A Triangulation Design for Integrating Classroom Observation, Semi-Structured Interviews and Focus Groups in a Single-Case Study of Vocational Classroom Engagement

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ABSTRACT

Triangulation is widely endorsed in qualitative research, yet its operational logic is often under-specified in single-case studies of classroom engagement, particularly where two course types are compared within one institution. This paper presents a triangulation design for integrating non-participant classroom observation, semi-structured interviews and focus group discussions in a single-case study of student classroom engagement in a resource-constrained higher vocational college in western China. The design is grounded in constructivism and adopts an intrinsic single-case logic in which institutional conditions are held constant while cultural-foundation and practical-training courses operate as contextual lenses for analysing behavioural, cognitive and affective engagement. Three data sources are treated as functionally complementary rather than parallel: observation records observable behavioural phenomena, interviews interpret participants' cognitive and motivational accounts, and focus groups capture collective perspectives and divergences. The paper specifies a cross-source coding matrix, procedures for confirming consistent evidence and interpreting contradictory evidence, and a thematic chain linking instructional behaviours, perceived classroom environment, intrinsic motivation and multidimensional engagement. Trustworthiness is addressed through data triangulation, member checking, researcher reflexivity and thick description, with ethical procedures for informed consent, anonymity and secure data storage. how triangulation can be operationalised in dual-course, resource-constrained vocational settings and offers transferable design principles rather than statistical generalisation.The paper also states the form of triangulation practised, which combines between-method and data triangulation, specifies a phased sequencing protocol in which observation sets the interview agenda and interviews set the focus-group propositions, and presents a joint display that records convergence, complementarity and divergence for every theme. Instrument piloting, peer debriefing and ethical provision for participants under eighteen are reported. Engagement claims are framed as analytic transferability rather than statistical generalisation. The contribution is methodological: the paper clarifies

Keywords: triangulation design, classroom engagement, vocational education, single-case study, qualitative methodology

INTRODUCTION

Qualitative case study research frequently relies on multiple data sources to construct credible interpretations of complex educational phenomena. Triangulation, in this context, is often invoked as a general warrant for trustworthiness. However, the methodological literature has long noted that triangulation is easier to recommend than to operationalise. In single-case studies that compare two course types within one institution, the challenge is particularly acute: the researcher must preserve the contextual specificity of each classroom setting while also producing a cross-source account that is analytically coherent, transparent and defensible.

This challenge is salient in research on student classroom engagement in vocational education. Engagement is commonly conceptualised as a multidimensional construct encompassing behavioural, cognitive and affective dimensions (Fredricks et al., 2004). Behavioural engagement refers to observable participation such as questioning, discussion and hands-on operation; cognitive engagement refers to effort, strategy use and depth of thinking; affective engagement refers to interest, belonging and emotional involvement. These dimensions are not directly reducible to one another, and they are experienced differently across course types. In vocational colleges, cultural-foundation courses and practical-training courses differ in pedagogical organisation, classroom climate, task structure and cognitive demands. A design that relies on a single data source risks capturing only one dimension or one participant perspective.

Existing vocational education research has increasingly recognised the value of multi-source qualitative designs, but three limitations remain. First, many studies describe triangulation as a quality criterion without specifying how data sources are functionally differentiated and cross-referenced. Second, studies that compare course types often treat engagement as a unitary variable and do not articulate how observational, interview and focus group data speak to one another across the two settings. Third, methodological accounts are frequently written as procedural descriptions rather than as design arguments, leaving unclear why particular sources are combined, how contradictions are handled, and what analytical work triangulation actually performs.

These critiques set four requirements for a defensible design account. The first is typological: the account must name the form of triangulation being practised, because data, method, investigator and theory triangulation support different claims and carry different evidential burdens (Denzin, 1978; Flick, 2018). The second is procedural: it must show how the sources are sequenced and how the output of one phase shapes the instrumentation of the next. The third is integrative: it must show where sources converge, complement or conflict, and how each conflict is adjudicated rather than merely noted. The fourth is evidentiary: sampling criteria, instruments, piloting and the limits of inference must be stated, so that readers can judge what the design can and cannot support. The design presented below addresses each requirement in turn.

This paper addresses these limitations by presenting a triangulation design developed for a single-case study of student classroom engagement at Chengdu Industry and Trade College, a resource-constrained public higher vocational college in western China. The study compares cultural-foundation courses and practical-training courses within the same institution and integrates three qualitative data sources: non-participant classroom observation, semi-structured interviews and focus group discussions. The paper does not report empirical findings. Instead, it specifies the design logic, the functional complementarity of the three sources, the operational procedures of cross-source analysis, and the trustworthiness and ethical safeguards that support the design.

It should be said at the outset that the design claims analytic rather than statistical generalisation. The single case is used to interrogate a configuration of conditions, namely institutional resource constraint, a dual-course curriculum and a largely rural intake, and what is offered for transfer is the design logic, not a set of population parameters. Statements about engagement in this paper are therefore design statements: they specify what each source is expected to capture and how competing claims will be adjudicated, not what the study found. Where the empirical study departs from the design, the departure belongs to the findings, not to this account.

First, the paper offers The contribution is fourfold.an explicit methodological rationale for combining observation, interviews and focus groups in a dual-course single-case study. Second, it specifies a cross-source coding matrix and a procedure for handling consistent and contradictory evidence. Third, it draws transferable design principles for qualitative classroom-engagement research in resource-constrained vocational contexts. is best understood not as the mere accumulation of data sources but as a structured analytical strategy that aligns each source with a distinct dimension of the engagement phenomenon.Fourth, it states what the design does not triangulate, namely investigator variation, and specifies the compensating devices that stand in for it. The paper argues that triangulation in such settings.

METHODOLOGICAL RATIONALE FOR TRIANGULATION DESIGN

Constructivist Positioning

The design is grounded in constructivism. Constructivism treats reality as socially constructed and multiple, rather than singular and externally given (Lincoln & Guba, 1985; Creswell & Poth, 2018). In classroom-engagement research, this positioning has three implications. First, engagement is not a fixed metric that can be fully captured by a single instrument; it is an individualised, context-dependent experience co-constructed by students, teachers and peers. Second, course-type differences are socially produced: low engagement in cultural-foundation courses may reflect the absence of meaningful connections between course content and students' career aspirations rather than a simple lack of learning desire. Third, the meanings that participants attach to instructional behaviours, classroom environments and learning tasks are central to interpretation.

