Knowing When to Be Visible: Tacit Participation Norms in Higher Education

Implications for Engineering Learning and Professional Practice

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Abstract

Professional learning in engineering is often framed in terms of formal competence, confidence, and visible contribution. Yet many of the judgements that shape effective participation in professional work are tacit, relational, and learned informally. This paper examines how engineers develop judgement about when to speak, when to listen, and when to remain deliberately unobtrusive, conceptualising these practices as strategic invisibility. Rather than treating silence or restraint as indicators of disengagement or lack of confidence, the paper reframes them as adaptive responses to uneven professional risk and organisational expectations.

Drawing on research in professional identity formation, workplace learning, and tacit knowledge, the analysis shows how visibility functions as a proxy for competence in both higher education and engineering practice. When participation norms remain implicit, capable individuals may experience reduced recognition or constrained access to learning opportunities, leading over time to what this paper terms quiet professional attrition: gradual withdrawal or marginalisation without overt conflict. These dynamics are rarely named explicitly, yet they shape career trajectories and the sustainability of professional communities.

The paper positions higher education as a critical formative site where participation norms are learned, and visibility comes to function as a proxy for competence. By recognising listening, interpretive judgement, and calibrated participation as legitimate forms of professional competence, educational settings can better prepare students for the relational realities of engineering work. This conceptual reframing expands understandings of contribution without prescribing uniform communicative behaviour, offering a foundation for more inclusive and sustainable participation in both learning and professional environments.

Keywords: professional identity; workplace learning; engineering education; tacit knowledge; participation

1. Introduction

Engineering work is often described in terms of technical competence, problem-solving ability, and visible leadership. In both educational and professional discourse, engineers may be frequently encouraged to demonstrate confidence, speak up, and make their contributions known. These expectations are often embedded in employability narratives, teamwork frameworks, and professional standards, shaping how competence and readiness for practice are understood. Yet such framings offer only a partial account of how professional work is learned and enacted. In higher education, participation is frequently treated as visible engagement, with speaking, leadership, and immediacy functioning as proxies for competence.

In practice, engineering involves navigating uncertainty, incomplete information, and complex social environments. Effective participation requires not only technical knowledge, but also judgement about when to act, when to question, when to listen, and when restraint is the most professionally appropriate response. These judgements are rarely articulated explicitly, yet they can play a critical role in shaping professional credibility, access to learning opportunities, and long-term career trajectories.

Despite their importance, such forms of judgement often remain largely invisible within dominant narratives of professional competence. Silence may be interpreted as disengagement, a lack of confidence, or the absence of leadership, while verbal assertiveness can be seen as evidence of contribution and capability (Acker, 1990; Ely and Meyerson, 2000; Kelan, 2010). These assumptions are infrequently questioned, even though they sit uneasily with accounts of professional learning that emphasise interpretation, reflection, and situated judgement. These expectations also shape how students first learn to interpret participation in higher education, where visibility is often treated as evidence of engagement and competence.

This invisibility has consequences. Engineers who learn to manage their participation carefully may do so as a form of professional judgement, particularly in high-stakes or uneven environments. Over time, however, such strategies may reduce visibility, limiting recognition, influence, and advancement. When these processes occur gradually and without overt conflict, they are challenging to detect and easy to misattribute. Capable professionals may withdraw, plateau, or leave without their experiences being recognised as systemic rather than personal. Because these interpretive habits often begin forming during university group work and early professional preparation, higher education plays a significant role in shaping how future engineers understand contribution and legitimacy.

Educational settings play a significant role in shaping how these dynamics unfold. Universities are often the first environments in which students encounter professional norms around participation, authority, and legitimacy. Group work, collaborative projects, and assessed teamwork provide powerful sites for learning not only technical content but also what counts as contribution and whose voices are heard (Pawley, 2009; Tonso, 2006).

This analysis contributes specifically to engineering identity scholarship by examining how professionals learn to navigate participation in ways that protect their developing identities while seeking recognition and belonging. Recent research demonstrates that identity formation in engineering is shaped not only by formal learning experiences but also by the subtle relational dynamics through which individuals negotiate their place within professional

communities (Huff et al., 2021; Tonso, 2006). By conceptualising strategic invisibility and quiet professional attrition, this paper extends identity research beyond questions of who identifies as an engineer to examine how professionals learn to calibrate their visibility as part of identity work. This dimension of identity formation—the tacit judgement about when and how to participate—has received limited attention in engineering education research, despite its significance for retention, inclusion, and sustainable professional trajectories.

At the same time, engineering education and practice are often characterised by increasing cultural diversity. Multicultural learning and working environments bring significant strengths, but also introduce variation in how communication, authority, and silence are interpreted. When participation norms remain implicit, these differences can be misunderstood, potentially reinforcing narrow expectations of competence that do not reflect the realities of contemporary engineering work.

This paper addresses these gaps by offering a conceptual analysis of participation, visibility, and professional learning in engineering. Drawing on theories of professional identity, workplace learning, and tacit knowledge, it introduces the concepts of strategic invisibility and quiet professional attrition to describe patterns of participation commonly reported in professional accounts in practice but under-theorised in scholarship. Rather than framing silence or restraint as individual deficits, the paper examines how such behaviours can reflect adaptive professional judgement shaped by context and experience.

