

Proposed Culturally Responsive Skill Learning Device for Vocational Education Learners in India: A Mixed Methods Design and Feasibility Study Protocol

Rashmi Kumari Rajora^{1*}; Dr. Renu Yadav²

¹Research Scholar, ²Professor

^{1,2}Department of Teacher Education, Central University of Haryana, Mahendargarh

ORCID ID: ¹0009-0008-8840-8196, ²0000-0001-9339-3760

Corresponding Author: Rashmi Kumari Rajora*

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Abstract: India's vocational education and training settings serve learners with varied languages, prior work experiences, and access to digital resources. This proposed protocol describes the planned development and feasibility evaluation of a culturally responsive skill learning device. The device is conceived as a portable, offline-first aid for practical competency modules; it has not yet been built or tested. The protocol does not report study findings.

The study will proceed through needs analysis, co-design and prototype development, expert review, usability testing and revision, and a two-group feasibility evaluation. The anticipated sample is approximately 60–80 second-semester B.Voc learners at Central University of Haryana in Biomedical Science, Industrial Waste Management, and Retail and Logistics Management. Hindi and English will be supported. Programme-specific simulated tasks, class availability and allocation will be documented before recruitment. Competency outcomes will be exploratory within programmes and will not be pooled across different tasks.

The feasibility study will assess recruitment, retention, delivery, fidelity, acceptability, and data completeness against predefined progression criteria. Practical competency, short-term retention, engagement, skill self-efficacy, and perceived cultural relevance will be examined as exploratory outcomes. Quantitative estimates will be interpreted alongside interviews, observations, learner work, and device usage records. The study will inform refinement of the device and the design of a future evaluation; it is not intended to establish effectiveness or generalisability. Relevant SPIRIT 2025 items and TIDieR will guide reporting, with the CONSORT extension for randomised pilot trials applied if class randomisation is selected.

Keywords: *Culturally Responsive Teaching; Vocational Education and Training; India; Skill Learning; Educational Device; Feasibility Protocol; Mixed Methods.*

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I. INTRODUCTION

In India, vocational education and training may be delivered through different institutional routes, including programmes under the Craftsmen Training Scheme in Industrial Training Institutes. The National Skills Qualification Framework (NSQF) organises qualifications around learning outcomes and competencies (Directorate General of Training, n.d.; National Council for Vocational

Education and Training, 2023). A proposed learning device should therefore align each module with the applicable qualification or curriculum and its mandatory safety requirements. Learners may also need explanations that connect technical vocabulary with languages and examples familiar in their setting. These are design considerations to be assessed locally, not assumed characteristics of all Indian learners.

Culturally responsive teaching draws on learners' cultural knowledge, communication, prior experience, and identities as instructional resources (Gay, 2002, 2018; Ladson-Billings, 1995). Culturally sustaining pedagogy also asks whether education supports linguistic and cultural plurality (Paris, 2012). In vocational education, relevant design possibilities include multilingual explanations, locally reviewed scenarios, diverse portrayals of workers, collaborative problem-solving, and fair ways to demonstrate competence.

Technology can support these approaches, although access to a device alone does not make instruction culturally responsive. Chuang et al. (2020) describe constructs for culturally responsive teaching in technology-supported environments. Cheng et al. (2021) illustrate technology-supported cultural scaffolding in a specific educational context; their findings do not establish effects in vocational training. The proposed device will let learners interpret demonstrations, practise decisions, document performance, receive feedback, and reflect on local applications.

The proposed culturally responsive teaching (CRT) Skill Learning Device is a concept-stage, portable, offline-first combination of hardware and software for guided practical learning in an Indian vocational education setting. Its architecture is intended to support instructor-authored modules across trades, while each module will require separate technical, cultural, and safety review against the applicable curriculum or competency standard. It would supplement instructors, workshops, and authentic practice. This protocol proposes to test development and study procedures; it reports no prototype performance or effectiveness.

II. LITERATURE REVIEW

➤ *Culturally Responsive Teaching*

Ladson-Billings (1995) framed culturally relevant pedagogy around academic achievement, cultural competence, and critical consciousness. Gay (2002, 2018) described how curriculum, communication, classroom relationships, instruction, and assessment can draw on cultural knowledge. Paris (2012) extended this discussion toward sustaining community languages and cultural practices. Together, these approaches suggest that culture affects examples, participation, and demonstrations of competence throughout instruction.