A constructivist stance does not imply methodological looseness. Rather, it requires a design that can access multiple layers of meaning while remaining systematic and transparent. Triangulation serves this purpose when it is explicitly linked to the differentiated functions of data sources. Observation provides access to observable classroom phenomena; interviews provide access to participants' interpretations and motivational accounts; focus groups provide access to collective sense-making and divergence. The design treats these as complementary windows onto the same phenomenon rather than as interchangeable measures.

Why Triangulation Rather Than a Single Method

A single-method design would be insufficient for three reasons. First, classroom engagement has behavioural, cognitive and affective dimensions, and no single method captures all three equally well. Observation is strong on observable behaviour but weak on internal cognitive and motivational processes. Interviews are strong on subjective experience but rely on retrospective accounts and may be shaped by self-presentation. Focus groups are strong on collective norms and shared interpretations but may suppress minority views. Combining sources allows the design to compensate for the limitations of each.

Type of Triangulation Adopted

Denzin (1978) distinguishes four forms: data triangulation, which varies sources, persons or occasions; investigator triangulation, which varies researchers; theory triangulation, which varies interpretive lenses; and methodological triangulation, which varies methods, either within a single method or between methods. The distinction is not taxonomic decoration. Each form supports a different kind of claim: data triangulation strengthens a description of a phenomenon, investigator triangulation guards against individual bias in judgement, theory triangulation tests the dependence of a reading on one conceptual frame, and between-method triangulation checks whether a phenomenon registered by one procedure is also registered by another that has different access to it (Flick, 2018).

This design is primarily a between-method triangulation combined with data triangulation. It is between-method because observation, interviews and focus groups are distinct procedures with different access points, namely behaviour, account and collective account, rather than variants of one procedure. Data triangulation operates on three axes: persons (students and teachers, high- and low-engagement profiles, both programmes), occasions (sixteen sessions distributed across a semester, with interviews conducted only after sustained observation), and settings (cultural-foundation classrooms and practical-training facilities). Theory triangulation is secondary: the same evidence is read through cognitive constructivism, situated learning theory and self-determination theory, and a theme that survives all three readings is treated as more robust than one that depends on a single lens.

Investigator triangulation is absent. Fieldwork, coding and interpretation are conducted by one researcher, and the paper does not claim otherwise. This is a limitation rather than a formality, and the design compensates in four ways: independent coding of a transcript subsample by a supervisor, scheduled peer debriefing, member checking with participants, and a reflexive audit trail that records interpretive decisions as they are made.

These devices do not produce investigator triangulation; they reduce the chance that a single researcher's reading passes unchallenged. The design therefore states both what is triangulated and what is not.

Second, the study compares two course types within one institution. The comparison requires evidence about what happens in classrooms, how participants interpret those classrooms, and how groups collectively frame engagement across course types. A single source would provide only a partial basis for cross-course interpretation.

Third, the study is situated in a resource-constrained vocational college in western China, where classroom conditions, digital infrastructure and student backgrounds differ from better-resourced institutions. Contextual specificity is essential. Triangulation enables the design to capture the institutional and classroom conditions that shape engagement without reducing them to a single explanatory factor.

Research Questions for the Design

The design is guided by three methodological questions rather than by empirical hypotheses:

MRQ1: How can non-participant classroom observation, semi-structured interviews and focus group discussions be functionally differentiated to capture behavioural, cognitive and affective engagement across cultural-foundation and practical-training courses?

MRQ2: How can cross-source analysis be operationalised to confirm consistent evidence and interpret contradictory evidence in a single-case dual-course design?

MRQ3: What trustworthiness and ethical safeguards are required to support triangulated interpretation in a resource-constrained vocational college setting?

These questions frame the paper as a design argument. They do not ask what the study found; they ask how the study was constructed to produce credible and context-sensitive interpretations.

SINGLE-CASE DESIGN AND DUAL-COURSE CONTEXT

Rationale for an Intrinsic Single-Case Design

The study adopts an intrinsic single-case design focused on Chengdu Industry and Trade College (Stake, 1995). The case is selected for its typicality and relevance. As a public grassroots higher vocational college in western China, the institution serves regional high-end equipment manufacturing and digital services. It exhibits the common challenges of resource-constrained vocational institutions: limited per-student teaching resources, uneven industry-education integration, and a student body drawn largely from county and township areas with diverse academic backgrounds.

Case selection follows four stated criteria rather than convenience. First, institutional category: the college is a public, municipally administered higher vocational institution in western China, which places it inside the resource-constrained segment the design addresses. Second, curricular structure: it runs cultural-foundation and practical-training provision for the same cohorts within the same programmes, which is the condition that makes a within-institution comparison possible at all. Third, programme alignment: its two flagship programmes, Mechanical Manufacturing and E-commerce, are tied to regional equipment-manufacturing and digital-service industries, so practical-training courses carry authentic occupational tasks rather than simulated placeholders. Fourth, student composition: the intake is drawn predominantly from county and township areas and is academically heterogeneous, which produces the variation in engagement the design needs to interpret. A case meeting all four criteria is typical rather than extreme (Stake, 1995; Yin, 2018); it is selected because its configuration of conditions is common in the target segment, not because it is unusual. Institutions with atypical resources were deliberately excluded, since a design argument drawn from a well-endowed college would not transfer to the settings the paper addresses.

The single-case design serves three methodological purposes. First, it holds institutional conditions constant. Funding, management models and student demographics vary across vocational colleges; by focusing on one institution, the design reduces confounding effects that would complicate cross-institutional comparison. Second, it enables concentrated analysis of course-type differences within the same institutional context. Cultural-foundation and practical-training courses are embedded in the same curriculum, taught by teachers in the same institution, and experienced by the same student population. This makes the dual-course comparison analytically meaningful. Third, it supports sustained fieldwork and thick description, which are essential for credible qualitative interpretation.