The paper also considers the implications of these dynamics for engineering education. By reframing listening, interpretive judgement, and calibrated participation as forms of professional competence, it suggests ways in which educational settings may better prepare students for the relational realities of professional work. In doing so, it seeks to broaden understandings of contribution without prescribing uniform behaviour or privileging particular communicative styles.

The paper proceeds as follows. Section 2 situates the analysis within existing literature on professional identity, workplace learning, and tacit knowledge, and outlines the conceptual orientation adopted. Section 3 develops the concepts of strategic invisibility and quiet professional attrition. Section 4 examines how educational structures, measurement practices, and multicultural contexts shape participation norms. Section 5 considers implications for educational practice, focusing on listening as professional competence. The paper concludes by reflecting on the ethical and academic significance of making tacit professional learning visible.

This analysis contributes to debates in higher education research on participation, assessment, and equity by examining how visibility functions as a proxy for competence in contemporary university settings.

2. Professional Identity, Workplace Learning, and Tacit Knowledge

Professional identity is widely understood as dynamic, relational, and continually negotiated rather than fixed or solely individual. Rather than being formed once through qualification or role entry, professional identity develops through ongoing participation in work, shaped by interaction with colleagues, organisational norms, and expectations about competence and

legitimacy (Beijaard et al., 2004; Ibarra, 1999; Pratt et al., 2006; Trede, 2009). From this perspective, becoming a professional is not simply a matter of acquiring skills, but of learning how one's contributions are recognised, valued, and positioned within a particular professional context.

In much of the engineering education and professional development literature, identity is often treated implicitly, embedded within discussions of competence, confidence, or employability. These framings privilege visible performance, verbal articulation, and demonstrable leadership as indicators of readiness for professional practice. While such attributes are undoubtedly relevant, they offer only a partial account of how professional legitimacy is established and sustained in complex engineering environments. Research on professional identity formation suggests that legitimacy is not solely earned through performance, but negotiated through relationships, histories, and shared understandings of what competent participation looks like in practice (Kogan et al., 1994; Trede, 2009).

Workplace learning scholarship provides essential insight into how these negotiations occur. A substantial body of research demonstrates that much professional learning takes place informally, through participation in everyday work activities rather than through formal training or instruction (Billett, 2004; Eraut, 2004; Lave and Wenger, 1991). Engineers learn how work is accomplished by observing others, engaging in problem-solving, responding to unexpected situations, and interpreting feedback that is often indirect or implicit. These learning processes are embedded within social relations and organisational routines, making them unevenly accessible across individuals and contexts (Billett, 2004; Eraut, 2004). Similar patterns are evident in higher education, where participation norms are often implicit, and students learn early to associate visibility with competence and legitimacy. Similar patterns are evident in higher education, where participation norms are often implicit, and students learn early to associate visibility with competence and legitimacy (Billett, 2004; Eraut, 2004).

Central to this literature is the recognition that professional competence relies heavily on tacit knowledge. Tacit knowledge encompasses forms of judgement, interpretation, and situational awareness that are difficult to articulate or codify, yet essential to effective professional practice (Collins, 2013; Polanyi, 2009). In engineering, such knowledge includes recognising when a system is behaving unexpectedly, anticipating downstream consequences, interpreting incomplete information, and judging when intervention is necessary or when restraint is more appropriate. These capacities are rarely assessed explicitly, yet they are widely understood to be related to safety, reliability, and professional credibility. In digitally mediated operational environments, visibility dynamics become particularly complex as performance monitoring reshapes how professional judgement is exercised and recognised.

Schön's (2017) notion of reflective practice further highlights the interpretive nature of professional judgement, emphasising that practitioners often act in conditions of uncertainty where rules and procedures offer limited guidance. Learning in such contexts involves developing sensitivity to context and consequence, rather than simply applying predefined solutions. Workplace learning scholars have since extended this view, showing how such judgment is shaped through participation in practice and through exposure to the values and norms of professional communities (Billett, 2016; Fenwick, 2016; Tynjälä, 2008).

Despite this rich body of work, the implications of tacit knowledge for participation and visibility in engineering have received comparatively limited attention. While the identity and workplace learning literatures acknowledge that access to learning opportunities is uneven,

less attention has been paid to how professionals learn to manage their own visibility as part of competent participation. Decisions about when to speak, when to listen, and when to remain deliberately unobtrusive are often treated as personal style or confidence-related traits, rather than as learned professional judgements shaped by experience and context.

Organisational research offers further insight into why such judgements matter. Studies of gendered and stratified organisations demonstrate that expectations about competence and authority are not distributed evenly, and that certain forms of participation are more readily recognised as legitimate than others (Acker, 1990; Ely and Meyerson, 2000; Kelan, 2010). These dynamics influence not only who is heard, but whose contributions are taken seriously, whose mistakes are tolerated, and whose restraint is interpreted as wisdom rather than disengagement.