Aronson and Laughter (2016) synthesized research on culturally relevant education across subject areas and noted variation in how it is defined and implemented. Franco et al. (2024) reviewed measures of culturally responsive classroom practice in school settings and reported limitations in available validity evidence. Because those contexts differ from vocational colleges, this study will combine learner accounts, observation, performance evidence, and instructor reports rather than assume that existing scales transfer directly.

➤ *Technology Supported Culturally Responsive Learning*

Chuang et al. (2020) validated an 18-item instrument with five dimensions for teachers' perceptions of culturally responsive teaching in technology supported environments. That work provides a useful construct map, but it does not establish that a learner operated device improves practical performance. Cheng et al. (2021) demonstrated how culture and technology can be integrated in preservice teacher practice and reported the prominence of technology enhanced cultural scaffolding. Their finding that technology often remained a visual aid clarifies an unresolved design question: how can a device make learners active producers of explanations, evidence, and contextually meaningful solutions?

The proposed device would offer five linked functions for local testing: learner-selectable explanations in languages identified during needs analysis; scenarios reviewed by learners and local occupational contributors; demonstrations segmented into observable steps; prompts to perform and document authentic tasks; and feedback linked to competency criteria. These are proposed design features, not validated affordances or observed effects.

➤ *Skill Education and Learner Engagement*

Engagement in vocational education can involve interest in the curriculum, relationships in the learning community, and access to suitable learning approaches (Niittylahti et al., 2023). Practical learning also involves performance, feedback, safe correction, and transfer beyond demonstration. In the proposed Indian setting, the feasibility study will examine whether the device fits the selected workshop, available power and connectivity, teaching time, and language practices. Such conditions will be documented rather than presumed to be uniform across institutions.

Self-efficacy is included because learners who can see a task modelled in accessible steps, attempt it, receive criterion-based feedback, and observe peers with relevant backgrounds may develop stronger beliefs about their capability (Bandura, 1997). Engagement is treated as behavioural, emotional, and cognitive participation rather than screen time alone (Fredricks et al., 2004). Device logs will therefore complement, not replace, performance ratings, learner reports, and observations.

➤ *Research Gap*

The protocol proposes to address three questions relevant to vocational education in India: how culturally responsive principles can be translated into reviewable device features for a selected competency; whether the prototype and study procedures can be delivered safely and acceptably in a chosen institution; and whether locally adapted measures are understandable and complete enough for further research. These are proposed research questions, not established gaps uniquely demonstrated for all Indian vocational settings. Co-design decisions, prototype revisions, measurement performance, and feasibility estimates will be documented if the study is conducted.

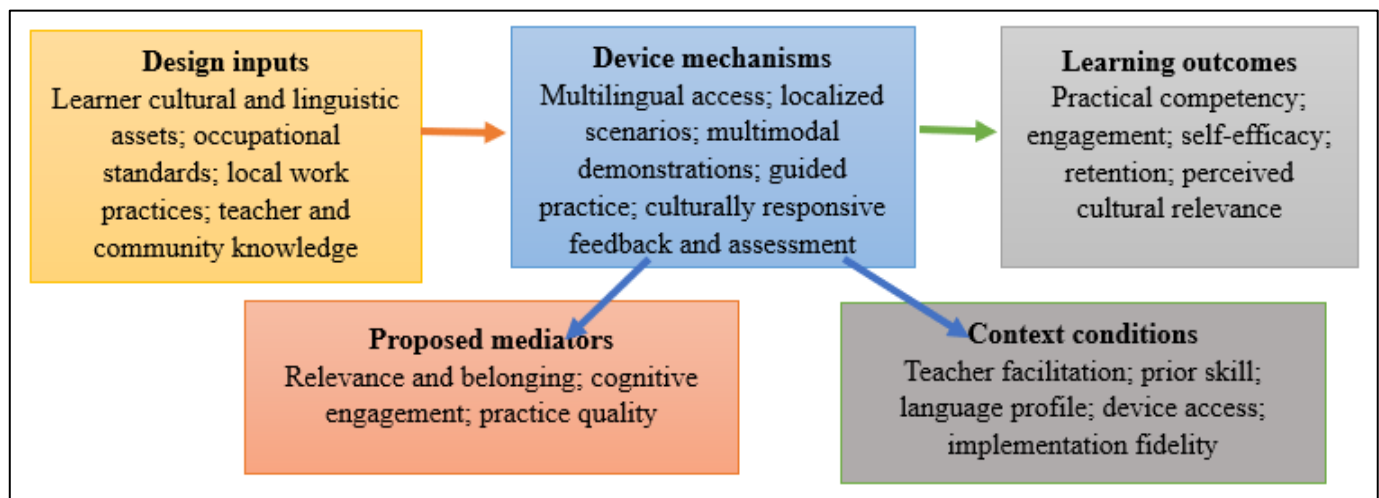
➤ *Conceptual Framework for the CRT Skill Learning Device*

