

Educational Pathways of Discipline-Based Student Organizations from the Perspective of Top-Notch Innovative Talent Cultivation

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Abstract: Discipline-based student organizations are commonly treated as an extracurricular vehicle for cultivating top-notch innovative talents, yet their educational function has largely remained a matter of experience that "occurs naturally," and pathway design grounded in the conditions of transformation is still lacking. Drawing on the "trigger-discourse-validation" three-condition model of transformative learning theory, and starting from a diagnosis of transformative failure in discipline-based student organizations, the study constructs three educational pathways: hierarchical progression, reflection embedding, and action validation. The hierarchical progression pathway covers experience triggering and cognitive conflict through a progressive sequence of triggers. The reflection-embedding pathway supplies rational discourse through reflective interfaces guided by multiple agents. The action-validation pathway closes the process through external evaluation and the practical transformation of experience. Together the three pathways form a nested core-and-shell structure, in which the core is a practice-reflection cycle and the shell is action validation. The study moves the discussion of education through student organizations from the empirical question of whether it works to the normative question of what conditions are required for it to work.

Keywords: Top-Notch Innovative Talents; Discipline-Based Student Organizations; Educational Pathways; Transformative Learning; Vocational Colleges

1. Introduction

Discipline-based student organizations are widely regarded as an extracurricular vehicle for cultivating top-notch innovative talents (a policy term in Chinese higher education denoting students selected for advanced innovative

training). In vocational education, classroom teaching mainly performs the function of knowledge transmission, whereas fostering innovative competence requires a practical, self-directed growth environment; student organizations, being close to students and strongly practice-oriented, have naturally assumed this expectation. Yet a familiar pattern keeps recurring: students "sign up in large numbers, persist in few, and produce even less." Registration figures are substantial, while the share of deep participants who improve their competence remains limited. Behind the pattern lies a structural rupture between the organizational vehicle and the educational effect it should deliver: student organizations have the organizational form of education but lack the internal mechanism that turns "student participation" into "student growth" [1]. Scholarship has approached this rupture along several lines. The empirical study by Sun and Lu [2] confirms that experience in student organizations has a positive effect on creative will, covering four dimensions: professional competence, public-mindedness, collaborative execution, and resource management. Research on education through student organizations falls into three strands: effect verification, which confirms the positive role of participation in innovative competence [2,3]; problem diagnosis, which identifies structural shortcomings in institutional support and mentoring capacity [4,5]; and experience summarization, which draws operating models from practice [6]. Discussions of pathways for cultivating top-notch innovative talents, meanwhile, have unfolded mainly as institutional coordination and integrated provision at the national and institutional levels [7,8], and have seldom addressed the functional conditions of a specific educational vehicle. These studies answer three questions in turn ("whether it works," "what is missing," and "how to build it"), but they share a limitation: few of them ask, from the perspective of transformative learning, through what process

student organizations actually "transform" students, and what conditions that transformation requires.

This limitation raises an antecedent question: oriented toward the cultivation of top-notch innovative talents, what functional conditions should the educational pathways of discipline-based student organizations satisfy, and how are those conditions related? Both questions turn on a more fundamental one: how does deep change in a person occur? That is the core proposition of transformative learning theory. Unlike other theories concerned with "learning from experience," transformative learning addresses "how people change already-acquired cognitive frameworks." The predicament of education through student organizations lies here: students do not lack experience; they lack the conditions under which experience triggers cognitive reconstruction. Jia [9], reviewing transformative learning theory systematically, argues that deep change in individuals depends on three interlocking conditions: experience triggering, rational discourse, and action validation. Drawing on this framework, and proceeding from a diagnosis of transformative failure in student organizations, the study constructs three educational pathways: hierarchical progression, reflection embedding, and action validation, thereby advancing the discussion of education through student organizations from the empirical level of "whether it works" to the conditional level of "what conditions are required for it to work."

2. Theoretical Foundation and Analytical Framework

2.1 The Condition Model of Transformative Learning and Its Transfer to Educational Settings

Transformative learning theory [9] defines the deep form of learning as the reconstruction of an individual's existing meaning perspective through critical reflection. Unlike knowledge-accumulation learning, transformative learning concerns "how a person changes" rather than "what a person knows." According to the theory, such change requires three interlocking conditions: first, experience triggering (disorienting dilemma), an experiential event powerful enough to unsettle the individual's existing cognitive framework; second, rational discourse, the systematic examination of one's

own experience under external guidance; and third, action validation, the confirmation of meaning reconstruction through practice.