Within this landscape, engineers learn—often implicitly—to calibrate their participation in response to perceived professional risk. Visibility can offer opportunities for recognition and advancement, but it can also expose individuals to scrutiny, misinterpretation, or disproportionate consequences for error. Learning when visibility is beneficial and when restraint is prudent, therefore, constitutes an important, though rarely articulated, dimension of professional competence. These judgements are not acquired through formal instruction, but through experience, observation, and reflection on prior outcomes, aligning closely with accounts of tacit professional learning (Billett, 2016; Eraut, 2004).

By bringing professional identity, workplace learning, and tacit knowledge into dialogue, this paper positions strategic invisibility as a learned and adaptive aspect of professional practice rather than as an individual deficit. This framing shifts attention away from confidence-based explanations of participation and toward the relational and organisational conditions under which professional judgement is exercised. It also provides a conceptual foundation for understanding how capable engineers may navigate participation carefully to sustain their professional identity within complex and uneven environments.

2.1 Positioning the Contribution

Much of the literature on engineering education and professional development frames participation in terms of concepts such as confidence, communication skills, and leadership presence. Within these framings, visibility is often treated as a proxy for engagement and competence, while silence or restraint is interpreted as a lack of confidence, preparedness, or professional maturity. Although these interpretations are rarely made explicit, they are embedded in dominant narratives about employability, teamwork, and professional readiness.

This paper challenges these assumptions by reframing participation as a matter of professional judgement rather than individual disposition. Drawing on insights from professional identity formation and workplace learning, it argues that decisions about when to speak, when to listen, and when to remain deliberately unobtrusive are not simply expressions of personality or confidence but learned responses to professional context and perceived risk. From this perspective, visibility is not inherently virtuous, nor is silence inherently problematic.

Existing accounts of professional learning acknowledge that access to learning opportunities is uneven. Still, they often stop short of examining how professionals actively manage their own participation in response to these conditions. As a result, the labour involved in

calibrating visibility—particularly in complex, high-stakes, or uneven environments—remains largely invisible. This paper contributes by naming this labour explicitly as strategic invisibility, positioning it as a form of tacit professional competence rather than an individual shortcoming.

By introducing the concept of quiet professional attrition, the paper also extends existing discussions of retention and participation beyond overt exclusion or formal barriers. Quiet attrition captures the gradual processes through which capable professionals become marginalised, withdraw, or exit without conflict or recognition. These processes are sometimes misattributed to personal preference or lack of ambition, obscuring their relational and organisational origins.

Importantly, this framing does not deny the value of visible leadership or articulate communication. Instead, it broadens the conceptualisation of professional competence to include listening, interpretive judgement, and situational awareness as legitimate and necessary forms of participation. In doing so, it shifts attention away from confidence-based explanations and toward the conditions under which different modes of contribution are recognised and rewarded.

Taken together, these arguments reposition participation as a core issue in higher education learning and assessment, rather than a matter of individual confidence or communicative style.

The contribution of this paper, therefore, lies not in proposing new skills to be acquired but in offering a reframing of how participation is understood in engineering education and practice. By making tacit judgements about visibility explicit, it provides a language through which professionals, educators, and students can recognise experiences that are widely shared yet rarely named. This reframing opens space for more inclusive understandings of competence, without requiring individuals to adopt participation styles that may be professionally risky or culturally incongruent.

2.2 Conceptual Orientation and Scope

This paper adopts a conceptual, practice-informed approach to understanding professional learning in engineering. Rather than reporting empirical findings, it aims to theorise patterns of participation widely recognised in practice but under-examined in formal scholarship. The analysis is grounded in established theories of professional identity, workplace learning, and tacit knowledge, and draws on sustained engagement with engineering practice across multiple organisational and educational contexts.

Conceptual papers often play an important role in fields where significant aspects of professional work are challenging to observe or measure through conventional empirical designs. Tacit judgement, interpretive awareness, and relational participation are central to engineering practice, yet they often operate below the level of explicit articulation (Collins, 2013; Schön, 2017). A conceptual approach allows such patterns to be surfaced, named, and situated within existing theoretical frameworks, providing a foundation for future empirical investigation.

The scope of the paper is deliberately focused on dynamics relating to visibility, participation, and professional judgement, with attention to how they intersect with identity,

learning, and organisational context. This paper is conceptual and practice-informed; it does not estimate prevalence or test causal pathways. The paper does not attempt to evaluate specific pedagogical interventions or prescribe universal solutions. Instead, it seeks to expand how participation is conceptualised, making visible forms of professional learning that are often overlooked when competence is equated primarily with verbal assertiveness or visible leadership. While engineering provides a particularly visible case due to its high-stakes and collective nature, the participation dynamics described here reflect broader patterns observed across higher education learning environments.

3. Strategic Invisibility and Quiet Professional Attrition

Within professional engineering contexts, participation is often not a neutral act. Engineers learn, often implicitly, that speaking, questioning, or challenging assumptions can carry different consequences depending on timing, audience, status, and organisational climate. Strategic invisibility can therefore be understood conceptually as a form of tacit professional knowledge rather than as an individual deficit. It reflects learned judgment about how to engage in ways that preserve professional credibility while managing risk.

