

# A Progressive Contextual Scaffolding Framework for Developing Engineering Students' Expressive Competence

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**Abstract:** Expressive competence does not emerge automatically from isolated competitions or short-term training. It develops through sustained task engagement, structured practice, diverse feedback, and transfer across contexts. To address low willingness to speak, weak organization, and limited professional transfer among first-year engineering students, this paper proposes a progressive contextual scaffolding model embedded in class management. The implementation context is a first-year automation class of 40 students at Xinjiang University of Technology. Drawing on sociocultural, experiential, and situated learning, together with feedback-literacy research, the model treats the class as a stable learning organization. Psychological, cognitive, contextual, and transfer scaffolds progressively move students from willingness to express toward structured, context-responsive, and autonomous high-quality expression. A recurring cycle of task engagement, expression practice, multiple feedback, reflective revision, and contextual transfer drives this process. The framework specifies a four-year objective matrix, task carriers, an assessment rubric, longitudinal data points, and ethical safeguards. Unlike approaches that infer competence from participation counts, it separates engagement, observable performance, feedback literacy, and transfer. Direct performance tasks and calibrated multi-rater scoring are proposed as the primary evidence. This conceptual and implementation study reports no uncollected outcomes. Its contribution is a testable, low-cost, longitudinal pathway for developing and tracking expressive competence in engineering classes in less-resourced regions.

**Keywords:** Class Management; Expressive Competence; Contextual Scaffolding; Feedback Literacy; Engineering Education; Action Research

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## 1. Introduction

Automation students must understand control theory, sensors, programming, and systems integration. They must also explain problems, organize evidence, and answer questions in classroom discussions, course projects, project pitches, competition defenses, and job interviews. Recent engineering-education research increasingly embeds communication, collaboration, and professional-identity development within authentic technical tasks rather than treating them as extracurricular additions<sup>[1-3]</sup>. Experiential and problem-oriented activities can make learning feel more authentic, but participation alone does not ensure improvement. Objectives, feedback, and assessment must form a coherent design chain<sup>[4-7]</sup>.

Current practice has three recurring weaknesses. First, training is often concentrated in speech contests or the recruitment season, so infrequent practice rarely produces stable behavior. Second, classroom evaluation often counts contributions or appearances but seldom measures content accuracy, argumentative structure, verbal clarity, nonverbal delivery, or live responses. Third, peer review can broaden the feedback base, yet students tend to offer vague comments when rubrics and rater training are absent. A recent meta-analysis found that explicit instructional support for feedback providers improves the quality of the feedback process. Research on oral presentations and peer assessment similarly identifies clear criteria, guided rehearsal, and teacher calibration as central implementation conditions <sup>[8-10]</sup>.

A class has relatively stable membership, frequent interaction, recurring tasks, and continuous teacher oversight. It may therefore mediate between formal coursework and informal learning. A year-by-year activity list, however, is not a theoretical model. The mechanism must explain how the class environment changes perceived participation risk, how structured tools support organization, how feedback becomes self-regulation, and how competence transfers to professional settings.

This paper addresses two questions. First, through what mechanisms can class-management-embedded training progressively develop expressive competence? Second, how can those mechanisms be translated into an executable, assessable, and revisable four-year framework? The study makes three contributions. It reframes the progression from willingness to autonomous high-quality expression as the gradual withdrawal of psychological, cognitive, contextual, and transfer scaffolds. It also links organizational conditions, learning mechanisms, competence dimensions, and assessment evidence, thereby separating participation from performance. Finally, it proposes an implementation and evaluation design for longitudinal action research with a first-year automation class of 40 students. The design can be adapted by comparable regional engineering institutions.

## **2. Theoretical Rationale and Model Development**

### **2.1 Components and Developmental Logic of Expressive Competence**

This paper defines expressive competence as the integrated capacity to select and organize content for a specific audience and task. It also includes using verbal and nonverbal resources, responding interactively, and revising performance through feedback. The construct has at least five observable dimensions: willingness and self-efficacy, content accuracy, structure and argumentation, delivery and interaction, and reflection and transfer. Expressive competence is not equivalent to participation. Participation indicates access to learning opportunities and degree of engagement, whereas competence must be judged through performance quality on comparable tasks. A recent review of oral assessment in higher education likewise emphasizes practice opportunities, assessment criteria, feedback, anxiety regulation, and task authenticity <sup>[11-13]</sup>.