Transferring transformative learning theory to educational settings has well-established precedents. Taylor's [10] systematic review of empirical research on transformative learning between 1999 and 2005 shows that the theory has expanded from its original setting of adult re-entry education to professional courses in higher education, teacher education, intercultural learning, and other educational domains, and that the connotation of the "triggering event" varies contextually across settings. Kitchenham [11], tracing the evolution of Mezirow's theory, likewise notes that the conceptual framework of transformative learning has theoretical elasticity for cross-contextual transfer, but that each transfer requires an operational, contextualized definition of key concepts. These studies provide the methodological basis for extending the theory to discipline-based student organizations, and the present study carries the contextualization of triggering events one step further. The technical difficulties that students in vocational colleges encounter in real project tasks do not alter the course of their lives, yet they are sufficient to unsettle the existing cognitive framework of "what I have learned is enough" and therefore function as the initiating condition of transformative learning. The employment-oriented training objectives of vocational colleges give students' meaning perspectives an inherent "career orientation." When participating in student organizations, they naturally ask "what am I suited to do" and "what does technical work mean." Transformative learning among vocational college students is often accompanied by a deep reconstruction of career self-perception, which makes the technical practice setting of discipline-based student organizations a natural field for such learning.

2.2 An Operational Definition of "Pathway"

The study defines an educational pathway as a series of institutionalized functional components oriented toward educational objectives, together with the logic of their combination. A pathway has three characteristics. First, it concerns "what educational functions should be satisfied" rather than "how specifically to operate"; its defining criterion is "what educational effect it produces" rather than "by what method it is realized."

Second, the same pathway can be realized through different operational schemes and is structurally equivalent. Third, the design logic of a pathway is transferable across contexts, whereas its operational parameters are constrained by specific conditions. These characteristics are not asserted arbitrarily. Because the three conditions of transformative learning are functional (triggering, discourse, and validation), a pathway that satisfies them must also be defined by function rather than operation; and because the theory has transferred successfully across multiple educational settings [10,11], its condition framework is cross-contextually flexible, and pathway design is transferable in the same way.

3. Theoretical Construction of the Educational Pathways

Transformative learning theory identifies the mechanism of deep change in individuals: experience triggering initiates cognitive disequilibrium, rational discourse guides meaning reconstruction, and action validation completes cognitive transformation. The three links are interlocking, and none is dispensable. In current practice, discipline-based student organizations fall short on all three: participation without triggering, experience without reflection, and outcomes without validation. Each deficiency calls for a corresponding educational pathway.

3.1 The Hierarchical Progression Pathway: Covering "Experience Triggering" and "Cognitive Conflict"

In practice, the triggering predicament of discipline-based student organizations shows two features. First, activity content is homogenized: all members attend the same kind of training or regular meeting, and no distinction is made between the trigger intensity that first-time participants need and that required by those with some foundation. Second, activity intensity is insufficient: a weekly technical training session or a club meeting can hardly generate an experiential impact of adequate strength. The two features combine into one result: students are "participating" in the organization, yet the experience triggering that transformative learning requires rarely occurs. The activities of student organizations in vocational colleges are especially dependent on the cycles of skills competitions and school-enterprise cooperation

projects, and periodic gaps further compress the time window for continuous triggering.

The effectiveness of a triggering event depends on the match between two parameters: whether its intensity is sufficient to unsettle the existing cognitive framework, and whether the individual's capacity to cope falls within a manageable range. Too weak an intensity fails to initiate learning; too strong an intensity produces frustration and withdrawal. The triggering condition therefore cannot be a uniform arrangement; it must be a progressive sequence, in which students build capacity reserves and self-confidence through low-intensity triggers and on that basis withstand the stronger ones that follow. A single "high-difficulty challenge" cannot substitute for progressive capacity reserves. Three further findings corroborate the necessity of progressive triggering: fostering creative thinking requires exposure to diverse activity curricula [12]; the cultivation system for top-notch innovative talents needs to move from standardized provision to an ecological, diversified model [13]; and academic excellence is distinct from innovative personality [3]. Project-task-based learning is widely used in cultivating innovative talents because real problems can support competence development [14]. That practical tasks, rather than theoretical instruction, prove the most effective triggering vehicle follows from the cognitive style of technically skilled talents, for whom knowing is inseparable from doing and creating [15]; creating new knowledge in action is what makes practical settings a natural field for experience triggering.