Strategic invisibility refers to the learned professional judgement involved in deciding when to speak, when to listen, and when to remain deliberately unobtrusive in response to contextual demands and perceived professional risk. It is not a lack of confidence, but an adaptive form of participation shaped by experience, organisational norms, and uneven consequences for visibility.

Strategic invisibility, when sustained over time in environments that fail to recognise diverse modes of contribution, can gradually lead to quiet professional attrition. In such contexts, adaptive restraint may preserve credibility in the short term but risks limiting recognition, progression, and long-term engagement.

These judgements are infrequently taught explicitly. Instead, they develop through experience, observation, and reflection on past outcomes, aligning closely with accounts of tacit learning in professional practice (Billett, 2016; Eraut, 2004; Polanyi, 2009). Engineers observe whose contributions are welcomed, whose are dismissed, and whose mistakes are tolerated. Over time, they learn to calibrate their own participation, adjusting visibility in response to context rather than solely on confidence.

Informal practices, such as participation in meetings, inclusion in problem-solving discussions, and access to information flows, often mediate access to learning opportunities in engineering work. These opportunities are not evenly distributed, nor are they always visible to those excluded from them (Billett, 2016; Fenwick, 2016; Trevelyan, 2014). Less visible engineers can therefore experience constrained learning, not because of a lack of capability, but because participation norms limit their access to developmental interactions. Similar patterns can emerge in higher education, where students learn early that visibility is often treated as evidence of engagement, shaping how they interpret participation long before entering professional practice.

Decisions to remain selectively invisible may serve as protective strategies in environments characterised by uncertainty, high stakes, or uneven power relations. Speaking up may offer

opportunities for recognition, but it may also expose individuals to heightened scrutiny, misinterpretation, or reputational risk. In such contexts, restraint may be read as professionalism or good judgement, particularly when exercised by experienced practitioners. However, over time, habitual restraint may reduce visibility, limiting recognition, progression, and influence.

When these dynamics persist, they may give rise to what this paper terms quiet professional attrition. We use quiet attrition to conceptualise gradual processes through which capable professionals can disengage, plateau, or exit professional pathways without overt conflict, formal complaint, or explicit exclusion. Unlike more visible forms of attrition, these processes often go unrecognised, attributed retrospectively to personal choice, lack of ambition, or poor fit, rather than to structural or relational conditions. Quiet professional attrition refers to the gradual narrowing of participation, influence, or career trajectory by capable professionals who withdraw in response to accumulated misrecognition, constrained opportunities, or uneven participation norms. It differs from "quiet quitting" because it is not disengagement from work effort, but a relational response to organisational conditions that limit safe or legitimate participation.

Quiet professional attrition is seldom intentional or malicious. It can emerge through the accumulation of small exclusions, missed opportunities, and misrecognitions that shape how individuals perceive their future within an organisation or profession (Acker, 1990; Kogan et al., 1994). Engineers may continue to perform competently while withdrawing from discretionary participation, leadership pathways, or professional visibility, effectively narrowing their own trajectories in response to perceived constraints.

Reframing strategic invisibility as adaptive practice shifts attention away from confidence-based explanations of participation and toward the organisational conditions under which professional judgement is exercised. It highlights how listening, restraint, and selective engagement can constitute competent participation, while also revealing how environments that privilege visibility without recognising these forms of judgement may inadvertently contribute to the quiet loss of capable professionals.

By naming strategic invisibility and quiet professional attrition explicitly, this paper provides language for experiences widely shared among practitioners but rarely discussed. This conceptual framing supports more nuanced conversations about participation and learning in engineering, enabling organisations and educators to distinguish between lack of engagement and deliberate, experience-based judgement about when and how to contribute.

Viewed in this way, strategic invisibility is not simply an individual coping strategy, but a relational outcome shaped by organisational expectations and participation norms. When professional environments consistently reward visibility without recognising interpretive judgement or restraint, engineers may learn to manage risk by narrowing their participation. While such strategies can preserve credibility in the short term, they may also limit opportunities for learning, recognition, and progression over time. Recognising this dynamic is often essential for understanding why capable professionals may disengage without overt conflict, and why attrition can occur quietly even in organisations that value competence and inclusion.

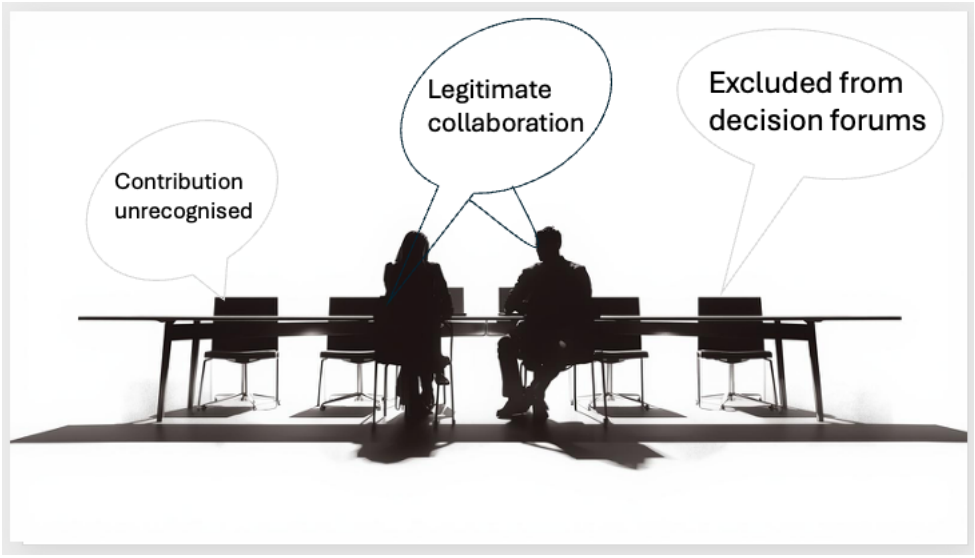

Figure 1. Boardroom metaphor illustrating strategic invisibility and quiet professional attrition.