Expression is a social practice. Through teacher modelling, peer observation, collaborative performance, and feedback dialogue, students develop criteria for effective expression and internalize them as self-monitoring tools. Studies of structured peer assessment show that rubrics reduce ambiguity and help students identify performance gaps. Their effectiveness nevertheless depends on rater preparation, relational trust, and teacher calibration <sup>[8-9]</sup>. Accordingly, peer assessment is not treated here as unrestricted commentary. It is a scaffolded process comprising criteria instruction, exemplar calibration, evidence-based comments, actionable suggestions, and a revised performance.

Experiential learning cycles through concrete experience, reflective observation, conceptual abstraction, and active experimentation. Engineering-education studies indicate that role-playing, authentic engineering problems, structured presentations, and team projects can connect technical knowledge with professional communication <sup>[2-3,7]</sup>. Transfer, however, requires progressive changes in task difficulty and audience. A student who can give a familiar self-introduction may still be unable to explain a control scheme or answer questions during a defense. Training should therefore begin with low-risk tasks for familiar audiences, then increase knowledge density, evidential demands, time pressure, and audience heterogeneity.

Feedback literacy involves more than receiving teacher comments. Students must understand criteria, judge quality, regulate emotional responses, and convert advice into subsequent action. Providing feedback and acting on feedback are related but distinct capacities, and receiving comments does not guarantee revision <sup>[14-15]</sup>. For that reason, revision after feedback is compulsory in the proposed model. Each core task includes an initial performance, rubric-based scoring, feedback discussion, revised performance, and reflective record.

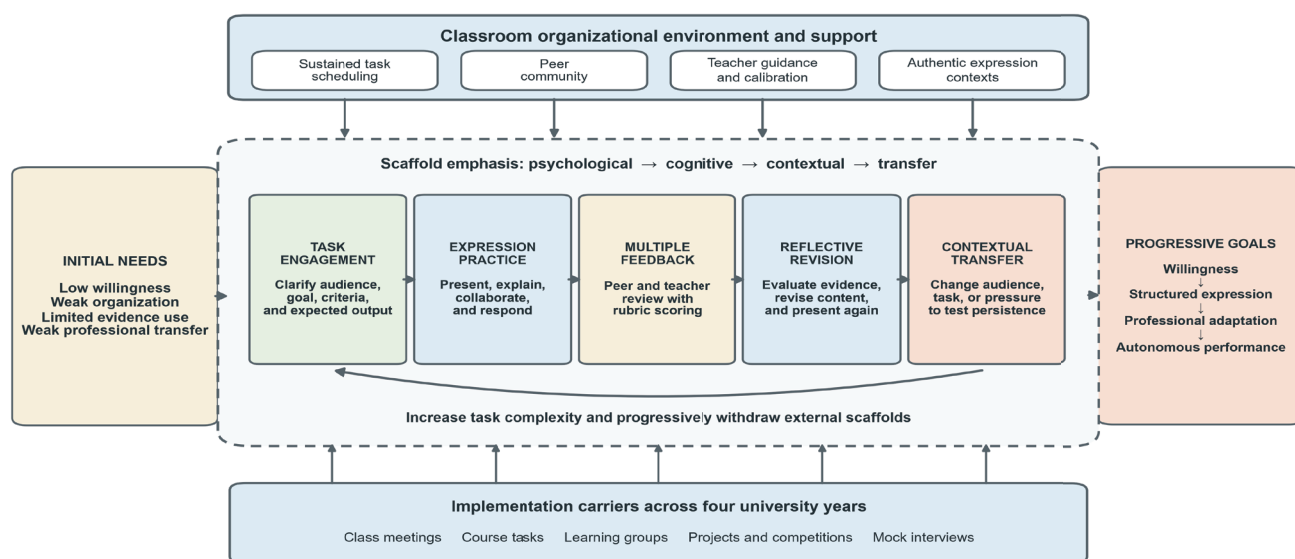
## 2.2 Progressive Contextual Scaffolding Model and Its Mechanisms

The model contains one organizational environment, four forms of stage-sensitive scaffolding, and one feedback loop. Class management supplies sustained tasks, a peer community, teacher guidance, and authentic expression contexts. These conditions allow frequent and traceable practice to be embedded in everyday learning at relatively low cost. The four scaffolds are not mechanically replaced each academic year. Instead, they represent a gradual transfer of control over expressive performance.

