SNU's evidence is institutional and descriptive. Second, the dominant-function assignment is a heuristic reading, not a measurement: each institution is likely to deploy all three functions in some combination, and what Table 2 records is which function the documentary record foregrounds, not which one occurs.

3.2 Documentary Pattern and the Limits of Pattern Claims

Read through the three-axis heuristic, the three cases display a suggestive but not demonstrated alignment in which the dominant facilitator function shifts from mediator (POSTECH) through translator (KAIST) toward catalyst (SNU) as documented integration depth increases. The emphasis on 'suggestive' is deliberate: the pattern is constructed by the heuristic and confirmed by the documentary record only at the resolution at which institutional self-descriptions operate. The convergence is theoretically meaningful – it follows the syntactic / semantic / pragmatic gradient identified by Carlile [27] – but it is not a measurement.

3.3 Quantitative Comparators (Correctly Attributed)

The pooled effect of design thinking on student learning across twenty-five primary studies is $r = 0.436$, $p < .001$ [9]; later meta-analyses report design-thinking effects of comparable magnitude on creativity and problem-solving outcomes [13, 14], and primary studies link design-thinking and design-innovation pedagogy to gains in students' problem framing and creative mindset [5, 6]. The Korean STEAM meta-analytic review by Kang [28] synthesises eleven prior Korean meta-analyses (2012–2018) reporting medium effect sizes across cognitive and affective outcomes. These figures characterise the broader literature; they are not estimates of effects at KAIST, POSTECH, or SNU. The case-specific Cohen's d values reported in the working draft have been removed because the documentary corpus does not support their assignment to specific institutions.

3.4 The Hierarchy-Protocol Convergence as Candidate Pattern

Across the three cases, the documentary record displays a structural feature unanticipated by the original three-axis heuristic. Korean academic culture is characterised by pronounced vertical hierarchy: faculty authority is rarely challenged, peer critique is normatively constrained, and students often suppress dissenting views to maintain relational harmony (*nunchi*, 눈치) [7]. Standard facilitation theory treats such cultural hierarchism as antithetical to the open, dialogic conditions that facilitative learning presupposes. The three documented Korean cases nevertheless report sustained facilitation

activity. Fig. 3 captures this conjecture schematically. The candidate pattern is reframed here as a hypothesis rather than a finding:

Hypothesis 1 (Hierarchy-Protocol Convergence). *In high-power-distance academic cultures, structured facilitative protocols – the design sprint, the Scrum cycle, the structured-dialogue seminar – may function as legitimising frameworks within which participants take epistemic risks (challenge assumptions, voice dissent, propose unconventional solutions) that would otherwise violate prevailing norms of deference. The protocol becomes the authorising structure that releases epistemic agency.*