Occupied chairs with speech bubbles represent visible, recognised participation, while empty chairs with thought bubbles represent tacit experiences of marginalisation associated with gradual withdrawal. The boardroom setting is illustrative rather than occupationally specific and is intended to surface implicit participation norms in educational settings.

The figure highlights the relational nature of participation. Strategic invisibility is not a matter of confidence or personality, but a learned judgement about when visibility carries professional risk. Over time, the accumulation of missed invitations, misinterpretations of silence, and lack of recognition can contribute to quiet professional attrition. By making these tacit dynamics visible, the figure provides a shared language through which educators and organisations can recognise experiences that are widely shared yet rarely named.

4. Education, Measurement, and Multicultural Contexts

Engineering education operates within regulatory, accreditation, and quality assurance frameworks that prioritise explicit, assessable learning outcomes. These frameworks play an important role in ensuring consistency, accountability, and minimum standards across programmes. However, they also shape what is most visible and valued within curricula, tending to privilege forms of learning that can be readily articulated, standardised, and measured. Tacit dimensions of professional judgement—such as knowing when to speak, when to listen, and how to participate effectively in group settings—are therefore difficult to capture through conventional assessment practices (Eraut, 2004; Schön, 2017; Tynjälä, 2008).

As a result, essential aspects of professional learning may often remain invisible within formal educational structures, despite being central to effective participation in engineering work. Capacities such as interpretive judgement, situational awareness, and sensitivity to group dynamics are typically developed through experience rather than instruction and are

infrequently named explicitly as learning outcomes (Billett, 2004; Collins, 2013; Fenwick, 2016). Graduates may still be expected to exercise these capacities in professional contexts, often without shared language to support their development or evaluation.

This gap between what is taught, what is assessed, and what is required in practice can leave students to navigate key aspects of professional participation privately and unevenly. Some may acquire these judgements informally through observation, mentoring, or early professional exposure. In contrast, others may learn through trial and error, absorbing implicit signals about when participation is welcomed and when it carries risk. These processes can be opaque, and their outcomes are often interpreted retrospectively as matters of confidence, personality, or individual fit, rather than as consequences of uneven access to informal learning opportunities. These interpretive challenges often begin during university group work, where participation norms are rarely made explicit, and students must infer what counts as a legitimate contribution.

The multicultural nature of engineering and academic environments further shapes these challenges. Engineering higher education and professional practice in engineering practice are characterised by a high degree of cultural diversity, which brings significant strengths in perspectives, problem-solving approaches, and reasoning. At the same time, norms surrounding communication, hierarchy, and participation vary across cultural contexts, influencing how visibility, silence, and authority are interpreted within groups (Ely and Meyerson, 2000; Kelan, 2010; Lewis et al., 2009).

In such environments, silence may signal respect, reflection, careful judgement, or strategic restraint rather than disengagement or lack of contribution. However, when dominant participation norms remain implicit, these alternative meanings may go unnoticed or be misinterpreted. This can inadvertently privilege communicative styles while rendering others less visible or less readily recognised as competent. Importantly, these dynamics do not arise from individual prejudice or deliberate exclusion, but from unexamined assumptions about what participation looks like in practice.

Educational settings are uniquely positioned to make these assumptions visible. Unlike professional environments, where interactional norms are often deeply embedded and reinforced through organisational reward structures, educational contexts offer space for reflection, experimentation, and dialogue. Within these settings, students can be encouraged to reflect on how different forms of participation contribute to collective learning and professional judgement, without framing difference as a deficit or prescribing uniform behaviour.

Making these dynamics visible does not require abandoning existing standards, assessment regimes, or accreditation requirements. Instead, it involves supplementing them with shared language that recognises listening, interpretive judgement, and calibrated participation as legitimate aspects of professional competence. Such recognition can help bridge the gap between educational preparation and real-world experience, while preserving the benefits of multicultural learning environments central to contemporary engineering practice.

Educators can also employ visual metaphors, such as the boardroom illustration in Figure 1, as teaching tools to surface tacit participation dynamics. By inviting students to interpret the occupied and empty chairs, and to reflect on the speech and thought bubbles, instructors can prompt discussion about how visibility, silence, and recognition operate in professional

contexts. Such activities make implicit norms explicit, encouraging students to consider how listening, restraint, and calibrated participation may be misread or undervalued. Using the figure in classroom dialogue can not only validate diverse modes of contribution but also equip learners with a shared language to analyse participation critically, thereby strengthening their preparedness for multicultural and stratified workplaces.