Psychological scaffolding uses low-risk tasks and stable relationships to reduce participation risk and establish willingness to speak. Cognitive scaffolding uses structural templates, concept maps, rubrics, and exemplars to reduce organizational load. Contextual scaffolding introduces projects, competitions, and interviews that increase audience heterogeneity, knowledge density, and response pressure. Transfer scaffolding then removes external prompts and requires students to select strategies independently in new tasks, including thesis defenses and peer mentoring. The developmental sequence is therefore not a set of four activity labels. It is a continuous process in which scaffolds are withdrawn, quality criteria are internalized, and expressive control shifts from teacher to student.

These relationships can be summarized as a dynamic mechanism linking organizational conditions, a learning cycle, scaffold adjustment, and competence transfer (Figure 1).

Figure 1. Mechanism for the progressive development of expressive competence in the classroom context



As Figure 1 shows, the class context does not directly produce expressive competence. It first provides repeatable opportunities through sustained task scheduling, peer community, teacher feedback, and authentic expression settings. Within that environment, task engagement, expression practice, multiple feedback, reflective revision, and contextual transfer form the smallest developmental unit. The first four processes explain how performance is formed and improved. Transfer then tests whether improvement persists outside the original task.

The cycle does not simply repeat the same activity. Task complexity, audience differences, evidence requirements, and live-response demands increase while external prompts gradually decrease. Scaffolding is thereby converted into self-monitoring and strategy selection. The model yields four testable propositions. First, among students with similar baseline competence, frequent low-risk tasks with clear rules should initially improve willingness and task engagement. Second, structural templates and exemplar calibration should first improve content organization and argumentative coherence. Third, students who receive rubric training and revise after feedback should improve more than students who only present. Fourth, transfer can be claimed only when performance is maintained after the audience, task, or pressure conditions change. These propositions make the framework open to verification and falsification in subsequent longitudinal research.

## 3. Progressive Training System and Implementation Pathway

### 3.1 Four-Year Developmental Pathway

The framework is intended for initial implementation in a first-year automation class of 40 students at Xinjiang University of Technology. Because the intact class enters the program as a natural cohort, the setting is suitable for design-based action research combined with longitudinal follow-up. The four-year plan does not merely make activities harder each year. Training objectives, task authenticity, scaffold intensity, and assessment priorities change together. Before the first data collection, researchers should record student characteristics, previous presentation experience, and baseline performance. They should also document attrition and missing data. This paper does not assume students' gender, ethnicity, family background, or baseline competence, and it reports no outcomes that have not been collected.

The mechanism explains how expressive competence may develop, whereas the pathway specifies how that mechanism changes across stages of study. The four-year pathway therefore moves progressively from psychological to transfer scaffolding (Figure 2).

Figure 2. Four-year progressive pathway for developing university students' expressive competence