Multiple cases were considered and set aside for two reasons. Analytically, cross-institutional comparison would reintroduce the variation in funding, staffing and intake that the design deliberately holds constant, and differences in engagement could no longer be attributed to course type with any confidence. Practically, sustained access of the kind required, namely a semester of observation, sixteen sessions, twenty-two interviews and two groups, is difficult to secure in more than one institution, and a thin multi-case study would buy breadth at the cost of the depth on which the design depends. The trade-off is accepted explicitly: the design purchases contextual control and depth, and pays for them in generality, which is why its claims are stated as transferability.

The design does not aim for statistical generalisation. It aims for analytical transferability: readers can assess whether the design and its interpretive logic are relevant to similar resource-constrained vocational settings (Lincoln & Guba, 1985).

Setting, Programmes and Participants

Table 1 gathers the setting, the participant groups and the data-collection parameters in one place, so that the scale of the fieldwork can be judged against the claims the design makes. Two features deserve comment. First, the sample is not a convenience sample: students are stratified by programme and by observed engagement profile, teachers by course type, teaching role and career stage, and inclusion and exclusion criteria are applied before invitation. Second, the numbers are justified by saturation logic rather than statistical power. Twelve student and ten teacher interviews, with two groups, were sufficient for the thematic structure to stabilise; evidence on thematic saturation in purposive samples indicates that saturation is typically reached well before twenty interviews in a relatively homogeneous group (Guest et al., 2006).

Table 1: Setting, participants and data-collection parameters

Item	Specification	Sampling criterion and rationale
Setting	Public municipal higher vocational college in western China; two programmes (Mechanical Manufacturing; E-commerce)	Typical resource-constrained case meeting the four stated selection criteria
Curricular contexts	8 cultural-foundation courses (College English, Applied Mathematics, Ideological and Political Education); 8 practical-training courses (equipment operation, project-based training, simulated professional environments)	Both course types experienced by the same cohorts, which makes within-institution comparison possible
Student participants	12 interviewees: 6 Mechanical Manufacturing and 6 E-commerce, each with 3 high- and 3 low-engagement students; first- and second-year full-time students	Maximum-variation purposive sampling; inclusion requires at least two semesters of both course types
Teacher participants	10 interviewees: 4 cultural-foundation, 4 practical-training, 2 teaching-research coordinators; early-, mid- and late-career	Stratified purposive sampling by course type, role and career stage
Focus groups	6 students (3 per programme, balanced engagement profiles); 5 teachers (2 cultural-foundation, 2 practical-training, 1 coordinator); 40–60 minutes	Drawn from interviewed participants; groups held separately to remove hierarchical pressure

Classroom observation	16 sessions (8 cultural-foundation, 8 practical-training), 40 minutes each, distributed across one semester	Multiple time points, to avoid single-snapshot bias
Individual interviews	22 interviews, 20–35 minutes each; audio-recorded; transcribed verbatim within 24 hours	Duration and format suited to semi-structured accounts (Seidman, 2019)
Fieldwork sequence	One-month pre-observation phase; semester of observation; interviews; preliminary coding; focus groups	Sequential design in which each phase informs the next
Exclusion criteria	Third-year students (off-campus internship); part-time and flexible-schedule students; administrative staff without teaching duties; substitute teachers; participants declining audio recording	Removes participants unable to sustain participation or to speak to both course types

Two boundary decisions should be read from the table. Third-year students are excluded because they are on off-campus internship and cannot be observed or interviewed across the semester; part-time and flexible-schedule students are excluded because they do not experience both course types in the same way. Neither exclusion is neutral: the design speaks to the engagement of full-time, on-campus first- and second-year students, and the absence of third-year experience is one reason the design cannot claim to represent a programme as a whole.

Dual-Course Context as Analytical Lens

The institution's curriculum is organised into two broad categories. Cultural-foundation courses include theoretical subjects such as College English, Applied Mathematics and Ideological and Political Education. Practical-training courses include hands-on modules such as equipment operation, project-based training and simulated professional environments. These two course types differ in pedagogical approach, classroom climate, task structure and cognitive demand.

In the design, course type is treated as a contextual lens rather than as a causal variable. The purpose is not to determine which course type produces higher engagement, but to examine how behavioural, cognitive and affective engagement is experienced and manifested across the two settings. This distinction is important. A variable-centred design would require controlled conditions and quantifiable measures; a contextual-lens design requires rich, situated evidence about how participants interpret and respond to different classroom conditions.

The dual-course lens shapes sampling, instrument design and analysis. Students are selected because they have experienced both course types, which provides a common experiential basis for comparison. Teachers are selected across course types, which provides instructional perspectives from both settings. Observation is distributed across both course types, which allows the design to capture classroom phenomena in each setting. Analysis compares themes across course types while remaining attentive to institutional conditions that are common to both.

Case Boundaries and Transferability

The case boundaries are the institution's on-campus cultural-foundation classrooms and practical-training facilities. The study does not include external internships, community-based activities or the perspectives of instructional managers and enterprise mentors. These boundaries are design choices, not claims about the irrelevance of other perspectives. They focus the design on the classroom-level conditions that are central to the research questions.

Transferability is supported through thick description of the institutional context, the course types, the participants and the fieldwork procedures. Readers can compare the case with their own settings and assess the relevance of the design logic. The paper does not claim that findings from one case apply to all vocational colleges. It claims that the design principles are transferable to similar resource-constrained, dual-course vocational contexts.

FUNCTIONAL COMPLEMENTARITY OF THE THREE DATA SOURCES

Non-Participant Classroom Observation

Non-participant classroom observation is the first data source. The researcher adopts a silent observer role at the back or side of the classroom, does not participate in teaching activities, and records field notes in real time. Observation covers 16 class sessions, comprising 8 cultural-foundation course observations and 8 practical-training course observations, each lasting approximately 40 minutes. Observation time points are distributed across the semester to capture engagement across different instructional phases and classroom contexts.

The observation checklist is organised around four dimensions: behavioural engagement, cognitive engagement, affective engagement and teachers' digital instructional behaviours. Behavioural engagement includes active participation such as voluntary hand-raising, verbal responses, class discussion, group collaboration and hands-on equipment operation, as well as passive behaviours such as silence, inattention and off-task conduct. Cognitive engagement includes active questioning, knowledge synthesis, note-taking, knowledge transfer and cognitive processing that connects theoretical knowledge with vocational skills and industry requirements. Affective engagement includes classroom climate, interest, belonging, fatigue, resistance and teacher-student affective connections. Teachers' digital instructional behaviours include multimedia use, online platforms, simulation software and digital training equipment.