5. What Good Preparation Could Look Like

Preparing engineers for professional work does not require anticipating every interpersonal challenge graduates may encounter, nor does it involve prescribing a single model of appropriate behaviour. Instead, it requires acknowledging that professional learning is both individual and relational, and that students learn not only what engineers do, but how participation, expertise, and legitimacy are negotiated in practice. From this perspective, preparation involves supporting students to develop judgement about when and how to contribute, including when listening is the most professionally appropriate response.

Much of what students come to understand about competence and leadership emerges through group interaction. In collaborative learning environments, norms of participation develop informally as students work together under time pressure, uncertainty, and assessment constraints. These norms are rarely the result of explicit instruction or deliberate enforcement. Instead, they reflect how groups organise themselves in the absence of shared language about participation, often drawing on familiar assumptions about confidence, assertiveness, and leadership.

When such dynamics remain implicit, groups may come to equate verbal immediacy with contribution, while quieter forms of engagement are less readily recognised. This does not indicate a failure on the part of educators or students, but a predictable feature of group learning in complex environments. In busy teaching contexts, interactional patterns can stabilise quickly, often before educators can observe or intervene.

Framing listening as professional competence offers a constructive way to address these dynamics without positioning any group as deficient. Listening in this sense is not passive reception, but an active practice involving interpretation, synthesis, and judgement. In professional engineering contexts, listening enables practitioners to integrate diverse forms of expertise, recognise emerging risks, and respond appropriately to incomplete or uncertain information. These capacities are central to practical engineering work, yet they are rarely named explicitly as competencies in educational settings.

Research on engineering education has shown that group work plays a decisive role in shaping students' understandings of competence and leadership (Beddoes and Pawley, 2014; Pawley, 2009; Tonso, 2006). More recent work on engineering identity further highlights how interactional norms influence whose contributions are recognised and valued within teams (Huff et al., 2021). Without explicit attention, these norms may inadvertently privilege communicative styles, reinforcing narrow interpretations of professional capability. These early experiences can shape how students later interpret when visibility feels professionally safe, and when strategic restraint may be the more appropriate response.

Educational environments are uniquely positioned to broaden these interpretations because students are still forming their professional identities. For verbally confident students, learning to listen attentively, invite perspectives, and recognise insight offered in less immediate ways constitutes an essential aspect of professional development. Framing these practices as elements of professional competence, rather than interpersonal courtesy, aligns educational preparation more closely with the realities of engineering work, where effective outcomes depend on collective sense-making rather than individual dominance (Billett, 2016; Trevelyan, 2014).

Importantly, emphasising listening does not require encouraging quieter students to adopt performative visibility, nor does it involve suppressing confident participation. Instead, it consists of designing learning environments that recognise multiple modes of contribution. Practices such as structured turn-taking, reflective pauses, written inputs, or deliberate solicitation of perspectives can support more inclusive participation without disrupting existing curricular demands. These approaches benefit groups by expanding the range of judgments available and improving the quality of collective decision-making.

Educational settings also serve as a formative space where these norms can be explored safely. Before interactional patterns become reinforced through professional authority and organisational reward structures, students can reflect on how group dynamics shape whose knowledge is heard and valued. By making listening, inclusion, and interpretive awareness explicit aspects of professional learning, education can interrupt the reproduction of exclusionary participation norms before they become normalised in professional practice.

Equally important is faculty development: educators themselves need opportunities to reflect on participation norms, learn to recognise tacit forms of contribution, and adapt their teaching practices accordingly. Supporting faculty in this way ensures that student preparation is reinforced by consistent professional modelling.

Universities represent a critical intervention point precisely because participation norms are not yet fully sedimented. Unlike professional environments, where interactional patterns are reinforced by hierarchy and organisational consequence, educational settings allow greater scope for experimentation and reflection. By explicitly naming listening, interpretive judgement, and calibrated participation as professional competencies, educators can offer students language and frameworks that travel with them into practice. This does not require predicting every workplace dynamic, but it does enable graduates to recognise when participation norms narrow learning rather than support it.

6. Limitations and Directions for Future Research

As a conceptual, practice-informed paper, this work has clear limitations that also point toward productive directions for future research. The analysis does not draw on primary empirical data, nor does it seek to quantify the prevalence of strategic invisibility or quiet professional attrition across populations. Instead, it aims to surface and theorise patterns of participation that are widely recognised in practice but remain under-articulated within existing scholarship. While this approach enables conceptual clarity, it necessarily limits the claims that can be made about distribution, causality, or generalisability.

One limitation lies in the difficulty of empirically capturing tacit judgements about participation, visibility, and restraint. Decisions to remain selectively invisible are often situational, context-dependent, and retrospectively rationalised, making them resistant to direct observation or self-report. Future research could address this challenge through qualitative approaches that foreground sense-making over frequency, such as longitudinal interviews, reflective accounts, or ethnographic studies of engineering teams. Such work would be well suited to examining how judgements about visibility develop over time and how they are shaped by organisational norms, power relations, and professional risk.