— Gradual Removal of Scaffolds, Continuous Enhancement of Ability —

| Training Objectives  | Year 1: Dare to Express<br>Build psychological safety and initiate willingness           | Year 2: Be Able to Express<br>Master structure and express clearly               | Year 3: Be Good at Expressing<br>Adapt to contexts and communicate professionally            | Year 4: Be Excellent at Expressing<br>High-level expression and sustained impact     |
|----------------------|------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|
| Typical Tasks        | Self-introduction, concept explanations, class sharing, campus application ideas         | Course reports, group presentations, thematic speeches                           | Project reports, competition presentations, job interview simulations                        | Thesis defense, experience sharing, peer training and mentoring                      |
| Key Activities       | 60-second self-introduction<br>3-minute concept explanation<br>Structured short-practice | Logical framework training<br>Group reports & Q&A<br>Peer feedback and revision  | Real project reporting<br>Competition presentations<br>Mock interviews and Q&A               | Formal defense training<br>Experience sharing<br>Peer mentoring                      |
| Scaffolding Supports | Low-risk tasks+clear templates<br>Peer support+encouraging feedback                      | Thinking maps+structural templates<br>Rubric training+exemplars calibration      | Diverse scenarios+time pressure<br>Professional mentor guidance + individualized improvement | High-level feedback+self-monitoring<br>Showcase best practices & sustained influence |
| Evaluation Focus     | Expression willingness, participation, accuracy of basic content                         | Structural clarity, logical coherence, feedback utilization and revision quality | Professional adaptation, response to complex questions, communication effectiveness          | Overall expression quality, transfer ability, influence and continuous improvement   |

Figure 2 shows that the four stages differ in developmental conditions, not only in task complexity. Year 1 reduces expression risk and initially emphasizes willingness, engagement, and basic content accuracy. Year 2 raises structural expectations and asks students to organize concepts, evidence, and logical relations. Year 3 introduces authentic audiences, time pressure, and live questioning through project reports, competition defenses, and mock interviews. Assessment then focuses on professional adaptation and communication about complex problems. Year 4 removes more template-based support and tests independent performance through thesis defense, experience sharing, and peer mentoring. The pathway thus combines scaffold withdrawal, greater task authenticity, higher assessment standards, and internalized control. It complements the cyclical mechanism in Figure 1 by linking developmental stages with recurring learning processes.

### 3.2 First-Year Units and Organizational Operation

Because the initial participants are first-year students, the first year should not begin with high-stakes defense tasks. It instead comprises four progressive units. The first establishes relationships and a baseline through a 60-second self-introduction and a short talk titled 'My Understanding of Automation.' The second develops knowledge explanation by assigning one group every two weeks to explain a course concept in three minutes. The third develops structure through a group micro-presentation using a problem-cause-evidence-conclusion template. The fourth is a transfer-oriented presentation in which students propose an improvement to an automation application on campus and answer questions.

The units repeat one developmental cycle under increasing complexity. The object of expression moves from self, to knowledge, and then to problem solving. The audience expands from familiar peers to teachers and the wider class

community. Assessment similarly shifts from willingness to structure, evidence, and live response. Every unit includes an initial presentation, peer rubric feedback, teacher calibration, revision, and a second presentation. This sequence ensures that feedback changes the next performance.

The activities do not require a separate, costly training course. They are embedded in themed class meetings, course learning groups, class projects, and stage reviews. The class can be divided into eight stable groups of five students. Roles rotate among chair, presenter, evidence checker, timekeeper, and feedback recorder. The advisor or class teacher maintains organizational continuity, subject teachers verify technical accuracy, and students use a common rubric for peer assessment. Records created only for learning must be managed separately from research data. Any material used for research requires separate informed consent.

## 4. Research Design and Evaluation Framework

### 4.1 Indicators and Direct Performance Rubric

The evaluation follows four principles: separate process from outcomes, prioritize direct performance, calibrate multiple raters, and maintain longitudinal comparability. Implementation indicators include attendance, task submission, expression opportunities, and feedback completion. They show whether the program occurred as planned and describe its delivered dose, but they do not demonstrate competence gains. Outcome indicators use identical or structurally equivalent tasks to assess willingness, content accuracy, structural logic, delivery, interaction, response quality, and revision after feedback. Distant outcomes, such as employability or class cohesion, cannot be inferred from short-term participation. They require independent instruments and cautious interpretation. Table 1 operationalizes the direct performance dimensions.