Observation is strong on observable phenomena. It captures what participants may not recall accurately in interviews, including the frequency and duration of participation, the quality of hands-on task completion, peer interaction patterns, and emotional expressions. It also captures the classroom conditions that shape engagement, such as task structure, teacher questioning patterns and the availability of digital tools. However, observation alone cannot access students' cognitive processing, motivational reasoning or interpretations of classroom events. It records behaviour but not the meanings that participants attach to behaviour.

Two caveats are treated as design constraints rather than as footnotes.

The first is the observer effect: teachers and students may behave differently when watched, and a single researcher at the back of the room is a visible presence. The design addresses this in four ways. Familiarisation precedes data collection: the researcher attends participating classes during the one-month pre-observation phase, so that presence becomes routine before analytic recording begins. Observation is distributed across the semester rather than concentrated, so that reactivity decays and early patterns can be checked against later sessions. Teachers are not given the checklist in advance, but they are told what the study concerns, which avoids covert observation while limiting strategic adjustment. Finally, session summaries are returned to the teacher concerned for comment, so that the researcher's reading can be corrected by the person who taught the class.

The second caveat is that judgements of engagement made in the room are inferential. Attentive silence and disengagement can look alike from the back row, and a reading of a facial expression is an interpretation rather than a record. The protocol therefore separates low-inference records from high-inference judgements. Frequency, duration and sequence of observable acts are recorded as events; inferences about interest, fatigue or resistance are recorded as flagged interpretive notes, dated and tied to specific incidents. Flagged inferences are treated as claims to be tested against interview and focus-group accounts rather than as findings in their own right. Where observation and self-report diverge on affective engagement, the divergence is carried into the joint display rather than resolved by preferring the observational record.

Semi-Structured Interviews

Semi-structured interviews are the second data source. Separate protocols are developed for students and teachers. The student protocol covers differentiated engagement experiences across course types, factors influencing engagement, perceptions of classroom environment, changes in learning motivation, and

expectations for improvement. The teacher protocol covers engagement pattern characteristics, challenges in enhancing engagement, digital teaching practices, and feasible optimisation strategies.

Interviews are conducted with 12 students and 10 teachers. Students are selected through purposive maximum-variation sampling, stratified by programme (Mechanical Manufacturing and E-commerce) and engagement level (high and low). Teachers are stratified by course type (cultural-foundation and practical-training), teaching role and career stage. Each interview lasts 20 to 35 minutes and is audio-recorded with informed consent. Transcripts preserve pauses, repetitions and hesitations, and are checked against the recordings for accuracy.

Interviews are strong on subjective experience. They access students' cognitive and motivational accounts, their perceptions of classroom environment, and their interpretations of instructional behaviours. They allow the researcher to probe why students engage differently across course types and how they make sense of classroom conditions. However, interviews rely on retrospective accounts, may be shaped by self-presentation, and may not capture collective norms or group dynamics.

Focus Group Discussions

Focus group discussions are the third data source. Two separate groups are convened: a student focus group with 6 participants and a teacher focus group with 5 participants. Participants are selected from those who have completed individual interviews. This sequencing allows the focus groups to build on individual accounts while also generating collective perspectives and divergences. The student group includes balanced representation from both programmes and both high- and low-engagement profiles. The teacher group includes cultural-foundation instructors, practical-training instructors and a teaching-research coordinator.

Each focus group lasts 40 to 60 minutes. Discussions are audio-recorded, and field notes capture non-verbal behaviour and group interaction dynamics. The student guide focuses on course-specific engagement differentiation, classroom environment and motivational factors, and low-cost optimisation pathways. The teacher guide focuses on characterising differentiated engagement patterns, constraints and enablers of engagement, and institution-based quality enhancement strategies.

Focus groups are strong on collective sense-making. They reveal shared understandings, group norms, points of consensus and points of tension that individual interviews may not surface. They also allow participants to respond to one another, which can generate richer accounts of classroom conditions. However, focus groups can suppress minority views, and group dynamics may shape what participants feel comfortable saying. The design mitigates this risk by conducting student and teacher groups separately and by using individual interviews as a prior, confidential space for personal accounts.

Three safeguards operate inside the group itself, because a group is not a neutral container for opinion (Kitzinger, 1995). First, students and teachers are never placed in the same group, and the student group is not moderated by a participant's own course teacher; the facilitator is the researcher, who holds no grading authority over participants. Second, ground rules are stated before discussion begins: one voice at a time, no attribution of comments outside the room, the right to decline any question, and an explicit invitation to record disagreement rather than consensus. Third, dominance is managed procedurally rather than by exhortation: opening rounds give each participant an uninterrupted turn, brief responses are followed up individually, and the facilitator records who spoke, who was interrupted and who did not speak, so that the pattern of participation becomes data rather than an invisible distortion. A group consensus that contradicts an individual interview is not averaged; it is logged as divergence and interpreted in the light of the group's composition.

Instrument Development and Piloting

Instruments were developed in four stages. Each dimension of the tri-theory framework was first restated as an observational or conversational focus; those foci were then written as open-ended recording tasks and questions rather than rating scales, in keeping with the interpretive aim of the design; draft protocols were submitted to two qualitative researchers for review of clarity, coverage and leading-question risk; and they

were refined against feedback from frontline teachers at the case institution before use. The sequence matters because a protocol that silently embeds the researcher's own categories will produce confirmation rather than evidence.

Piloting was kept separate from the analytic corpus. Two teachers and two students were interviewed with draft versions of their respective protocols, and the observation protocol was trialled during the pre-observation phase; pilot material was used only to revise wording, sequencing and duration, and is excluded from the analysed dataset. Three revisions followed. Questions that invited evaluation rather than description, such as asking students whether a course was interesting, were rewritten as comparative and incident-based prompts. The number of prompts per topic was reduced so that a 20–35 minute interview could cover every domain without rushing. Probes were added for silence, because students who rarely speak in class tend to answer in monosyllables unless asked for a specific episode. The pilot was not used to compute reliability or validity coefficients, which would be inappropriate for open-ended instruments; its function was to test intelligibility and coverage, and the pilot record is retained in the audit trail. Table 2 summarises the resulting instrument architecture.