A further limitation concerns the scope of professional contexts considered. While the conceptual framing is grounded in engineering education and practice, the paper does not differentiate systematically between sectors, organisational forms, or career stages. Future research could explore how strategic invisibility operates differently across settings such as consultancy, operations, construction, or research-intensive environments, and how early-career engineers' experiences compare with those of more senior practitioners. Attention to these variations would help refine the concept and identify where particular risks or protective factors may be most pronounced.

The paper also does not empirically examine how strategic invisibility intersects with dimensions such as gender, culture, or organisational hierarchy, despite acknowledging their relevance. This represents an important area for future investigation. Empirical studies could explore how participation norms are interpreted across cultural contexts, how silence is read differently depending on identity or status, and how these interpretations shape access to learning opportunities and professional recognition. Such work would extend existing research on inequality and inclusion by focusing not only on overt exclusion, but on subtler forms of misrecognition and withdrawal.

In educational contexts, further research is needed to examine how participation norms are established and stabilised within group learning environments, and how educators can intervene without prescribing uniform behaviour. Design-based studies could investigate pedagogical strategies that recognise listening, interpretive judgement, and calibrated participation as legitimate forms of contribution, while remaining compatible with accreditation and assessment requirements. Evaluating such approaches provides practical insight into how educational settings interrupt the reproduction of narrow participation norms before they become embedded in professional practice. Future research could also examine how higher education settings shape early interpretations of visibility and restraint, particularly as students learn to navigate participation norms without explicit guidance.

Finally, future work could examine the longer-term consequences of quiet professional attrition for organisations and the profession. While this paper focuses on individual trajectories and learning opportunities, cumulative attrition of capable professionals has implications for knowledge continuity, safety, and organisational learning. Empirical research that connects participation dynamics to retention, performance, and organisational resilience would strengthen understanding of why these often-invisible processes matter beyond individual experience.

By outlining these limitations and directions, the paper aims not to close debate, but to open a coherent research agenda around participation, visibility, and professional learning. The concepts developed here are intended as analytical tools rather than definitive explanations,

offering a foundation for future empirical and theoretical work that can deepen understanding of how professional competence is enacted, recognised, and sustained in engineering.

6.1 Implications for Practice

- Recognise listening as competence: Treat listening, interpretive judgement, and calibrated participation as legitimate professional skills, not deficits.
- Make tacit dynamics explicit: Use visual metaphors (e.g., the boardroom figure) and structured reflection to surface invisible participation norms.
- Diversify assessment practices: Move beyond privileging verbal assertiveness in group work by valuing contributions in multiple modes.
- Address attrition proactively: Identify and discuss quiet professional attrition as a systemic issue rather than an individual choice to support retention and inclusion.

7. Conclusion

This paper has argued that professional learning in engineering extends beyond formal competence to include judgment about participation, visibility, and listening. By conceptualising strategic invisibility as a form of tacit professional learning, the analysis reframes silence and restraint not as individual deficits, but as adaptive responses to professional context and perceived risk. In doing so, it challenges confidence-based and visibility-focused narratives that dominate both educational and professional discourse, offering a more nuanced account of how engineers learn to participate and belong.

Bringing together perspectives from professional identity, workplace learning, and tacit knowledge research, the paper highlights how participation is shaped relationally rather than solely through individual capability. Decisions about when to speak, when to listen, and when to remain deliberately unobtrusive are learned through experience and interaction, often in environments where recognition and consequence are unevenly distributed. These judgements are rarely articulated explicitly, yet they play a central role in shaping access to learning opportunities, professional credibility, and long-term career trajectories.

The concept of quiet professional attrition extends existing discussions of participation and retention by drawing attention to gradual, unrecognised processes of withdrawal and marginalisation. Unlike overt exclusion, quiet attrition often occurs without conflict, complaint, or formal acknowledgement, making it difficult to detect and easy to misattribute. By naming this phenomenon, the paper provides language for experiences that are widely shared yet rarely discussed, enabling more reflective engagement with the conditions under which capable professionals are sustained—or quietly lost—within engineering.

The analysis also underscores the critical role of education as a formative space for professional learning. Universities cannot determine professional cultures wholesale, yet they are uniquely positioned to shape early understandings of competence, contribution, and legitimacy. By making tacit dimensions of participation visible and discussable, educational settings can better align preparation with professional realities. Framing listening, interpretive judgement, and calibrated participation as professional competencies broadens what counts as contribution without prescribing uniform behaviour or privileging particular communicative styles. Such alignment is particularly important in higher education, where early

interpretations of participation can shape how graduates navigate visibility and restraint in their professional lives.

Importantly, this approach does not seek to diminish the value of visible leadership, articulate communication, or confident participation. Instead, it situates these qualities alongside other forms of professional competence that are equally necessary for effective engineering work. Recognising multiple modes of participation strengthens collective decision-making, supports more inclusive learning environments, and reflects the diverse contexts in which contemporary engineering is practised.

By articulating a conceptual orientation grounded in practice and theory, this paper contributes to mainstream discussions of engineering higher education and professional practice in engineering learning without resorting to personal narrative or prescriptive solutions. Its aim is not to offer definitive answers, but to expand the conceptual space in which participation is understood. In doing so, it invites educators, researchers, and practitioners to reflect more carefully on how professional competence is recognised, rewarded, and sustained over time.

