

Article

Technical Mentorship in Undergraduate Technical Education: A Qualitative Study of Symbolic Interpretation and Responsive Guidance

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Abstract: Undergraduate technical education is expected to develop skilled professionals, yet the guidance through which students learn technical standards remains underexamined. This interview-based qualitative case study examines how six teachers and six high-achieving students in one Chinese undergraduate technical institution describe and interpret technical mentorship. Symbolic interactionism informed the analysis, but Mead's "I" and "me" were used only as sensitizing concepts, not as labels for teachers and students. Semi-structured interviews were analyzed through constructivist coding procedures with inductive, abductive, and theory-informed steps. The study reports patterns in participants' narratives; it does not claim to document interaction sequences. Teachers described making written standards concrete, adjusting guidance to learners' difficulties, and using practice to test understanding. Students described interpreting abstract requirements, assessing what counted as acceptable work, planning their development, and revising their understanding when practice did not match expectations. Three interpretive processes recurred in the accounts: constructing a personal understanding, negotiating standards with autonomy, and connecting external requirements to personal goals. These processes were not uniform. Anxiety about misunderstanding, a preference for direct instruction, and mismatches between classroom preparation and equipment use complicated the more orderly accounts. The analysis offers a context-specific interpretation of how technical mentorship was narrated in one institution and identifies theoretical propositions for future research. It does not establish causal mechanisms, long-term career effects, or transferability to other settings.

Keywords: Undergraduate Technical Education; Technical Mentorship; Symbolic Interactionism; Qualitative Case Study; Interview Accounts

1. Introduction

Undergraduate technical education is important for economic and social development. Explaining how it develops highly skilled technical professionals, however, is not easy. How should a student be developed into such a professional? The question has long been central to undergraduate technical education [1–3]. It arises in Germany's universities of applied sciences, in the polytechnics of the United Kingdom, and in China's undergraduate technical institutions. Education policies in these countries specify the knowledge, skills, and abilities that such professionals should possess. Yet little detailed account is offered of the technical guidance involved in the process of developing them [4,5].

Technical mentorship is used here to mean sustained, practice-oriented guidance that combines instruction in

technical tasks with feedback, modeling, and gradual transfer of responsibility. The term overlaps with teaching, supervision, coaching, and laboratory instruction. We do not treat it as a wholly separate activity. Instead, we focus on forms of guidance in which teachers help students interpret standards and take increasing responsibility for technically sound practice [5–8].

The competency requirements of undergraduate technical education have been examined in some studies [1,3]. How industry-education integration is implemented has also been investigated [4,9]. These studies have supported talent development in undergraduate technical education. Yet few have focused on technical mentorship itself. How teachers and students interact within it remains especially underexplored [10,11].

Symbolic interactionism provided a sensitizing framework; it was not a fixed coding scheme. Blumer [12] argued that people act toward things according to the meanings those things have for them, and meanings are formed and revised through social interaction. In technical settings, standards, tools, and expected roles can be understood as meaningful objects. Their meaning is not fixed by a teacher's message. It is interpreted and acted on by students in particular situations. This perspective directed attention to interpretation in accounts of mentorship, not to a linear transfer of information.

Mead's [13] distinction between the "I" and the "me" offered additional interpretive language. The "me" refers to the organized attitudes and expectations that a person takes over from others; it is not simply a set of rules imposed by one person. The "I" is the self's response to those expectations in a given situation. Both belong to the same self; they cannot be assigned to different groups of people or observed as a fixed sequence. In this study, the distinction helps describe how participants talked about adopting professional standards while also responding to them through judgment and improvisation. It does not assign the "me" to teachers and the "I" to students.

Blumer's [12] account of social interaction further suggests that meanings are negotiated and can change. Technical mentorship is therefore treated here as jointly produced in interaction, not as a one-way process. The analysis asks how participants described the beginnings, maintenance, and breakdowns of that interaction. Because the study relies on interviews, these descriptions are participants' accounts and interpretations rather than direct observations of interaction [14].

The study addresses three questions: (1) How do teachers describe the ways they make technical standards understandable and respond to student difficulty? (2) How do students describe interpreting those standards and putting them into practice? (3) Which interpretive processes do teachers and students describe as shaping technical mentorship, including processes that complicate a stable model?

2. Methods

2.1. Theoretical Framework

This study used symbolic interactionism as a sensitizing framework [12,13]. Three ideas guided our attention: meanings are formed in social situations and can be revised; the self has both socially organized and responsive dimensions; and interaction is not reducible to a sender-receiver sequence. We did not assume that teacher statements constitute the "me" or that student responses constitute the "I." Those concepts informed our interpretation of the accounts, but they were held loosely during initial coding and revisited during axial and selective coding.