Table 2: Instrument architecture and safeguards

Data source	Instrument structure	Anchoring indicators or domains	Safeguards against misinterpretation
Non-participant observation	Structured field-note log: event record plus flagged interpretive notes; session summary written within 24 hours	Behavioural: hand-raising, verbal response, discussion, group collaboration, equipment operation, off-task conduct. Cognitive: questioning, synthesis, note-taking, transfer between theory and workshop task. Affective: interest, belonging, fatigue, resistance, teacher–student affect. Digital: multimedia, platforms, simulation software, training equipment	Low- and high-inference records kept separate; multi-point observation; session summaries returned to teachers for comment; no rating scales
Student interviews	Semi-structured protocol, five topic domains, incident-based probes	Differentiation of engagement across course types; factors shaping engagement; perceived classroom environment; change in motivation; feasible improvements	Piloted and revised; private setting; member checking; verbatim transcription within 24 hours
Teacher interviews	Semi-structured protocol, four topic domains	Engagement patterns by course type; challenges and constraints; digital teaching practice; practicable optimisation strategies	Domain structure parallel to the student protocol, permitting cross-role comparison
Focus groups	Separate student and teacher groups; semi-structured guide; ground rules stated before discussion	Student: course-specific differentiation; environment and motivational factors; low-cost optimisation. Teacher: pattern characterisation; constraints and enablers; institution-based strategies	Groups held separately; equal-turn opening round; facilitator holds no assessment role; confidentiality within the group agreed in advance

Piloting has limits that should be stated. Two interviews per role cannot establish whether a question works across the full range of participants, and the pilot was conducted at the same institution, so it tested intelligibility rather than the transferability of the protocol. What it did establish was that several questions were being heard as requests for evaluation rather than description, which is the failure mode most damaging to a design of this kind.

Complementarity Rather Than Redundancy

The three sources are not treated as redundant checks on the same piece of information. They are functionally differentiated. Observation records behavioural and contextual phenomena. Interviews interpret cognitive, motivational and perceptual processes. Focus groups capture collective perspectives and group-level divergences. this functional complementarity. Table 3 summarises

Table 3: Functional complementarity of the three data sources

Data source	Primary function	Strengths	Limitations addressed by other sources
Non-participant observation	Records observable behaviour and classroom conditions	Captures real-time participation, task completion, interaction patterns and affective expressions	Cannot access cognitive processing, motivation or participant interpretations
Semi-structured interviews	Interprets subjective experience, cognition and motivation	Accesses reasons, perceptions and personal accounts across course types	Relies on retrospective self-report; may not capture collective norms
Focus group discussions	Captures collective perspectives and divergences	Reveals shared understandings, group norms and points of tension	May suppress minority views; group dynamics shape expression

This differentiation is the basis of the design's analytical logic. The sources are integrated not because more data is inherently better, but because each source addresses a distinct layer of the engagement phenomenon.

OPERATIONALISING TRIANGULATION: PROCEDURES AND MATRIX

Sequencing and Iterative Linkage of the Three Sources

Triangulation is often described as if all sources were collected in parallel and then compared. In this design the sources are deliberately sequenced, because the analytical value of a second source depends on what the first has already made visible. The sequence runs through five phases, summarised in Table 4.

Phase one is preparatory: institutional approval, expert review and piloting of instruments, and a month in the participating classes without analytic recording. Phase two is the observation phase, spread across the semester. Its output is not only the observation corpus but an interim analytic memo recording recurring behavioural patterns, first impressions of course-type differences and puzzles that observation alone cannot resolve. That memo is the hinge of the design. Phase three is the interview phase, in which the guides are revised against the memo before fieldwork begins: where observation recorded sustained silence in cultural-foundation classes, student interviews add probes asking for a specific episode of silence and what preceded it; where observation recorded high task involvement but low verbal participation in workshops, teacher interviews add probes on how group task design absorbs or suppresses talk. Phase four is the focus-group phase, convened only after interviews have been transcribed and preliminarily coded, with prompts derived from the interview corpus rather than from the original guide alone: points of agreement are put to the group as propositions to be tested, and points of divergence as alternatives to be argued. Phase five is integration.

Table 4: Sequencing and linkage of observation, interviews and focus groups

Phase	Timing	Source and output	Linkage to the next phase
1 Preparation	One month before the semester	Ethical approval; institutional permission; expert review of instruments; pilot interviews and trial of the observation protocol	Revised protocols; researcher familiar with classrooms and participants

2 Pre-observation and observation	Pre-observation month; weeks 1–16 of the semester	16 observation sessions (8 + 8); field notes; session summaries; interim analytic memo	Memo identifies behavioural patterns and puzzles that set the interview agenda
3 Interviews	After the observation phase, weeks 17–20	22 interviews (12 students, 10 teachers); verbatim transcripts; source-tagged coding	Observation-derived probes added to the guides; interview corpus generates the propositions put to the groups
4 Focus groups	After preliminary coding of interviews, weeks 21–22	2 groups (6 students, 5 teachers); transcripts; notes on participation and interaction	Group consensus tested as a proposition; group divergence put forward as competing alternatives
5 Integration	Weeks 23–26	Coded corpus across three sources; coding matrix; joint display; member checking	Themes classified as converging, complementary, divergent or silent; each decision logged in the audit trail

The linkage is directional rather than symmetrical. Observation supplies the agenda for interviews; interviews supply the propositions for focus groups; all three supply the evidence the joint display adjudicates. The sequencing has a cost, which the design accepts: later phases are shaped by earlier ones, so the sources are not fully independent tests of the same proposition. The compensation is that each later phase asks a better question than it could have asked in isolation, and that the joint display records which source originated each claim, so that a theme's dependence on a single originating source remains visible.