Fig 1 Conceptual Framework for the CRT Skill Learning Device

The conceptual framework proposes that locally reviewed language and occupational examples may influence perceived relevance, participation, and practical rehearsal. Instructor facilitation, prior skill, accessibility, and fidelity may shape use. These relationships are hypotheses for future investigation, not effects demonstrated by this protocol. The proposed small feasibility study will describe implementation

and exploratory outcomes, without testing mediation or moderation.

➤ *Device Design*• *Design Principles*

Table 1 Design Principles

Principle	Operational Device Feature	Evidence to Collect
Cultural and linguistic access	Learner selectable language, audio, text, images, and locally understandable terminology with a glossary for occupational terms	Language selection, comprehension checks, interviews
Contextual relevance	Scenarios from local work, household, enterprise, and community settings reviewed by learners, instructors, and community or industry experts	Expert ratings, relevance survey, artifact review
Competency alignment	Every module maps demonstrations, practice prompts, and assessment criteria to an explicit occupational competency	Content validity, rubric scores, fidelity records
Active learner use	Learners predict, choose, perform, capture evidence, explain decisions, and revise instead of only watching content	Usage logs, observation, learner artifacts
Cultural plurality	Examples show more than one legitimate context or approach and avoid fixed claims about groups	Cultural audit, interviews, revision log
Accessible offline operation	Core modules work without continuous internet; data synchronize only when a secure connection is available	Task completion, error logs, access records
Teacher agency	Instructors can select modules, review evidence, add local examples, and override automated sequencing	Teacher logs, interviews, fidelity checks
Transparent assessment	Learners can view criteria before performance and receive feedback tied to observable actions	Assessment audit, feedback comprehension

• *Minimum Prototype Specification*

Table 2 Minimum Prototype Specification

Layer	Minimum Specification	Rationale
Hardware	Portable 8-to-10-inch touch display or equivalent low-cost unit, speaker or headphone output, camera for evidence capture, rechargeable power, protective enclosure	Supports workshop use and multimodal learning
Offline content	Local storage for videos, diagrams, narration, quizzes, rubrics, and learner records	Reduces dependence on stable connectivity
Content authoring	Instructor interface for adding local language labels, examples, safety notes, and scenario variants without coding	Prevents cultural content from becoming fixed or externally imposed

Practice workflow	Demonstrate, predict, perform, capture, self-assess, receive feedback, repeat	Aligns the device with deliberate practical learning
Assessment	Competency rubric, formative checks, evidence portfolio, rater view, and exportable anonymized dataset	Connects learning activity with valid outcome evidence
Data protection	Mandatory encrypted storage for learner evidence, authenticated role-based access, minimal identifiers, separate recording consent and specified deletion controls	Protects learner data and recorded performance
Accessibility	Captioned video, adjustable text, high contrast mode, audio replay, simple navigation, and alternative input where feasible	Improves access without treating language support as remediation

• *Module Sequence*

- ✓ Connect: The learner chooses language and reviews a local scenario that makes the skill purpose visible.
- ✓ Activate: The device elicits prior knowledge, familiar tools, and existing ways of performing related tasks.
- ✓ Demonstrate: The system presents a segmented expert demonstration with safety cues and optional alternative explanations.
- ✓ Plan: The learner predicts steps, selects tools, and explains the intended procedure.
- ✓ Perform: The learner completes the practical task in the workshop or authentic setting while the device provides limited prompts.
- ✓ Evidence: The learner or instructor captures observable evidence, including photographs, short clips, readings, or checklist entries as permitted.
- ✓ Assess: The learner self-assesses against the rubric before an instructor or blinded assessor rates performance.
- ✓ Reflect and Transfer: The learner explains where else the skill applies, identifies a local variation, and plans the next attempt.