The analysis therefore sought to describe how participants interpreted guidance and what those interpretations revealed about the conditions of mentorship. It did not seek to construct a causal or temporally sequenced model. When students described difficulties, we examined how they and their teachers accounted for those difficulties without treating the accounts as direct evidence of what occurred.

2.2. Research Design

We conducted an interview-based qualitative case study at one undergraduate technical institution in eastern China [15]. The case was selected because it offered access to established degree programs in technical fields, teachers with substantial experience, and students with documented achievements. It is an information-rich case, not a representative institution.

Qualitative methods were appropriate because the study focused on meaning and interpretation. Interviews generated accounts of technical mentorship. The analysis drew on constructivist grounded theory coding procedures [16,17], but the study was not designed to generate a full grounded theory.

Grounded theory supplied coding procedures, not the overall methodology. We did not use theoretical sampling, and we did not follow the full Glaser-Straussian or Charmazian approach. Case study provided the bounded context, while coding procedures supported a systematic reading of interviews. Without theoretical sampling and the full iterative methodology, the categories are interpretive summaries of this sample, not a saturated theory.

Semi-structured interviews were adopted for data collection. During the interviews, teachers described how they approached technical guidance, and students described how they interpreted requirements and used them in practice. The data are nevertheless limited to retrospective accounts. The study did not include classroom observations, instructional records, student assignments, interaction transcripts, or field notes. These materials could have supported triangulation, but they were not available under the access and privacy conditions of the study. The findings are therefore interpreted as narrated experience, not as direct evidence of interaction. This boundary is discussed further in Sections 3.4 and 4.6.

2.3. Research Setting and Participants

The case is an established undergraduate technical institution in eastern China. Participants came from programs in intelligent manufacturing, robotics, construction, and electronic information engineering. The institution emphasizes industry-education integration, dual-qualified teachers, and 1+X certificates, which are common policy features in this sector. These features describe the setting; they were not used as evidence that the institution is representative or strong. Purposive sampling [15] was used to recruit teachers with direct mentoring responsibilities and students with documented technical achievement. Six teachers and six students agreed to participate. In this manuscript, G denotes a teacher (guide), and L denotes a student (learner).

The sample was deliberately selective. All teachers held doctoral degrees and professorships, and all students had scholarships, competition awards, or innovation awards. This decision produced rich accounts from experienced faculty and high-achieving students, but excluded junior instructors, technicians, industry mentors, lower-performing students, and students with weak motivation or limited confidence. The teacher and student participants were not matched as mentor-mentee dyads; their accounts refer to technical mentorship in general and did not center on shared episodes. The two groups therefore cannot be compared as two views of the same interaction. The information of teacher participants is shown in **Table 1**, and the information of student participants is shown in **Table 2**.

Table 1. Teacher participant characteristics.

Code	Gender	Age	Years of Teaching	Discipline	Degree	Title
G1	Male	47	13	Industrial Robot	PhD	Professor
G2	Male	49	18	Industrial Internet Application	PhD	Professor
G3	Female	41	10	Application of Artificial Intelligence Technology	PhD	Professor
G4	Female	45	13	Industrial Robot	PhD	Professor
G5	Male	55	25	Automotive Intelligent Technology	PhD	Professor
G6	Male	49	22	Industrial Internet Application	PhD	Professor

Table 2. Student participant characteristics.

Code	Gender	Age	Year	Discipline	Achievement Type	Specific Achievement
L1	Female	20	Junior	Industrial Robot	Skills Competition	First Prize, Provincial Skills Competition
L2	Male	21	Junior	Industrial Robot	Skills Competition	Second Prize, Municipal Skills Competition
L3	Male	21	Junior	Application of Artificial Intelligence Technology	Academic Honor	National Scholarship
L4	Male	21	Junior	Application of Artificial Intelligence Technology	Innovation & Entrepreneurship Skills Competition	Second Prize, Municipal Innovation Competition
L5	Female	22	Junior	Industrial Internet Application	Skills Competition	Third Prize, Provincial Skills Competition
L6	Female	22	Junior	Application of Artificial Intelligence Technology	Academic Honor	University Scholarship

We did not claim theoretical saturation; instead, we assessed the stability of the coding set. After each interview was coded, new initial codes were compared with existing codes. Fifteen initial descriptive codes had appeared by

the sixth transcript, and no new codes appeared in the seventh or eighth transcript. The remaining four interviews added no new codes and were used to examine whether the code definitions continued to fit the accounts. This finding indicates coding stability within the sample, not saturation in the grounded-theory sense. No theoretical sampling was used, so the result is specific to this sample and does not establish theoretical or role-specific saturation. Broader interviews with other teacher and student groups could generate different codes.