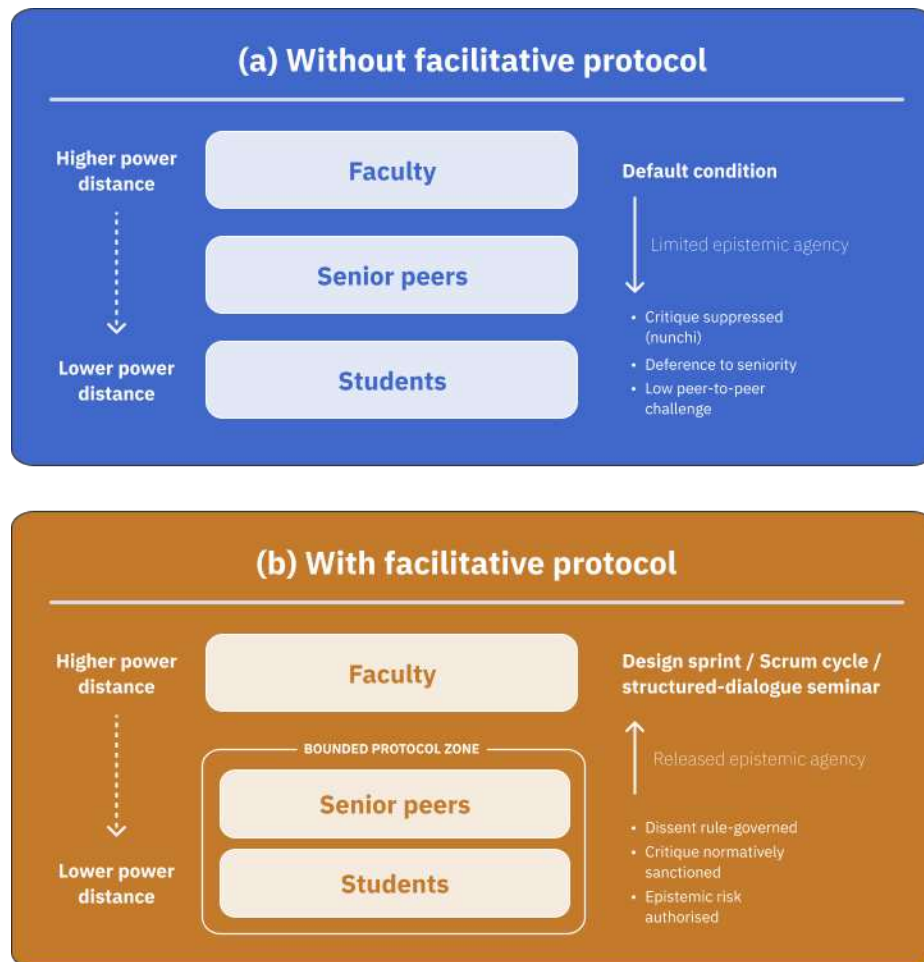


Fig. 3. Hierarchy-protocol convergence (conceptual schematic). Panel (a) represents the default condition in a high-power-distance academic culture, where vertical hierarchy is associated with suppressed peer critique and constrained epistemic agency. Panel (b) represents the hypothesised mechanism: a structured facilitative protocol creates a bounded zone within which dissent is rule-governed and epistemic risk is normatively sanctioned. The schematic depicts no empirical measurement; the hypothesis is empirically testable using the instruments listed in Table 1.

This is offered as a hypothesis, not a finding. Its plausibility rests on convergence between the documentary record and the cross-cultural psychological-safety literature: Edmondson’s seminal validation of the seven-item team psychological-safety scale [30] showed that perceived safety mediates the relationship between team structure and learning behaviour; Nembhard and Edmondson’s [31] cross-disciplinary healthcare study found that leader inclusiveness moderates the relationship between professional-status hierarchy and team psychological safety; and Krishnakumar, Caskey and Hughes [33] replicate the structural relationship in interprofessional teams. The hypothesis advanced here is that structured facilitative protocols may substitute, in part, for the default psychological safety that is missing in high-power-distance settings. This claim is empirically testable using existing validated instruments; the present paper does not test it.

4 Discussion

4.1 Operationalising the Tripartite Taxonomy

The taxonomy proposed in Section 1 – the facilitator as mediator, translator, and catalyst – is the article’s strongest contribution. Table 3 specifies, for each function, the epistemic work it performs, the boundary type it addresses (following Carlile [27]), the behavioural indicators a trained observer could code, and the illustrative documented practice from the corpus.

Table 3. Facilitator role taxonomy: epistemic work, boundary type, behavioural indicators, and illustrative practice.

Function	Epistemic work	Boundary type (Carlile [27])	Behavioural indicators	Illustrative documented practice
MEDIATOR	Process regulation: maintaining shared turn-taking, time-boxing, role-allocation; building procedural common ground	Syntactic (<i>transfer</i>)	• Restates procedural rules • Invites contributions from quiet members • Manages time-boxes and hand-offs • Surfaces resource constraints	POSTECH Scrum cycle: Scrum Master role at sprint planning and retrospective; external Product Owner mediating between team and industry stakeholder

Function	Epistemic work	Boundary type (Carlile [27])	Behavioural indicators	Illustrative documented practice
TRANSLATOR	Semantic conversion: rendering vocabularies, problem frames, and success criteria across disciplinary registers	Semantic (<i>translation</i>)	• Renders disciplinary jargon • Reframes problem statement across disciplines • Maps technical specs to user concerns • Surfaces tacit disciplinary assumptions	KAIST K-School needfinding [26]: instructor structures iterative observation tasks converting user behaviour into engineering problem re-frames; empathy maps as semantic boundary objects
CATALYST	Pragmatic disruption: provoking re-examination of entrenched assumptions, problem frames, and disciplinary identities	Pragmatic (<i>transformation</i>)	• Asks Socratic counter-questions • Introduces disorienting dilemmas [22] • Sanctions productive disagreement • Names tacit disciplinary commitments	SNU College of Liberal Studies: structured-dialogue seminars in a transdisciplinary core; appreciative inquiry and Socratic questioning protocols