These principles inform a three-tier progressive triggering structure. The first tier is primary triggering (participation experience), open to all members of the organization. By completing an introductory practical task (analyzing a real innovation case, writing a one-page project abstract, or taking part in a team technical discussion), students obtain, in a low-risk environment, the experiential anchor of "I have participated in innovative practice for the first time." What matters at this stage is not which technique is taught but whether students form a basic cognitive grasp of the organization's innovative function, which is where preliminary experience triggering takes hold. The second tier is intermediate triggering (cognitive conflict). Entry is by voluntary application from students who already have basic participation experience

and the willingness to go deeper, not by competitive elimination by teachers; once admitted, they confront the technical uncertainty of real project tasks, whether a plan overturned, an experiment that fails to produce the expected result, or disagreement within the team. This step matters most for transformative learning: a problem with no standard answer in the classroom begins to unsettle the student's existing conviction that "what I have learned is enough." The third tier is advanced triggering (external test), which pushes project outcomes into external evaluation: entering disciplinary competitions, applying for patents, or helping an enterprise solve a technical problem. The aim here is not to confirm what has been done but to generate, under real external evaluation, a cognitive impact stronger than that of intermediate triggering. Students discover a gap between "I think I did well" and "external standards consider it good," and that gap is itself the most intense triggering event.

The three tiers are linked in sequence: the output of one is the entry condition of the next, and the conflict intensity of the next is pitched to the capacity reserves established in the preceding tier, so that each trigger remains within students' capacity to cope.

3.2 The Reflection-Embedding Pathway: Covering "Guided Reflection"

Discipline-based student organizations also tend to emphasize doing over thinking. Students take part in project tasks but, once the task is "finished," they have no "review" stage and no structured occasion to ask "what I have learned," "why the technical plan failed," or "what has changed in my understanding." What follows is experience without reflection, and participation without growth. Mentoring is concentrated mainly on skill transmission ("how to solder this circuit board," "how to debug this code") and lacks guidance for the systematic examination of experience. The problem is sharper in vocational colleges, where students are long immersed in the pattern of "learning technique, practicing technique, using technique" and rarely ask about the "why" behind a technique or "what it means."

Rational discourse is the mediating link from cognitive conflict to meaning reconstruction; its function is to embed a "reflective interface" of guided reflection between "the student encountered a difficulty" and "the student

understood the difficulty." Sun and Lu [2] bear this out empirically: organizational leadership experience cultivates creative will more effectively than administrative leadership experience, because student-organization activities carry a high intrinsic "reflection density," giving students structured opportunities for reflection in activity planning, team coordination, and outcome review. Dang and Li [3] find that academic excellence is not equivalent to innovative personality, which points to the same necessity from the opposite direction: if academic performance alone cannot predict innovative personality, educational pathways must reserve a specific interface for reflection rather than assume that students improve by participating.

Three reflection channels are designed on this basis, each embedded in a triggering node of Pathway One. They are divided not by the type of mentor but by the function the guidance performs. Faculty mentors lead the technical channel, which sits at plan review and project debriefing, where the guiding question is "why did the technical plan fail, and what would happen with a different approach"; it helps students lift scattered technical experience to methodological understanding. Placed after intermediate triggering, it works on students who have just met cognitive conflict and therefore hold the richest material for reflection. A second channel brings in industry and sector professionals to address career meaning, asking "what does this mean in the real industry" and connecting technical learning with career self-perception; it follows advanced triggering, when students need to place their achievements in an industrial context. A third channel runs on peer experience, through a "mentorship" arrangement with senior core members or through their sharing of experience; its role is not technical guidance but the provision, at a close cognitive distance, of the reference that "others have encountered the same problem," which eases the isolation and defensiveness that accompany cognitive conflict. Peer relationships are themselves an important supporting condition for the growth of top-notch innovative talents [16], and the peer channel accordingly carries an educational function of its own. Across the three, the design idea is to raise interface density, that is, the timeliness and frequency of guided reflection available after each cognitive conflict, rather than to increase the total number of

mentors.

3.3 The Action-Validation Pathway: Covering the "Action Validation" Condition

Transformative learning theory emphasizes that meaning reconstruction must be confirmed through action validation; otherwise transformation remains at the cognitive level and is difficult to consolidate into a stable meaning perspective. In the context of student organizations, action validation cannot be left entirely to students' own initiative. The "action" in a student organization naturally points to practical outcomes, but the "validation" link requires an institutionalized external evaluation mechanism to provide it. The principle that follows is that organizations need an institutional channel leading from "internal practice" to "external validation," so that cognitive reconstruction obtains objective feedback and confirmation.