2.4. Data Collection

Data were collected through semi-structured interviews. Each participant took part in one individual, face-to-face interview. Before the interviews, the researcher developed an interview guide based on the research questions. The teacher guide focused on how technical standards were established, how teachers responded to different students, and how they handled difficult situations. The student guide focused on students' understanding of technical mentorship and how they moved from theory to practice. Before the interviews began, written consent and permission to record the audio were obtained from all participants. Each interview lasted about one hour, and the audio was transcribed in Chinese. English translations of reported extracts were prepared for this manuscript. The translation was meaning-oriented, not verbatim, and no independent back-translation was performed.

2.5. Data Analysis

The analysis used coding procedures associated with constructivist grounded theory [16,17] and was managed in NVivo 14. The process combined inductive, abductive, and theory-informed steps. Initial coding remained close to participants' wording. Later coding asked how those descriptive codes related to one another and to sensitizing concepts from symbolic interactionism. The sequence was interpretive and was not purely inductive.

Initial coding was line by line and used participants' language where possible. For example, a teacher statement such as "I adjust how hard the task is depending on the student's level" was first coded as "adapting task difficulty to learner level," not "differentiated instruction." Fifteen descriptive codes were retained after comparison across transcripts (**Table 3**). These codes summarize repeated actions, concerns, or conditions in participants' accounts; they are not direct quotations or objective descriptions of practice.

Table 3. Initial descriptive codes organized by reported action, concern, or condition.

Initial Descriptive Code	Description in Participants' Accounts	Node References	Source Count	% of Participants
A1	How teachers described written technical standards	16	10	83.3%
A2	Ways teachers explained standards in practical terms	10	9	75%
A3	Reasons teachers varied guidance across students	12	11	91.7%
A4	How teachers responded when students struggled	13	10	83.3%
A5	Students' efforts to identify required competences	15	11	91.7%
A6	Students' attention to errors and non-negotiable requirements	12	10	83.3%
A7	Students' planning of learning timelines and milestones	14	10	83.3%
A8	Moving from understanding a procedure to performing it	19	10	83.3%
A9	Using equipment, laboratories, peers, or teachers during practice	18	9	75%
A10	Connecting course content to a concrete technical task	17	9	75%
A11	Trying approaches beyond a prescribed solution	14	9	75%
A12	Balancing rules with independent exploration	18	10	83.3%
A13	Describing standards and innovation as related but sometimes conflicting	17	10	83.3%
A14	Linking learning activities to career goals	20	12	100%
A15	Revisiting requirements as experience develops	17	10	83.3%

Axial coding examined relationships among the initial codes. We asked which concerns appeared together, which were described as conditions, and which were described as consequences. Seven axial codes were developed. These codes began to use analytical language, and rival interpretations were recorded in memos. For example, direct requests for guidance were treated as a challenge to a simpler account of autonomy, not as noise.

Selective coding grouped the axial codes into three interpretive categories (**Table 4**). The categories were not treated as causal stages or as categories that emerged without theoretical influence. They summarize patterns in the interviews and were revised in light of contrasting accounts. **Table 5** provides an audit trail from selected quotations to initial, axial, and selective codes.

Table 4. Analytical coding structure.

Selective Category	Axial Code	Initial Descriptive Codes
C1: Making standards understandable and responsive	B1: Framing technical standards in teachable terms	A1, A2
C2: Interpreting and enacting standards	B2: Responsive guidance and task adjustment	A3, A4
C3: Negotiating standards, autonomy, and personal goals	B3: Making sense of technical requirements	A5, A6, A7
	B4: Testing understanding in practice	A8, A9
	B5: Constructing a personal understanding	A10, A11
	B6: Negotiating standards and autonomy	A12, A13
	B7: Connecting requirements to personal goals	A14, A15

Table 5. Illustrative audit trail from a quotation to the analytical categories.

Selected Quotation	Initial Descriptive Code	Axial Code	Selective Category
"Sometimes I don't know if I've understood correctly and I get anxious about it, especially before assessments." (L2)	Uncertainty about whether technical requirements have been understood	Making sense of technical requirements	Interpreting and enacting standards
"Technical mentorship must be adapted when facing different students... You cannot use a single method to frame all situations." (G4)	Adapting guidance to the learner and the situation	Responsive guidance and task adjustment	Making standards understandable and responsive
"In many cases, I want the teacher to tell me directly what to do, rather than offering me choices." (L3)	Preference for direct guidance over open choices	Negotiating standards and autonomy	Negotiating standards, autonomy, and personal goals

2.6. Trustworthiness

Credibility was supported in two ways. The findings were discussed with administrators, collaborators, and researchers in undergraduate technical education. A preliminary account was presented to these individuals for comment. After preliminary coding, summaries were also returned to participants whose accounts corresponded to the coded content. Several participants suggested corrections, which were checked against the transcripts and incorporated when they improved the interpretation [18].