• *Purpose*

The proposed study aims to develop and assess the feasibility of a culturally responsive device framework for practical skill learning in an Indian vocational education institution.

➤ *Research Objectives*

- Identify the cultural, linguistic, occupational, pedagogical, accessibility, and technical requirements for the device.

- Translate the requirements into design principles, content rules, assessment specifications, and a functional prototype.
- Establish the content, cultural, instructional, technical, and assessment validity of the prototype and study instruments.
- Determine the prototype's usability, feasibility, reliability, and implementation fidelity in a pilot.
- Estimate recruitment, retention, delivery, acceptability, fidelity, data completeness, and preliminary learning outcomes in a two-group feasibility study.
- Use feasibility and qualitative evidence to decide whether and how to conduct a later definitive effectiveness trial.

➤ *Research Questions*

- What requirements do learners, instructors, community contributors, and occupational experts identify in the selected Indian vocational setting?
- To what extent does expert evidence support the content, cultural, instructional, technical, and assessment validity of the prototype?
- Is the prototype usable and feasible during authentic practical instruction?
- Can eligible learners in the selected vocational institution be recruited, retained, assessed, and exposed to the proposed intervention as planned?
- What are the preliminary patterns and uncertainty in practical competency, engagement, self-efficacy, perceived cultural relevance, and short-term retention?
- Which implementation mechanisms, adaptations, and context conditions should inform a later definitive trial?

➤ *Progression Criteria*

Table 3 Progression Criteria

Domain	Progress Criterion	Decision Rule
Recruitment	At least 70 percent of eligible invited students consent within the planned recruitment period.	Green at least 70 percent; amber 50 to 69 percent; red below 50 percent
Retention	At least 80 percent of enrolled students complete post-test and at least 70 percent complete delayed assessment.	Green if both targets are met; amber if one is met; red if neither is met
Delivery	At least 80 percent of scheduled core device sessions are delivered without a critical technical or safety failure.	Green at least 80 percent; amber 60 to 79 percent; red below 60 percent
Acceptability	At least 75 percent of respondents choose an acceptable or higher rating on a prespecified five-point global acceptability item; no serious unresolved cultural concern.	Green at least 75 percent; amber 50–74 percent; red below 50 percent. An unresolved serious cultural or safety concern overrides the percentage.
Fidelity	At least 80 percent of observed intervention sessions include all five prespecified core components.	Green at least 80 percent; amber 60 to 79 percent; red below 60 percent.

Data completeness	At least 85 percent of required feasibility fields and primary competency ratings are complete.	Green at least 85 percent; amber 70 to 84 percent; red below 70 percent
Overall progression	The steering group will review each threshold, feasibility precision, qualitative concerns, safety, burden, and required redesign.	All green: proceed with minor refinements. Amber and no red: modify. Any non-safety red: modify and repeat the affected feasibility check or stop. Serious unresolved harm: stop progression. See steering-group decision procedure.

III. METHODOLOGY

➤ Research Design

This proposed five-phase educational design research protocol embeds a two-group pretest–posttest feasibility evaluation and a four-week delayed assessment (McKenney & Reeves, 2019). The intended site is Central University of Haryana. The anticipated sample is approximately 60–80 second-semester B.Voc learners from Biomedical Science, Industrial Waste Management, and Retail and Logistics Management. Hindi and English will be supported. Modules will be reviewed separately for each programme. Overall feasibility indicators may be combined with programme-specific summaries, but competency outcomes will remain

programme-specific. No institutional permission, prototype, recruitment or observed result is claimed.

The phases would proceed from requirements to prototype, expert review, usability revision, and feasibility testing. The protocol proposes class randomisation if sufficient classes and an analytically credible design are available; otherwise, it proposes a matched intact-class feasibility study. The chosen route, eligibility criteria, comparator, feasibility indicators, and analysis plan would be fixed before phase-five recruitment. Relevant SPIRIT 2025 items and TIDieR would guide protocol and intervention descriptions; the CONSORT extension for randomised pilot studies would apply only to a randomised final design (Chan et al., 2025; Eldridge et al., 2016; Hoffmann et al., 2014).