Cross-Source Coding Matrix

The design operationalises triangulation through a cross-source coding matrix. The matrix is organised by the study's core thematic dimensions: instructional behaviours, perceived classroom environment, intrinsic learning motivation, and multidimensional engagement outcomes. Each dimension is linked to the data sources that can address it. the matrix.Table 5 presents

Table 5: Cross-source coding matrix

Thematic dimension	Observation focus	Interview focus	Focus group focus
Instructional behaviours	Teacher questioning, task organisation, digital tool use, feedback patterns	Perceptions of teaching approaches, task difficulty, digital teaching effectiveness	Collective views on teaching constraints and enablers across course types
Perceived classroom environment	Classroom climate, peer interaction, physical and digital conditions	Perceptions of safety, belonging, relevance and teacher-student relationships	Shared understandings of environmental differences across course types
Intrinsic learning motivation	Observable interest, persistence and engagement intensity	Self-efficacy, task value, goal orientation and motivational change	Group norms around motivation, professional identity and course value
Multidimensional engagement	Behavioural, cognitive and affective engagement indicators	Accounts of behavioural investment, depth of thinking and emotional response	Consensus and divergence on engagement patterns and their causes

The matrix serves two functions. First, it guides data collection by clarifying which source is expected to address which dimension. Second, it guides analysis by providing a structure for cross-referencing codes across sources. When a code appears in observation, interviews and focus groups, the design treats it as a candidate for a stable theme. When a code appears in only one source, the design treats it as source-specific and interprets it accordingly.

Because coding is organised by the matrix rather than by the corpus as a whole, the matrix also works as a reduction device. Coding is confined to the dimensions the design can adjudicate across sources, which limits the accumulation of coded material that no combination of sources could resolve, a real risk when three datasets are generated from one setting. Material outside those dimensions is not discarded; it is retained in the audit trail as context and reconsidered if a theme later requires it.

Procedure for Confirming Consistent Evidence

The design adopts a three-step procedure for confirming consistent evidence. First, within-source coding is conducted. Observation field notes, interview transcripts and focus group transcripts are coded separately using a combination of theory-driven and data-driven coding. Theory-driven codes are derived from the behavioural, cognitive and affective engagement framework and from the tri-theory lens of cognitive constructivism, situated learning theory and self-determination theory. Data-driven codes are generated from the raw material to capture emergent issues and implicit patterns.

Second, cross-source comparison is conducted. Codes that appear across sources are grouped into candidate themes. The researcher examines whether the same phenomenon is described consistently across observation, interviews and focus groups. For example, if observation records low behavioural engagement in cultural-foundation courses, interviews attribute it to perceived irrelevance of course content, and focus groups identify shared norms of passivity in those courses, the design treats the pattern as triangulated evidence.

Third, theme consolidation is conducted. Candidate themes are reviewed against the full dataset. Themes supported by consistent evidence across sources are retained. Themes supported by only one source are either retained as source-specific findings or set aside if they lack sufficient evidence. The purpose is not to force convergence but to distinguish between patterns that are robust across sources and patterns that are situated in a particular data source.

Fourth, the decision reached for each candidate theme is entered in the joint display and in the audit trail, with the sources that support it and the evidence that qualifies it. Consolidation is thereby a recorded judgement rather than a private one, and every theme in the report can be traced back from claim to excerpt.

Procedure for Interpreting Contradictory Evidence

Contradictory evidence is treated as analytically informative rather than as a problem to be eliminated. The design specifies three interpretive responses. First, the researcher examines whether the contradiction reflects a difference in perspective. For example, teachers may describe students as disengaged in cultural-foundation courses, while students describe themselves as engaged but silent. This contradiction may reflect different definitions of engagement rather than a factual disagreement.

Second, the researcher examines whether the contradiction reflects a difference in context. Observation may record high engagement in a practical-training session that interviews describe as routine and unmotivating. This contradiction may reflect a difference between a single observed session and the participant's broader experience across the course.

Third, the researcher examines whether the contradiction reflects a limitation in one data source. Focus groups may produce a consensus that individual interviews contradict. This may reflect group pressure or the dominance of certain voices in the focus group. The design documents such contradictions as points for discussion and uses them to refine the interpretation rather than to dismiss one source.

Joint Display for Convergence, Complementarity and Divergence

A procedure that resolves contradictions in prose leaves the reader unable to see how often they occurred or what was done with them. The design therefore carries its integration into a joint display: one table in which each thematic dimension is a row, each source a column, and the status of the evidence and the analytic decision are stated explicitly. The display is completed for every theme retained in the analysis. The

abbreviated extract in Table 6 is a design illustration rather than a report of findings; it shows how entries are recorded and adjudicated, not what the study found.

Each row receives one of four statuses. Converging means that at least two sources record the same phenomenon and no source contradicts it; the theme is retained and its evidential basis is named. Complementary means that the sources address different facets of the same dimension without making overlapping claims; entries are combined into a fuller description rather than treated as mutual confirmation. Divergent means that sources make incompatible claims about the same phenomenon; the row is retained rather than deleted, and the resolution is recorded with the interpretive category applied, whether difference in perspective, in context, in timing, or limitation of a source. Silent means that a source with access to a phenomenon recorded nothing; the silence is logged, because the reach of a method is itself information.

The final column is the audit point. It records the resolution category, the evidence on which the resolution rests and, where a claim was weakened or abandoned, that decision and its date. A theme that moves from converging to divergent after member checking is not quietly amended; the movement is shown. The display does double work: it makes integration inspectable for the reader, and it prevents a convenient narrative from replacing the record of what the sources actually said.

Table 6: Joint display for recording convergence, complementarity and divergence (illustrative extract)

Thematic dimension	Observation record	Interview account	Focus-group account	Status and analytic decision
Behavioural engagement in cultural-foundation courses	Low rate of volunteered talk; sustained silence under whole-class questioning; note-taking predominant	Students describe silence as deliberate avoidance of visibility, not as lack of interest	Group confirms a shared norm of non-participation; two participants dissent and describe active participation in one course	Converging on the pattern, divergent on its meaning; resolved as difference in perspective (students treat silence as strategy, teachers as disengagement)
Cognitive engagement in practical-training courses	High task persistence in workshop tasks; questions concentrate on procedure rather than principle	Students report learning by doing and limited transfer of theory; teachers report surface compliance	Group disputes the term engagement and treats task completion as compliance	Complementary: observation records persistence, interviews record the theory–practice gap, group supplies participants' own criterion; divergence over terminology resolved as difference in definition
Affective engagement across course types	Interest visible in workshop sessions; fatigue in long lecture blocks	Accounts of belonging tied to teacher relationship rather than subject content	Teachers describe affection for students but not students' affect for the subject	Divergent between teacher and student accounts; logged as difference in perspective, theme retained subject to member checking
Perceived classroom environment	Seating, equipment availability and group size differ systematically between course types	Students weigh relevance of content more heavily than physical conditions	Group ranks teacher fairness above facilities	Complementary; environment treated as a composite condition rather than a single variable

Note. Entries are illustrative and demonstrate the recording format; they are not empirical findings.