Detailed descriptions of the context were provided to improve transferability. Readers can judge the extent to which the findings are applicable. Specificity and confidentiality were balanced as well; for this reason, the institution is described in general terms.

Relevant materials were retained to support dependability. These included the original interview audio, transcripts, coding records, analytic memos, peer discussions, and participant feedback. Two months after the initial coding was completed, the first author recoded 20% of excerpts selected at random. Agreement with the original coding was 87%. This was an intra-coder consistency check, not an independent inter-coder reliability estimate. The coding definitions and examples used for this check are included in the audit trail.

Confirmability was supported by an audit trail containing raw transcripts, coding records, analytic memos, and documentation of peer debriefing and member checking. The audit trail also records coding decisions that changed during analysis. It therefore shows how interpretations were developed, including places where the initial categories did not fit the contrasting accounts.

2.7. Researcher Positionality and Reflexivity

The first author specializes in technical education and conducted the interviews and analysis. Familiarity with the sector helped in understanding reform terminology and local routines, but it also created a risk of treating familiar practices as self-evident. Memos were used to record assumptions and alternative readings.

Symbolic interactionism guided the study from the design stage. During initial coding, attempts were made to stay close to participants' language. Theory became more prominent during axial and selective coding, where sensitizing concepts were compared with the codes. This sequence is reported so readers can see where inductive and deductive influences entered the analysis.

The first author had no institutional role at the case site or a collegial relationship with the participants. This outsider position may have reduced concerns about internal evaluation, but it also limited access to informal context. The interviews themselves were the main source of contextual knowledge.

Reflexive practices included analytic memos, peer discussions, and repeated checking of codes against participants' wording. These practices did not remove the researchers' influence, but they made some interpretive

decisions visible [19,20].

2.8. Methodological Reflection

One methodological limitation should be acknowledged before the findings are discussed. All data were drawn from interviews. Participants described technical mentorship from their own positions, but the study did not observe mentoring episodes or collect matched teacher-student accounts. Nonverbal aspects of the process are therefore absent, including how teachers positioned themselves during demonstrations or how students responded in the moment. The study presents accounts of mentorship, not the process itself. Its claims therefore concern narrated experience, not observed interaction.

3. Findings

The findings are organized around participants' accounts, not observed interaction sequences. Teachers described how they presented standards and adjusted guidance; students described how they interpreted requirements and tested them in practice. The last section presents three interpretive processes that recurred across the accounts: constructing personal understanding, negotiating standards with autonomy, and connecting external requirements to personal goals. Contrasting accounts are discussed alongside these patterns.

3.1. Making Technical Standards Understandable: Framing and Responsive Guidance

Teachers described two main aspects of guidance. The first was framing technical standards in ways students could recognize and use. The second was adjusting guidance when students encountered difficulty. Participants did not present these as a fixed sequence; most described moving between them.

3.1.1. Framing Technical Standards in Teachable Terms

The accounts showed how teachers turned abstract requirements into concrete expectations. In symbolic interactionist terms, standards become meaningful objects through the examples, language, and practices that surround them [12].

Every program has written standards, and every program says what students should know and do. Documents do not teach. G1 made the point plainly: "Our discipline has clear and rigorous technical requirements, and the institution provides explicit documentation for this. However, in the learning process, students still need the teacher's prompting and reminding. This kind of reminding is not merely a repetition of institutional requirements—it is a distinctive form of processing carried out by the teacher. The supervisor's reminders make students feel that technical standards are not only institutional demands but also a concrete manifestation of the teacher-student interaction, making the standards more directly perceptible."

Framing standards involved more than repeating written requirements. Teachers drew on experience to explain what the standards meant in particular tasks. G6 described the consequences of unclear expectations in these terms: "Technical work leaves no room for risk. This demands strict standards during instruction. Such strictness is reflected in teachers leading by example. If teachers are not strict, students will imitate them, and correction later becomes extremely difficult."

G6 described two dimensions of technical standards: operational skills and broader workplace competencies. Similar distinctions appeared in G1's and G4's accounts. These dimensions were part of how participants explained what students needed to learn; they are not separate processes identified through observation.