Table 3 has two pedagogical implications. First, the three functions are not equally costly. The mediator function is the most familiar and lowest-friction – most engineering instructors can perform it after short training. The translator function requires sustained interaction with another discipline’s norms; the cost is mostly time. The catalyst function is the most costly: it requires the instructor to be willing to provoke productive disagreement and to tolerate the discomfort that follows. This asymmetric cost-structure helps explain why programmes plateau at the interdisciplinary level. Second, the behavioural indicators in Table 3 are directly codable: an observational study using the indicators column as a coding rubric, with two independent raters, would provide the empirical evidence the conceptual taxonomy currently lacks.

4.2 What the Documentary Pattern Means, If It Is Real

The pattern identified across the three institutions – mediator at the multidisciplinary end, translator in the middle, catalyst at the transdisciplinary end – is consistent with Carlile’s [27] distinction between syntactic, semantic, and pragmatic boundary processes, taken up in education by Smith and colleagues [25] and Zheng, Jiang and Fu [16]. The contribution this paper adds is to specify these distinctions in pedagogical terms and locate them within identifiable institutional practices.

The dialogue with Mezirow’s transformative learning [22] applies most directly to the catalyst function: SNU’s documented use of structured dialogue and appreciative inquiry resembles the disorienting-dilemma scaffolds that Mezirow and Taylor’s [29] empirical review identify as conditions for perspective transformation; comparable disorienting dilemmas are documented in interdisciplinary and technology-education

settings [21, 23]. The communities-of-practice frame [19] fits the mediator function best: POSTECH's industry-linked capstone places students within an external community whose norms the facilitator helps them read. The translator function, central to KAIST's design-thinking pedagogy [26], occupies the analytically interesting middle ground in which semantic conversion is the dominant epistemic work.

4.3 The Hierarchy-Protocol Convergence: Theoretical Implications

Hypothesis 1 challenges a foundational assumption in the facilitation literature: that psychological safety requires a flat, egalitarian relational structure, and that hierarchical authority is antithetical to open dialogue. The Korean documentary evidence is consistent with a more differentiated mechanism. What may matter for productive facilitation in high-power-distance contexts is not the absence of hierarchy but the presence of a legitimising protocol that creates a bounded, rule-governed space within which epistemic risk-taking is normatively sanctioned. Hierarchy is not eliminated; it is temporarily suspended within the protocol's frame. The empirical line connecting Edmondson [30] to Nembhard and Edmondson [31] to Krishnakumar and colleagues [33] supports the broader claim that the relationship between hierarchy and psychological safety is moderated by structural features of the team's working context. The conjecture proposed here – that the facilitative protocol itself is one such moderator in academic settings – is testable. It is not tested in this article.

4.4 Implications for Engineering Education and Humanitarian-Technical Collaboration

If the tripartite taxonomy is sound – and it is the most defensible part of the contribution – three implications follow for engineering programmes seeking to integrate humanistic and technical work. First, facilitator training in engineering programmes should be specified by function rather than by method: a programme adopting design thinking will need to develop the translator function in its instructors; a programme adopting Agile/Scrum capstones will need to develop the mediator function; a programme aiming for transdisciplinary integration must invest specifically in the catalyst function. Second, the catalyst function – epistemological disruption – is the function least well supported by current engineering-faculty development practice and the function most needed for genuinely transdisciplinary integration. Third, the high cost of the catalyst function (Section 4.1) helps explain why programmes plateau at the interdisciplinary level: the catalyst's work is structurally aversive to the engineering norm of efficient problem-solving and requires explicit institutional protection. On the student side, engineering students' engagement with and persistence in cross-disciplinary work is shaped by their expectancy and value beliefs, so facilitation that raises the perceived value of humanistic-technical integration may matter as much as faculty capability [20].

4.5 Propositions for the Russian Polytechnic Setting under FSES 3++

The original draft's three-vector "transferability framework" is reframed here as four propositions for empirical testing in Russian polytechnic settings under FSES 3++. Table 4 maps each proposition to the specific universal competencies (YK, UC) it engages, a suggested testing design, and a candidate outcome instrument.