Ultimately, making tacit professional learning visible is an ethical as well as an educational concern. When participation is equated narrowly with visibility, valuable forms of judgement and contribution risk being overlooked. By offering language for these often-invisible dimensions of professional work, this paper seeks to support more sustainable professional trajectories and to ensure that engineering retains not only those who speak most loudly but also those whose judgment is exercised through careful listening, restraint, and insight.

AI assistance statement

The author used AI-based tools to support language and grammar refinement during manuscript preparation. All conceptual development, argumentation, interpretation, and scholarly judgement are the author's own. The author takes full responsibility for the content, originality, and integrity of the manuscript, including the selection and verification of all sources.

References

- Acker, J., 1990. HIERARCHIES, JOBS, BODIES: A Theory of Gendered Organizations. Gend. Soc. 4, 139–158. https://doi.org/10.1177/089124390004002002
- Beddoes, K., Pawley, A.L., 2014. 'Different people have different priorities': work–family balance, gender, and the discourse of choice. Stud. High. Educ. 39, 1573–1585. https://doi.org/10.1080/03075079.2013.801432
- Beijaard, D., Meijer, P.C., Verloop, N., 2004. Reconsidering research on teachers' professional identity. Teach. Teach. Educ. 20, 107–128. https://doi.org/10.1016/j.tate.2003.07.001
- Billett, S., 2016. Learning through health care work: premises, contributions and practices. Med. Educ. 50, 124–131. https://doi.org/10.1111/medu.12848
- Billett, S., 2004. Workplace participatory practices: Conceptualising workplaces as learning environments. J. Workplace Learn. 16, 312–324. https://doi.org/10.1108/13665620410550295

- Collins, H.M., 2013. Tacit and explicit knowledge, Paperback ed. ed. The University of Chicago Press, Chicago.
- Ely, R.J., Meyerson, D.E., 2000. Theories of Gender in Organizations: A New Approach to Organizational Analysis and Change. Res. Organ. Behav. 22, 103–151. https://doi.org/10.1016/S0191-3085(00)22004-2
- Eraut, M., 2004. Informal learning in the workplace. Stud. Contin. Educ. 26, 247–273. https://doi.org/10.1080/158037042000225245
- Fenwick, T., 2016. Professional Responsibility and Professionalism: A sociomaterial examination, 1st ed. Routledge. https://doi.org/10.4324/9781315750354
- Huff, J., Okai, B., Shanachilubwa, K., Sochacka, N., Walther, J., 2021. Unpacking professional shame: Patterns of White male engineering students living in and out of threats to their identities. J. Eng. Educ. 110, 414–436. https://doi.org/10.1002/jee.20381
- Ibarra, H., 1999. Provisional Selves: Experimenting with Image and Identity in Professional Adaptation. Adm. Sci. Q. 44, 764–791. https://doi.org/10.2307/2667055
- Kelan, E.K., 2010. Gender Logic and (Un)doing Gender at Work. Gend. Work Organ. 17, 174–194. https://doi.org/10.1111/j.1468-0432.2009.00459.x
- Kogan, M., Moses, I., El-Khawas, E.H., 1994. Staffing higher education: meeting new challenges, Higher education policy series. Kingsley Publishers, London.
- Lave, J., Wenger, E., 1991. Situated Learning: Legitimate Peripheral Participation, 1st ed. Cambridge University Press. https://doi.org/10.1017/CBO9780511815355
- Lewis, S., Brannen, J., Nilsen, A., 2009. Work, families and organisations in transition: European perspectives. Policy press, Bristol.
- Pawley, A.L., 2009. Universalized Narratives: Patterns in How Faculty Members Define “Engineering.” J. Eng. Educ. 98, 309–319. https://doi.org/10.1002/j.2168-9830.2009.tb01029.x
- Polanyi, M., 2009. The tacit dimension, Reproduction en fac-similé. ed. University of Chicago press, Chicago.
- Pratt, M.G., Rockmann, K.W., Kaufmann, J.B., 2006. Constructing Professional Identity: The Role of Work and Identity Learning Cycles in the Customization of Identity Among Medical Residents. Acad. Manage. J. 49, 235–262. https://doi.org/10.5465/amj.2006.20786060
- Schön, D.A., 2017. The Reflective Practitioner, 0 ed. Routledge. https://doi.org/10.4324/9781315237473
- Tonso, K.L., 2006. Student Engineers and Engineer Identity: Campus Engineer Identities as Figured World. Cult. Stud. Sci. Educ. 1, 273–307. https://doi.org/10.1007/s11422-005-9009-2
- Trede, F., 2009. Becoming Professional in the 21St Century. Australas J Paramed. 7. https://doi.org/10.33151/ajp.7.4.180
- Trevelyan, J., 2014. The Making of an Expert Engineer, 0 ed. CRC Press. https://doi.org/10.1201/b17434
- Tynjälä, P., 2008. Perspectives into learning at the workplace. Educ. Res. Rev. 3, 130–154. https://doi.org/10.1016/j.edurev.2007.12.001