Other teachers described limits to strict framing. G3 argued that pressure could undermine confidence when standards were presented without attention to students' starting points. His comment that "some students only want to pass" also shows that teachers held different views about how much to adapt standards. We treat this as variation within the accounts, not as evidence that one approach worked better.

3.1.2. Responsive Guidance and Task Adjustment

Teachers linked standards to their students' circumstances. They described changing examples, pacing, and levels of support when previous guidance did not help. We use the term responsive guidance for this reported pattern, not as an established process. G1 framed individualized guidance as more difficult than stating standards:

“Teachers need to have the capacity for individualized guidance in technical mentorship. This is different from setting technical standards; it is the harder part, because individualized guidance reflects a teacher’s level of differentiated instruction.”

When students struggled, teachers described changing the example, pace, or form of support instead of repeating the same instruction. G2 described this as follows: “When a student keeps trying but cannot succeed, the teacher should pause and reflect. Some students have problems with comprehension, and the teacher cannot guide them in only one way but must try different approaches. Others have problems with learning attitudes, and in those cases the teacher needs to offer support and encouragement.” These accounts indicate how teachers explained their responses; they do not show what students experienced in the same episode.

Across the interviews, teachers spoke more often about adjustment than about stating standards. They explained that a clearly stated requirement still had to be interpreted and acted on. G4 described this as follows: “Technical mentorship must be adapted when facing different students, and the adjustment is based on the characteristics of the learner. You cannot use a single method to frame all situations.”

G5, the most experienced in the sample, said regulation becomes “less deliberate” with time: “After a while you don’t think about it so much. You just know—this student needs more time, this one needs a push.” G1, ten years in, still described it as conscious work. Regulatory skill may eventually go tacit. It may also be that G5 had stopped reflecting on what he was doing; the data do not settle which. The variation is worth following up.

Mead’s [13] concepts offer one way to read these accounts. Adopting professional expectations can be described as a “me” dimension of the self, while judgment and improvisation in practice can be read as an “I” dimension. Both dimensions belong to the same person. The interview data do not show a sequence in which standards create a technical “me” and guidance creates a technical “I.” They do show that teachers discussed the tension between reliable adherence and independent judgment.

3.2. Interpreting and Enacting Technical Standards

Teachers described standards; students described what they understood those standards to mean and how they acted on that understanding. Interpretation and practice were closely connected in the accounts [3,8].

3.2.1. Making Sense of Technical Requirements

Students did not describe receiving a fixed meaning. They described working out what requirements implied for their own tasks. G5 had a phrase that appeared in several forms: students need to “digest” things. “For students, technical mentorship requires transferring symbols from the external to the internal. They need to digest the content themselves.”

Students described three recurring concerns as they made sense of requirements. The first was understanding which competences mattered. Teachers talked about abilities such as reflective capacity, but students had to work out what those abstractions required in practice.

“In technical mentorship, much of what the teacher says requires the student’s own interpretation—especially regarding capabilities. The teacher talks about capabilities in abstract terms, such as ‘reflective capacity,’ and the student must figure out, through the learning process, what reflective capacity actually means in practice.” (G3)

The second concern was avoiding errors and identifying requirements that could not be compromised if the work was to count.

“Teachers have many rigid requirements in technical mentorship—for example, the entire process of operation must be rigorous, with no errors permitted at any point—only then is our operation considered standardized. Therefore, students’ technical understanding must take technical normativity as a crucial objective. No matter how well you understand the content, if you neglect normative requirements, the former becomes meaningless.” (G6)

The third concern was development planning: understanding the sequence and time needed for particular stages of learning.

“Technical mentorship involves not only capability requirements but also temporal specifications—for example, what should be accomplished in the first week, what in the second week, all clearly delineated. The development of high-level technical expertise follows temporal regularities, and understanding how long it takes to reach particular levels of achievement is a crucial part of technical understanding—having a clear awareness of the temporal patterns governing one’s own development.” (G1)

Students differed in how they described interpretation. L1 and L3 presented it mainly as cognitive work. L2 and L5 described anxiety about misunderstanding, especially before assessment. L2 said: “Sometimes I don’t know if I’ve understood correctly and I get anxious about it, especially before assessments.” L5 described the same worry: “When the teacher explains it, I understand the steps, but I still worry whether I have really got it. One mistake in the assessment makes me doubt all of it.” The teachers did not describe this anxiety. The contrast suggests that interpretation involved emotional risk for some students, and the more orderly teacher accounts may capture only part of the process.

3.2.2. Testing Understanding in Practice

Some students described their understanding as provisional. They said they only knew whether they had understood after trying to perform the task and receiving feedback.