From Triangulated Data to Thematic Analysis

Triangulated data are analysed through Braun and Clarke's six-phase thematic analysis (Braun & Clarke, 2006). The phases are data familiarisation, generating initial codes, searching for themes, reviewing themes, defining and naming themes, and producing the report. The design integrates triangulation into each phase.

In the familiarisation phase, the researcher reads all observation notes, interview transcripts and focus group transcripts in their entirety. In the coding phase, codes are tagged by source so that cross-source patterns can be traced. In the theme-search phase, candidate themes are organised around the cross-source coding matrix. In the theme-review phase, themes are checked against each source to ensure that they are supported by evidence and that contradictions are documented. In the defining-and-naming phase, themes are articulated with attention to cross-source convergence and divergence. In the reporting phase, representative quotations and field note excerpts are presented alongside the thematic interpretation.

The thematic chain adopted in the design links instructional behaviours, perceived classroom environment, intrinsic motivation and multidimensional engagement. This chain is not treated as a causal model to be tested statistically. It is an interpretive structure that organises the qualitative evidence and guides cross-source analysis.

TRUSTWORTHINESS, ETHICS AND DESIGN BOUNDARIES

Trustworthiness Criteria

The design adheres to Lincoln and Guba's four qualitative quality criteria: credibility, transferability, dependability and confirmability (Lincoln & Guba, 1985). Credibility is supported through data triangulation, member checking and prolonged engagement in the field. Transferability is supported through thick description of the institutional context, course types, participants and fieldwork procedures. Dependability is supported through a documented audit trail of instruments, procedures and analytical decisions. Confirmability is supported through researcher reflexivity and the use of direct quotations and field note excerpts in reporting.

Data triangulation is the primary credibility strategy. The design cross-references observation, interview and focus group evidence to identify stable patterns and to interpret contradictions. Member checking is conducted after initial thematic analysis. Findings are returned to participating students and teachers for verification, and their feedback is incorporated into the final thematic structure. Researcher reflexivity is maintained through a reflective log documenting initial assumptions, interpretive decisions and the influence of the researcher's familiarity with the institution. Thick description is provided through detailed contextual information about the college, the two course types and the classroom conditions observed.

Two further procedures complete the trustworthiness set. Peer debriefing is scheduled at three points: after the observation memo, after preliminary interview coding and before the thematic structure is finalised, with supervisors and doctoral peers who are not part of the fieldwork. Its purpose is to test whether coding decisions can be defended to someone who has not been in the room, and the substance of each session is recorded in the audit trail. An independent coding check is conducted on a subsample of transcripts: a second coder applies the codebook to selected transcripts, disagreements are discussed to the point of a shared definition, and amendments are documented. Neither procedure converts a single-researcher study into investigator triangulation, and the paper does not claim that it does; they are compensating devices whose limits are acknowledged below.

The audit trail is the design's memory. It holds the instrument versions and pilot record, the observation memos, the codebook with its successive revisions, the joint display and the record of interpretive decisions, each dated. Because a qualitative judgement is only as defensible as the record of how it was reached, the audit trail is treated as a data object rather than administrative residue.

Researcher positionality requires explicit statement. The first author teaches at the case institution, which yields three advantages and one hazard: access to timetables and workshops is unproblematic, participants speak in a familiar idiom, and institutional history is already understood, but familiarity also creates the risk of reading the familiar as the natural and of under-reporting what is ordinary. Three measures address the hazard: the reflective log records assumptions before each phase and revisits them after it; observation summaries are returned to teachers, whose corrections may reframe a session; and peer debriefing is conducted with colleagues who do not work at the institution. The hazard is not eliminated, and the design does not present the researcher as neutral. It presents the researcher as positioned, and it makes the position visible enough for readers to discount for it.

Ethical Procedures

The design adheres to ethical standards for qualitative social science research. Ethical approval is obtained from the Faculty of Education and Social Sciences, Universiti Selangor (UNISEL), and formal on-site research permission is obtained from Chengdu Industry and Trade College. All participants provide written informed consent. The consent process explains the research objectives, data collection procedures, audio recording, voluntary participation and the right to withdraw at any time without negative consequences.

Anonymity is protected through the removal of names, student identification numbers and employee identification numbers. Participants are assigned codes (S1, S2 for students; T1, T2 for teachers). The cross-reference file linking codes to personal information is stored separately and securely. Audio recordings, field notes and transcripts are stored on password-protected devices, and access is restricted to the research team. Data not included in the final report are deleted after the study.

Two ethical issues specific to this design are handled explicitly. The first is age. Some first-year vocational students are under eighteen, and for them written consent is supplemented by consent from a parent or guardian, together with the student's own assent obtained in language suited to a school-leaver; where a guardian declines, the student is not approached again. Consent is treated as a process rather than a signature: it is restated at the start of each interview and each group, and participants are reminded that declining a question, stopping the recording or withdrawing entirely carries no academic consequence.

The second is the management of power inside the focus groups. Students discuss their teachers, and teachers discuss colleagues and their institution, in a room on campus. Three provisions follow. Groups are composed so that no participant's direct superior or own teacher is present, and the facilitator holds no assessment role. Participants are told at the outset that comments will not be reported to named staff, that no quotation will be attributed to an identifiable person, and that the limits of confidentiality within a group are real: the facilitator can protect the transcript but cannot bind other participants. Finally, transcripts are anonymised at the point of transcription, and audio files are destroyed once transcription has been verified.