Table 4. Operational propositions for adaptation in Russian polytechnic settings, mapped to FSES 3++ universal competencies and outcome instruments.

Proposition	Claim	FSES 3++ UC engaged	Test design / outcome instrument
P1 <i>Function-first faculty training</i>	Training the facilitation function (mediator / translator / catalyst) rather than the method (design thinking, Scrum, structured dialogue) produces more durable changes in instructor behaviour than method-specific training of equal duration.	UC-3 (teamwork) UC-6 (self-development)	Cluster-randomised trial: two faculty cohorts, function-based vs. method-based training; observe behaviour at 3 and 12 months using Table 3 indicators.
P2 <i>Cross-departmental capstone</i>	Mandatory cross-departmental capstones with a designated facilitator (analogous to POSTECH's external Product Owner) accelerate UC-1 and UC-3 development relative to single-department capstones of equal duration.	UC-1 (analysis & synthesis) UC-3 (teamwork)	Pre-post quasi-experiment with FSES 3++ competency self-assessment of Bayandina & Gafurova [34]; matched comparison cohort.
P3 <i>Protocol-as-authorisation in high-hierarchy contexts</i>	Structured facilitative protocols function as authorising structures for student dissent in Russian polytechnic contexts where instructor hierarchy and student deference resemble Korean patterns, mirroring Hypothesis 1.	UC-3 (teamwork) UC-5 (intercultural)	Within-subjects design measuring perceived psychological safety with and without protocol scaffolding using Edmondson [30] 7-item scale.
P4 <i>Translator emphasis at interdisciplinary tier</i>	Polytechnic programmes pursuing interdisciplinary integration that explicitly develop the translator function achieve higher cross-disciplinary problem-framing competence than programmes investing equally in mediator or catalyst training.	UC-1 (analysis & synthesis) UC-2 (project management)	Comparative course-level design with HASS Convergence Competency tool of Jung et al. [15] adapted for the Russian context.

The four propositions are deliberately staggered in difficulty: P1 and P2 require modest institutional commitment and existing instruments; P3 is the empirically riskiest claim and the one most directly tied to Hypothesis 1; P4 becomes testable only after the function-based training of P1 is in place. None of the propositions is treated as established; each is presented in a form a polytechnic curriculum committee could prototype within an existing degree programme.

5 Limitations

The article relies on documentary rather than observational data: it reads documents about facilitation, not facilitation itself. Three elite institutions – KAIST, POSTECH, and SNU – are not representative of Korean HEIs. The English-language peer-reviewed primary evidence base is uneven across cases: strongest for KAIST (anchored by Koo [26]), weak for POSTECH (no primary study located, and the Korean PBL proxy of Lee and Jung [32] is not POSTECH-specific), and descriptive only for SNU. The three-axis heuristic is constructed, not validated. The EB-Index and DIE remain conceptual; their psychometric viability is unknown, although Table 1 specifies a credible operationalisation pathway. The Russian transferability propositions are theoretical, although Table 4 specifies testable designs. Publication bias is a further concern: institutional self-descriptions over-represent successful programmes, and there is no register of failed convergence initiatives at the three institutions.

6 Conclusions

This paper contributes (i) a conceptual model of the facilitator as epistemic bridge with three functional modes – mediator, translator, catalyst – derived from Carlile’s [27] boundary-knowledge typology and operationalised through Table 3 behavioural indicators; (ii) two heuristic indicators (EB-Index, DIE) framed as targets for future psychometric development and linked in Table 1 to peer-reviewed validated instruments; (iii) a candidate cross-case pattern, the hierarchy-protocol convergence, raised as a hypothesis grounded in agreement between documentary evidence and the cross-cultural psychological-safety literature [30, 31, 33]; and (iv) four propositions for empirical testing in Russian polytechnic settings under FSES 3++ [34], each mapped in Table 4 to specific universal competencies and a candidate outcome instrument. The article does not claim to have measured facilitator effectiveness or to support inference to Korean higher education as a whole. Future priorities include observational validation of the tripartite taxonomy at KAIST building on Koo [26], psychometric piloting of the EB-Index using the instruments in Table 1, and a small-scale Russian polytechnic intervention study testing P3 via the FSES 3++ self-assessment frame [34].

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