“The ultimate measure is practice—it is not sufficient to remain at the cognitive level; what matters is your performance in the final technical assessment.” (G2)

Two conditions appeared in the accounts. The first was the move from knowing a procedure to performing it. All six teachers said this move was difficult. G4 put the point directly: “The key to becoming a highly skilled technical professional lies in moving from cognition to practice.”

The second condition was the practice environment. G1 described it as involving both equipment and supporting software.

Some participants described access to laboratories and equipment, support from peers and teachers, and the conditions of the practice setting as important for turning understanding into performance. After students understood a procedure, they still had to enact it under particular material and social conditions.

L4 described an unsuccessful practical experience. Although he had understood the design principles, he found that the actual operating conditions differed from those described in the textbook. Because the teacher had not mentioned this situation in earlier guidance, he had to solve the problem through practice. L6 described a similar mismatch: “I thought I had understood the design principles, but when I reached the equipment, the settings were different. I had to work out what was wrong before I could begin the operation.” These accounts show that students had to interpret technical requirements and then enact them under conditions that could not be fully anticipated.

In symbolic interactionist terms, meaning is tested and revised through action [12]. The accounts described a cycle of interpretation, practice, feedback, and revision. This pattern summarizes participants’ accounts; it is not a measured learning sequence.

3.3. Interpretive Processes in Participants’ Accounts

Participants also described processes that shaped how standards were interpreted over time. Three recurred in the interviews: constructing a personal understanding, negotiating standards and autonomy, and connecting requirements to personal goals. We present them as interpretive categories, not causal processes. The categories overlap, and contrasting accounts limit their generality.

3.3.1. Constructing a Personal Understanding

Participants said students needed to build an understanding they could use themselves instead of reproducing a teacher’s account [8].

A teacher described the task in these terms: “For highly skilled technical professionals, merely understanding technology is not enough; they need to construct their own understanding. Technical standards are objective, but everyone interprets them from a subjective perspective.” (G5)

Students and teachers described a tension between clarity and openness. Boundaries were expected, but participants also said students needed room to work out how a task should be approached. This was not described as a fixed framework. It was a practical balance that changed with the task and the student.

As one teacher explained, “Interaction between teachers and students is very important. Teachers need to provide students with a path for exploration, and this path should be flexible.” (G3)

Teachers linked this balance to development beyond a single assignment. They described wanting students to carry technical expectations into later work while also developing their own judgment. This is an educational aspiration expressed in the interviews, not evidence of long-term learning.

The accounts were not uniform. L2 described benefiting from room to explore, while L3 wanted more direct instruction: “In many cases, I want the teacher to tell me directly what to do, rather than offering me choices.” L3’s account shows that open choices can create uncertainty. The interviews do not show whether direct guidance would have produced better learning for this student, or whether the preference was stable.

3.3.2. Negotiating Standards and Autonomy

Teachers and students described negotiation between standards and autonomy. They did not present the two as opposites. Instead, they described repeated judgments about when to enforce a requirement, when to allow an alternative, and when to intervene. This category summarizes those reported judgments; it does not identify a causal relation.

One teacher connected this to the broader nature of undergraduate education: “Students in undergraduate technical education must be autonomous learners; they cannot rely entirely on classroom learning. This reflects a common feature of undergraduate education, namely the characteristics of learners in higher education.” (G2)

Teachers said students needed some capacity to direct their own learning, but they also described the limits of that expectation. The accounts therefore point to a negotiated balance, not a fixed level of autonomy.

A teacher warned against turning students into copies: “When developing highly skilled technical professionals, teachers should not turn students into copies of themselves. Every highly skilled technical professional has a distinctive character rather than being an identical copy. So after teachers provide guidance, students should not simply imitate; they also need to think for themselves.” (G6)

G3 stated this balance most clearly: “Innovative capacity is the most important capacity for highly skilled technical professionals, and it is also the most difficult to cultivate. If teachers are too strict, innovation is suppressed. If they are too lenient, innovation loses the constraints provided by standards. Developing students’ innovative capacity requires a state of balance.”

G3’s account illustrates why we treat balance as an interpretive theme, not an established process. It captures a tension that teachers described, but it does not show how different degrees of guidance affect student outcomes. The interview data provide no basis for that comparison.

3.3.3. Connecting Requirements to Personal Goals

Some students described external requirements as becoming personally meaningful. We label this reported process “connecting requirements to personal goals.” It does not imply that mentorship caused the change or that the requirements became a stable part of professional identity.

“In technical mentorship, the technical requirements embedded in every learning activity should converge toward the development objectives, and these requirements must have a logical relationship among themselves. Only in such a context can students clearly understand the meaning of their learning and be more motivated in their studies.” (G6)

A second theme was a longer view of development. Teachers described wanting students to be able to continue learning after graduation. This was a goal they expressed, not an outcome that was measured.