Two channels of action validation follow from this principle. The first pushes student-organization projects into external evaluation systems such as disciplinary competitions, patent applications, and enterprise technical acceptance. The cognitive shift from "I think I did a good job" to "external standards consider it a good job" is a typical manifestation of action validation in transformative learning. This channel shares its external evaluation mechanism with the advanced triggering of the experience-triggering pathway, though the two serve different functions: in the former, the external test generates higher-intensity conflict; in the latter, external evaluation exists to confirm meaning reconstruction. That dual dependence can create tension when competition results conflict with educational objectives, and in such cases the aim of confirming meaning reconstruction should take precedence, so that the space for reflection and practical transformation is not compressed in pursuit of external results. The second converts project outcomes into sustainable service vehicles: an award-winning competition project, for instance, may become a technical solution an enterprise can use, or a patent a teaching case. The role of enterprises in talent cultivation has shifted from resource provider to process participant [17], so external uptake of transformed outcomes has a realistic foundation. This channel aims not at one-off validation but at a cycle of "outcome → practice → re-testing" that lets students

consolidate a new meaning framework through repeated action and avoid the rupture of "learning ends when the competition ends." The cycle matches the closed-loop management logic of cultivation systems [18].

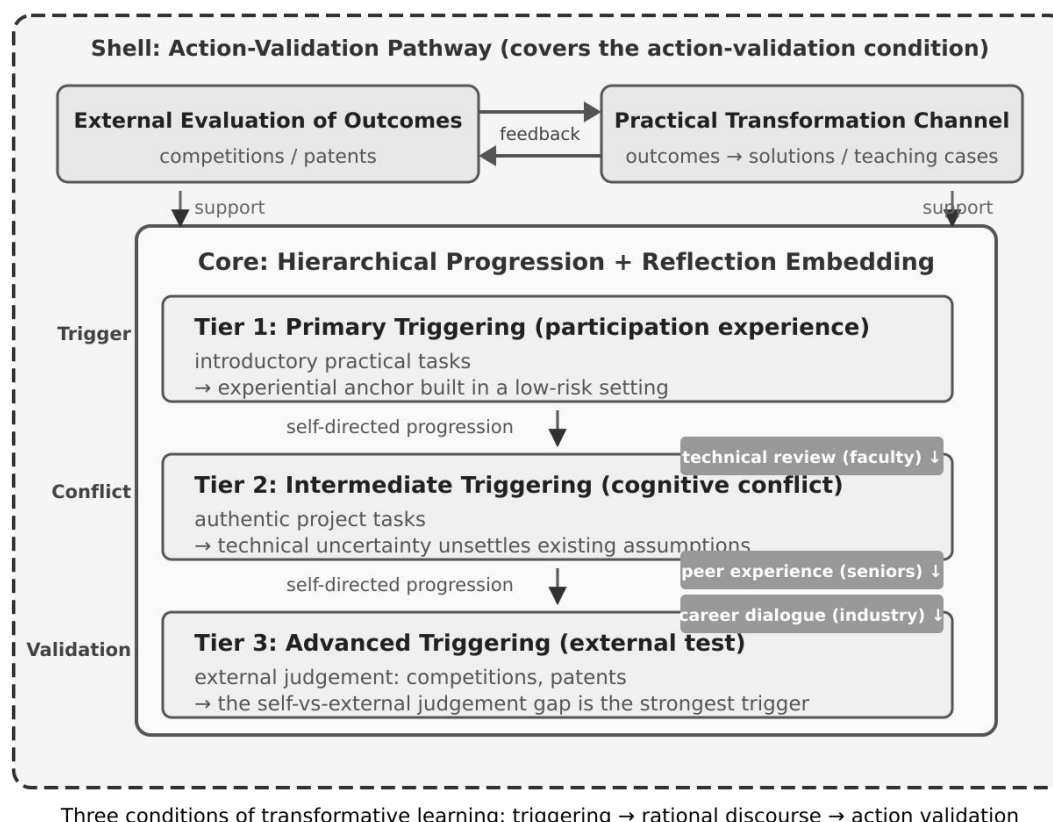
Together the two channels close the loop from "producing internally" to "confirming externally" and then to "consolidating in practice," which is the full logic of action validation.

3.4 The Systemic Relationship among the Three Pathways

The three pathways are not parallel, independent modules but two functional layers of one educational pathway system (see Figure 1):

Pathways One and Two form the core: Pathway One generates triggers and conflicts, while Pathway Two provides reflective guidance at the points of conflict. Together they carry the student through the cycle of "triggering → guidance → re-triggering → re-guidance." Pathway Three forms the shell, giving every output of that cycle an action-validation channel through which the outcomes of transformation are confirmed and consolidated.