*Table 1. Direct performance rubric for expressive competence*

| Dimension                   | Level 1                         | Level 2                          | Level 3                        | Level 4                                    |
|-----------------------------|---------------------------------|----------------------------------|--------------------------------|--------------------------------------------|
| Content accuracy            | Critical error                  | Mostly correct; limited evidence | Accurate; appropriate evidence | Accurate and concise; addresses boundaries |
| Structure and argumentation | Fragmented information          | Ordered; weak links              | Complete; clear relationships  | Concise; addresses alternatives            |
| Language and delivery       | Hard to follow or far over time | Generally clear                  | Clear, fluent, and on time     | Precise and audience-adapted               |
| Interaction and response    | Avoids or misses the question   | Answers; weak support            | Direct, evidence-based answer  | Clarifies and integrates evidence          |
| Feedback and revision       | Does not use feedback           | Superficial changes              | Substantive revision           | Judges feedback and explains choices       |

Table 1 does not provide a generic score for public-speaking technique. It operationalizes variables in the model. Content accuracy and argument structure primarily indicate whether cognitive scaffolding has been internalized. Delivery and interaction show whether students can regulate expression for a particular audience and context. Feedback and revision directly represent feedback literacy and self-regulation. High-level performance therefore requires more than fluency. Students must handle knowledge boundaries, respond to alternative explanations, adapt to audiences, and justify how they used or rejected feedback. The assessment target shifts from completing a presentation to controlling its quality independently. These mappings also provide observable evidence for testing which competence dimensions respond first to each scaffold.

### 4.2 Longitudinal Evaluation and Evidence Criteria

Longitudinal evaluation should form a progressive chain of implementation, performance, and transfer evidence. Students must first receive sufficient and reasonably balanced opportunities to perform. Attendance, task submission, and feedback completion document whether implementation actually occurred. Participation itself is not evidence of competence. Improvement must appear in scores from identical or structurally equivalent performance tasks. Transfer evidence requires students to maintain stronger performance after the audience, task, or pressure condition changes.

Five longitudinal measurement points are proposed. T0 is the entry baseline, and T1 through T4 occur at the end of each

academic year. Each point uses an oral task with equivalent structure but a different topic. Video recordings, rating forms, and student reflections should be retained. At least two raters should score each task independently after exemplar-based calibration. Brief reflections may also be collected after each first-year unit to identify expression anxiety, feedback uptake, and group-interaction barriers. The final report must disclose all instruments, item sources, rater identities or roles, and indices of inter-rater agreement.

Once empirical data are available, each time point should be reported with sample size, reasons for missingness, central tendency, and uncertainty. Longitudinal scores may be analyzed with a linear mixed model or a suitable robust method, depending on the distribution. Students should be treated as repeated-measure units and time as a fixed effect. Effect sizes and confidence intervals should accompany the estimates. If the sample cannot support complex inference, individual trajectories and descriptive results should take priority. Interviews and reflections may be double-coded thematically, but a few favorable quotations must not substitute for evidence across the cohort.

Formal research must receive institutional ethics approval or a written exemption before data collection, and students must provide informed consent. Routine class activities may continue as teaching, but students may decline research use of their performance data without consequences for grades, awards, or relationships. Videos and rating forms should be de-identified, access controlled, and retained only for a defined period. When the researcher is also the teacher or class advisor, recruitment or data de-identification should be handled by a third party. This separation reduces the risk of participation driven by unequal power relations.

## 5. Conclusion

This paper develops a progressive contextual scaffolding model for class-management-embedded expressive-competence training in a first-year automation class of 40 students. The model uses psychological, cognitive, contextual, and transfer scaffolds to move students from willingness toward structured, context-responsive, and autonomous high-quality expression. Task engagement, expression practice, multiple feedback, reflective revision, and contextual transfer form the recurring developmental cycle. The framework further specifies a four-year pathway, a direct performance rubric, longitudinal measurement points, and ethical safeguards.

The central proposition is that competence develops through increasing task complexity, progressive scaffold withdrawal, feedback that changes subsequent action, and repeated transfer tests. These conditions shift control from teachers and external tools toward student self-regulation. The paper does not claim empirical effectiveness because standardized longitudinal outcomes have not yet been collected. Its contribution is to convert a set of experiential activities into an implementable, measurable, and falsifiable framework. The design provides a basis for rigorous class-based action research and future comparative studies.

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## Conflict of Interests

The authors declare that there is no conflict of interest regarding the publication of this paper.

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