A teacher described the longer-term view: “We cannot cultivate talent merely to satisfy companies’ entry-level hiring needs. Otherwise, the career development of these individuals will be constrained. Highly skilled technical professionals are those capable of sustained development. When setting talent cultivation goals, we must look beyond immediate employment and anticipate technological trends, enabling students to adapt to longer-term career

demands.” (G2)

L1’s account illustrates this theme. She described a change in her aspirations, from becoming a qualified employee to continuing to develop as an engineer. The interview does not establish when or why this change occurred, or whether mentorship caused it. Her account is therefore presented as an example of how one student narrated the change.

Mead’s [13] concepts can be used as a tentative interpretive vocabulary here. A student may take on professional expectations while also responding to them as a person with goals and preferences. We do not claim that the interviews show a completed integration of an “I” and a “me” or that this process produced a stable professional identity.

3.4. Contrasting Accounts and Limits of the Interpretation

The three categories were not uniform. L2 and L5 described anxiety about misunderstanding; L3 wanted direct guidance instead of open choices; L4 and L6 described gaps between classroom preparation and equipment conditions. These accounts do not fit a model in which flexible guidance consistently supports autonomy or in which construction moves smoothly toward personal goals. They show that the meaning and value of guidance varied by student and situation. Because the sample included only high-achieving students, accounts from students with weaker confidence or motivation may differ. These contrasts are treated as limits of the categories, not as exceptions to be coded away.

4. Discussion

Symbolic interactionism [12,13] provided the analytical lens for this study. We examined how teachers and students described standards, interpretation, adjustment, and practice in technical mentorship.

4.1. The Interpretive Character of Technical Mentorship

The accounts presented technical standards as interpreted in context, not simply received. This is consistent with the symbolic interactionist view that meanings are formed through social action, but the interviews cannot show how meanings changed within a particular interaction.

The accounts overlap with research on negotiated teacher-student relationships and autonomy support [6,21,22]. They also parallel pedagogical concepts such as scaffolding, guided participation, cognitive apprenticeship, and gradual release of responsibility [23–26]. The idea of bounded autonomy is relevant here: learners may exercise choice within limits set by professional standards [21,22]. Our contribution is not the discovery of responsive guidance. It is a context-specific account of how experienced teachers and high-achieving students in one technical institution described standards, adjustment, interpretation, and practice.

Contrasting accounts also show where the interpretation stops. Anxiety, preference for direction, and equipment mismatches suggest that responsive guidance may feel supportive to some students and uncertain to others. Why this variation occurs cannot be determined from retrospective interviews. Future observation and matched dyads could examine it.

4.2. Analytical Value and Limits of Symbolic Interactionism

In some discussions of undergraduate technical education, normative requirements and learner autonomy are presented as opposing forces [1,4]. The present accounts complicate that division. Teachers described enforcing standards while adjusting how students could meet them, and students described both reliance on guidance and attempts to work independently. The interviews do not show which approach produced better learning.

The categories organize participants’ accounts; they do not establish a causal model. Framing and responsive guidance describe how teachers explained their work. Interpretation and practice describe how students explained their engagement. The three interpretive processes describe repeated concerns that cut across those accounts. **Figure 1** presents these relationships as analytical links, not observed processes.

The study offers an application of symbolic interactionist ideas to an educational setting, not a new theory. Established concepts such as scaffolding, cognitive apprenticeship, guided participation, and gradual release of responsibility already address supported participation and the transfer of responsibility [23–26]. The contribution

here is interpretive and contextual: it shows how a small group of participants used ideas of standards, adaptation, and personal development to explain technical mentorship. The framework should not be treated as a general model.



Figure 1. Analytical framework of participants' accounts of standards, interpretation, practice, and negotiation.

4.3. Relationship to Existing Interpretations

The analysis is consistent with two broad lines of work. First, research on scaffolding and guided participation emphasizes that support should be adjusted as learners gain competence [23–26]. The accounts showed similar adjustment, although participants did not use those terms. Second, research on student-teacher partnerships and authentic care emphasizes negotiation and respect [6,21,22,27,28]. Teachers and students also described negotiation, but their accounts came from different roles and were not matched to shared episodes.

These similarities should be treated as interpretive connections, not as confirmation of either literature. The interview design did not include independent measures of support, autonomy, learning, or professional development. The study therefore cannot show that the guidance described by participants matched the constructs used in prior studies or that it produced particular outcomes.