Design Boundaries and Limitations

The design has four boundaries. First, it is a single-case design and does not aim for statistical generalisation. Its findings are intended for analytical transferability to similar resource-constrained vocational contexts. Second, the fieldwork is conducted within one semester, which limits the design's ability to capture long-term changes in engagement. Third, the design focuses on instructional, classroom-environmental and motivational factors and does not incorporate personal psychological traits, family background or other extra-curricular factors. Fourth, the design includes teachers and students but not instructional managers, enterprise mentors or other stakeholders. These boundaries are acknowledged as design choices rather than as claims about the irrelevance of other factors or perspectives.

The four boundaries above describe the scope of the design; they do not exhaust its limitations. The following limits are limits of method and inference, and each is paired with the measure that partly offsets it.

Generalisation: a single case yields no population parameters, so all claims are stated as transferability, supported by thick description of the conditions a reader would need in order to compare. Sample size: twelve student and ten teacher interviews are appropriate for thematic saturation in a purposive sample, but they do not represent the institution's programmes, year groups or ability range; the design claims depth of interpretation, not coverage. Field time: one semester registers the patterns of that semester and cannot show how engagement shifts across a programme or a year, so patterns are reported as situated rather than developmental. Observer effect and inferential judgement: presence alters behaviour, and readings of affect are interpretations, which is why observation claims are separated into low- and high-inference records and tested against self-report. Self-report: interviews and groups are exposed to social desirability and retrospective reconstruction, and students in particular may wish to appear conscientious, so self-report is read alongside observed behaviour rather than treated as transparent testimony. Group dynamics: a focus group can manufacture consensus and silence dissentients, which is why separate groups, turn rules and participation

records are used, and why group consensus is never averaged with individual accounts. Single researcher: investigator triangulation is absent, and the devices described above are compensations rather than substitutes.

METHODOLOGICAL CONTRIBUTIONS AND TRANSFERABILITY

Contributions to Qualitative Design

First, it specifies a functional differentiation of observation, interviews and focus groups in a dual-course single-case study. The design does not treat the three sources as interchangeable. It assigns each source a distinct role: observation for behavioural and contextual phenomena, interviews for cognitive and motivational interpretation, and focus groups for collective perspectives and divergences. This differentiation provides a clearer rationale for triangulation than the general claim that multiple sources enhance credibility.The paper makes four methodological contributions.

Second, the paper operationalises triangulation through a cross-source coding matrix and a procedure for confirming consistent evidence and interpreting contradictory evidence. The matrix links thematic dimensions to data sources, and the procedure specifies how cross-source patterns are identified and how contradictions are interpreted. This operationalisation addresses a common gap in qualitative methodology, where triangulation is endorsed but not fully specified.

Third, the paper integrates triangulation with Braun and Clarke's six-phase thematic analysis. Triangulation is not treated as a separate quality check conducted after analysis. It is embedded in the coding, theme-search, theme-review and reporting phases. This integration ensures that cross-source evidence shapes the thematic structure rather than being appended to it.

Fourth, the design makes explicit what it does not do. It names the form of triangulation it practises, records the absence of investigator triangulation and specifies the devices that stand in for it; it distinguishes low- from high-inference observation; it treats silence in a source as data; and it pairs each acknowledged limitation with a measure that partly offsets it. Methodological accounts that present triangulation as an unqualified strength leave these gaps for readers to discover. Naming them is, in this design, part of the argument.

Transferability to Similar Contexts

The design is transferable to similar resource-constrained vocational contexts. Researchers working in dual-course vocational settings can adapt the functional differentiation of data sources, the cross-source coding matrix and the procedures for handling consistent and contradictory evidence. The design is also relevant to single-case studies that compare different course types, different instructional settings or different student groups within one institution.

Transferability is supported by the design's explicit attention to context. The paper describes the institutional conditions, the two course types, the participant sampling logic and the fieldwork procedures. Readers can compare these conditions with their own settings and assess the relevance of the design. The paper does not claim that the design is universally applicable. It claims that the design principles are adaptable to contexts with similar characteristics.

Implications for Future Research

Future research can extend the design in three directions. First, multi-case designs can compare triangulated findings across institutions with different resource conditions. Second, longitudinal designs can examine how engagement patterns and triangulated interpretations change over time. Third, designs that include additional stakeholder perspectives, such as instructional managers and enterprise mentors, can enrich the interpretation of classroom conditions and their relationship to engagement. A fourth direction is more immediate: applying the design in a second setting and reporting the joint display in full, including the themes that failed to resolve, so that the design is evaluated by what it produced rather than by what it promised.

CONCLUSION

This paper has presented a triangulation design for integrating non-participant classroom observation, semi-structured interviews and focus group discussions in a single-case study of student classroom engagement in a resource-constrained higher vocational college in western China. The design is grounded in constructivism and adopts an intrinsic single-case logic in which institutional conditions are held constant while cultural-foundation and practical-training courses operate as contextual lenses for analysing behavioural, cognitive and affective engagement.

The paper has argued that triangulation is best understood as a structured analytical strategy rather than as the mere accumulation of data sources. The three sources are functionally differentiated: observation records observable behaviour and classroom conditions, interviews interpret cognitive and motivational accounts, and focus groups capture collective perspectives and divergences. The design operationalises this differentiation through a cross-source coding matrix, a procedure for confirming consistent evidence, and a procedure for interpreting contradictory evidence. Triangulation is embedded in Braun and Clarke's six-phase thematic analysis, and trustworthiness is supported through data triangulation, member checking, researcher reflexivity and thick description.

The design also specifies what is commonly left implicit: the form of triangulation practised, the sequence through which each source informs the next, a joint display that records convergence, complementarity and divergence for every theme, instrument piloting, and the devices that stand in for the absence of investigator triangulation. Whether these procedures perform the analytical work claimed for them can only be established empirically. The next step is therefore not further elaboration of the design but its application and its reporting: a study that uses the display should publish the display, including the rows that did not resolve, so that the design can be judged by what it produced rather than by what it promised.

The contribution is methodological. The paper clarifies how triangulation can be operationalised in dual-course, resource-constrained vocational settings and offers transferable design principles for qualitative classroom-engagement research. It does not claim statistical generalisation. It claims that the design logic is analytically transferable to similar contexts and that it provides a transparent and defensible basis for interpreting student classroom engagement across course types.

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