The relationship among the three can be understood through the nested model of "core plus shell." The core answers "what functions effective education requires" (Pathway One provides triggering material and Pathway Two provides reflective support); the shell answers "how the effects of these functions are confirmed and sustained" (Pathway Three provides the external test channel). Without the core, an organization has a validation channel but no educational effect; without the shell, even when triggering and reflection are completed, students' transformative outcomes can hardly obtain institutionalized confirmation. The three pathways also correspond to how top-notch innovative talents actually grow. The self-directed progression of Pathway One meets the requirement that such talents develop through "self-selected development" rather than "selection-based elimination," since entrance screening cannot substitute for support during the process [19]. The structured reflection of Pathway Two lifts technical innovation competence from accumulated experience to methodological self-awareness. The action validation of Pathway Three places individual outcomes in external evaluation, where they receive social confirmation.



Three conditions of transformative learning: triggering → rational discourse → action validation

Figure 1. The Educational Pathway Model of Discipline-Based Student Organizations

4. Educational Pathways for Top-Notch Innovative Talents in Discipline-Based Student Organizations

Each pathway now needs a mechanism to carry it in practice.

4.1 Establishing a Three-Tier Participation Ladder

A three-tier participation ladder moves activity design from uniform provision to tiered, differentiated provision. At the primary stage, the priority is not technical difficulty but broad access to low-risk participation experience, for which the organization must provide a sufficient number of introductory practical tasks. The intermediate stage requires a stable source of real projects, which in turn depends on the organization's capacity to connect with faculty research projects and school-enterprise cooperation programs. The advanced stage requires routine linkages with external evaluation systems, from competitions and patents to enterprise technical acceptance. Organizations should progressively build their project reserves in accordance with their own resource conditions, ensuring that students at each stage can obtain trigger opportunities matched to their current competence, while

maintaining an open progression channel between the tiers.

4.2 Establishing the Embedding Mechanisms of the Three Guidance Channels

Embedding the three guidance channels shifts the allocation of mentoring capacity from an aggregate approach to a node-based one. The technical review channel requires faculty mentors to be present and involved at key project nodes (plan review, mid-term inspection, and concluding review) rather than delivering routine technical instruction. The career positioning channel requires a stable source of industry practitioners and regularly scheduled career dialogues. The peer reference channel requires a mechanism for selecting and training senior core members so that they are able to guide junior members. What the three channels turn on is not the number of mentors but whether students can obtain guided dialogue within a limited time after each cognitive conflict.

4.3 Establishing the Mechanisms of the Two Institutional Validation Channels

The two institutional validation channels shift outcome management from "activity completion" to "closed-loop output." The external evaluation channel requires the

organization to maintain continuous attention to competition cycles, patent application procedures, and information on enterprise technical needs, helping students match project outcomes to suitable external evaluation channels. The practical transformation channel requires the organization to establish an awareness of "transformable outcomes" already at the project initiation stage: considering whether the project topic has the potential for outcome transformation, accumulating process documents and technical materials during implementation, and actively connecting with transformation pathways after completion. The two channels are linked by feedback: the results of external evaluation feed the practical transformation link, and the experience of transformation informs the next round of project selection, forming a continuous cycle of optimization.

5. Conclusion

Taking the "trigger-discourse-validation" three conditions of transformative learning as its analytical framework, the study has asked what functional conditions the educational pathways of discipline-based student organizations should satisfy and how those conditions are organized, and has built three pathways on that basis: hierarchical progression, reflection embedding, and action validation. The three pathways are nested in the form of "core plus shell": the first two constitute a core in which practice and reflection advance each other, while the third provides a channel of confirmation and continuation for every output of the core.

The contribution lies in a shift in the basis of definition. Discussion of education through student organizations has long rested on the empirical question of whether it works and on resource provision such as holding more activities and assigning more mentors. Defining an educational pathway as functional components oriented toward educational objectives, together with the logic of their combination, shifts the building of student organizations from comparing resource inputs to configuring functional conditions. Because pathways are defined by function rather than operation, the same pathway can be realized through different operational schemes, and its design logic can therefore be transferred across contexts.

This construction rests on preconditions:

Pathway One needs a source of projects that can be turned into project tasks, Pathway Two needs sufficient density and response timeliness among guides, and Pathway Three needs resource coordination and institutional authorization at the institution level. The actual effects of the three pathways in combination, and how the threshold of progressive trigger intensity is to be determined, still require empirical research to answer.

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