4.4. Boundaries of the Interpretation

The data come from one institution in eastern China. It operates under a specific undergraduate technical policy context. Industry-education integration, the dual-qualified teacher system, and 1+X certificates are emphasized there. These are not universal features of technical education. Teacher-student relationships in China also carry cultural particularities. Expectations around authority, and around a teacher's role extending beyond instruction, may not hold elsewhere.

Whether similar interpretive patterns appear in other contexts remains open to further verification. Germany's dual system offers one comparison: technical guidance is delivered separately by company mentors and school teachers. Patterns of interaction may therefore differ between contexts with multiple guidance sources and those with a single source.

4.5. What This Means for Practice

These findings suggest three considerations for practice. They are hypotheses for discussion, not tested recommendations. First, teachers may need to make technical standards concrete while adjusting how students are expected to meet them [29,30].

Second, technical learning can involve repeated movement between understanding, action, feedback, and revision. The interviews suggest that this cycle should be planned and not assumed [2,7].

Third, programs should consider how standards, support, and opportunities for independent judgment work together across a course of study. The study does not show that any particular combination produces better career development.

4.6. Limitations

This study has several limitations. First, the evidence consists of retrospective interviews. The study did not observe mentoring episodes, examine student work, collect interaction transcripts, or use records of teacher-

student exchanges. It therefore describes how participants narrated mentorship, not how interaction unfolded. Because mentoring and general technical teaching were not independently classified, the study also cannot determine whether participants' accounts applied uniquely to mentorship or to high-quality technical instruction more broadly. Second, teacher and student participants were not matched as dyads, so their accounts cannot be compared within the same episode. Third, the sample was selective: all teachers were professors with doctoral degrees, and all students had documented achievements. Junior instructors, technicians, industry mentors, lower-performing students, and students with limited confidence or motivation were not represented.

Fourth, theoretical sampling was not used, and the final categories were informed by symbolic interactionism. Coding stability within this sample does not establish theoretical saturation. Fifth, the study was conducted at one institution with specific policy and cultural conditions. The categories may not transfer to other settings. Finally, interviews were conducted in Chinese and translated into English by the research team. Translation was meaning-oriented; no independent back-translation was performed.

5. Conclusions

This interview-based case study examined how six teachers and six high-achieving students in one Chinese undergraduate technical institution described technical mentorship. The analysis used symbolic interactionism as a sensitizing framework and coded interview accounts through inductive and theory-informed steps. Teachers described making standards concrete and adjusting guidance; students described interpreting requirements and testing them in practice. Three overlapping interpretive categories organized the accounts: constructing personal understanding, negotiating standards and autonomy, and connecting requirements to personal goals.

The study does not establish a causal model, a sequence of interaction, or long-term effects on professional development. Its contribution is a bounded, theoretically informed interpretation of participants' accounts. The findings suggest theoretical propositions about responsive guidance and student interpretation that require observation, matched dyads, broader samples, and longitudinal work. In this form, the study offers a context-specific basis for asking more precise questions about technical mentorship.

Author Contributions

Conceptualization, methodology, data collection, data analysis, writing—original draft, Q.W.; supervision, theoretical framework guidance, writing—review and editing, B.B. Both authors have read and agreed to the published version of the manuscript.

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Institutional Review Board Statement

The research followed the ethical principles of the Declaration of Helsinki. Before data collection, participants received written information about the study, provided written informed consent, and consented separately to audio recording. Participation was voluntary, participants could decline any question, and they could withdraw before transcription. The first author's institution did not require ethics committee approval for interview-based research of this type at the time of data collection. The research team reduced re-identification risk by removing names, institutional identifiers, and specific employment details from reported transcripts and quotations.

Informed Consent Statement

Participants received a study information sheet describing the purpose, procedures, confidentiality protections, and intended use of de-identified quotations. Written informed consent was obtained before data collection began, including consent for audio recording. Participation was voluntary. Participants could decline any question and could withdraw before transcription without penalty. The options for withdrawal and data removal were explained during the consent process.

Data Availability Statement

The full interview transcripts are not publicly available because they contain potentially identifiable institutional and personal information. The interview guide, selected de-identified excerpts used to support the findings, and the analytic codebook may be made available by the corresponding author upon reasonable request. Any such request will be considered subject to an appropriate data sharing agreement and a review of re-identification risk. Requests should be directed to the corresponding author.

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Conflicts of Interest

The authors declare that they have no competing financial interests or personal relationships that could have influenced the work reported in this paper.

AI Use Statement

During the preparation of this manuscript, the authors used DeepSeek solely for language refinement. No AI tools were used for data analysis, interpretation, or generation of scientific content. All outputs were critically reviewed and edited by the authors. The authors take full responsibility for the integrity and accuracy of the work.

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