Table 4 Study Phases and Decision Criteria

Phase	Participants and Evidence	Main Outputs	Decision to Progress
One needs analysis	Approximately 30 to 40 learners, 8 to 12 instructors, and 4 to 6 community or industry contributors; interviews, focus groups, observation, curriculum audit	Requirement specification and cultural risk register	Requirements are traceable to at least two evidence sources or justified as safety or standards requirements
Two co design and development	Learner and instructor design workshops, content specialists, developer team	Design principles, storyboard, prototype modules, data plan	Each programme-specific competency has mapped content, safe practice and assessment evidence
Three expert validations	8 to 12 experts across CRT, skill education, assessment, language, accessibility, and educational technology	Aiken V and content validity evidence; prioritized revision log	All content and assessment elements reviewed; unresolved critical technical, safety or cultural concerns corrected before usability testing
Four usability pilot	Approximately 12 to 20 learners and 2 to 4 instructors outside the feasibility sample	Usability, error, burden, timing, and instrument evidence	No unresolved critical error; at least 80 percent task completion; all serious safety or cultural concerns resolved
Five: feasibility study	Approximately 60–80 anticipated second-semester B.Voc learners at Central University of Haryana across the three specified programmes; Hindi and English; two study conditions; final enrolment depends on eligibility, consent and class availability	Recruitment, retention, delivery, fidelity, acceptability, data completeness, and preliminary outcome estimates	Progression decision uses the prespecified green amber red criteria

➤ Setting and Participants

The intended study site is Central University of Haryana, Mahendragarh, Haryana, India. The author-supplied sampling frame lists 428 B.Voc learners: Biomedical Science (135), Industrial Waste Management (117), and Retail and Logistics Management (176). The proposed feasibility sample is expected to comprise approximately 60–80 second-semester vocational learners across these programmes, with eligibility open to all genders. The counts describe the supplied planning frame, not recruitment or study findings; their reference date and the number of eligible second-semester learners in each programme must be verified from

institutional records before recruitment. Institutional permission and ethics approval are not claimed.

The intervention will use programme-specific supervised simulation modules in Biomedical Science, Industrial Waste Management, and Retail and Logistics Management. The primary outcome remains feasibility of delivery and study procedures across the recruited learners. Practical competency is exploratory and will be summarised within each programme using a separately reviewed curriculum-aligned task and rubric; raw competency scores from different programmes will not be pooled. Retail

simulation may cover customer interaction, product selection, inventory checking and transaction documentation without real customer data or financial transactions. Biomedical Science and Industrial Waste Management modules require specialist-selected tasks, safety review and clean simulation materials without infectious or hazardous exposure. The exact competencies, curriculum identifiers, eligible programme counts and programme-level allocations will be fixed in the phase-five registration. Hindi and English will be available for instructions, narration, captions and questionnaires with a bilingual occupational glossary.

Within the verified second-semester learner frame, programme recruitment targets will be proportional to eligible learner counts, with rounding to the feasible overall target selected before recruitment. All-semester programme counts will not be used as second-semester quotas without verification. Eligibility will require enrolment in the selected programme and competency module, capacity to provide informed consent, and availability for the planned assessments. Gender, home language, disability, prior technology experience or lack of a personal device will not by themselves be exclusion criteria. Where the eligible pool is smaller than the planned target, all eligible learners may be invited; achieved numbers and reasons for differences from the target will be reported without treating 80 as a required total. Participation will be voluntary, and accommodations will be recorded. Allocation and matching will preserve programme comparability; where comparable conditions cannot be formed within a programme, that programme will contribute development or usability evidence rather than a pooled competency contrast. Instructors and programme specialists will review the tasks, language, cultural relevance, accessibility and safety.

➤ *Sample Size*

The anticipated sample is approximately 60–80 second-semester B.Voc learners, with roughly balanced study conditions where class structure permits, for feasibility estimation rather than effectiveness testing. As an illustrative planning calculation, assuming independent observations, a proportion of 0.80 has a Wilson 95% confidence interval of approximately 0.682–0.882 at $n=60$ and 0.700–0.873 at $n=80$. For a proportion of 0.50, corresponding intervals are approximately 0.377–0.623 and 0.393–0.607. These examples show the limited precision available; they are not power calculations or observed results. Recruitment precision will use all eligible invited learners as its denominator, whereas retention will use enrolled learners. Session and response denominators will be defined separately. Repeated sessions and classmates are not independent; the actual class structure will be reported, and independent-binomial intervals will be labelled as reference estimates where clustering cannot be estimated reliably. The sample will not be increased to pursue statistical significance. This range is a planning estimate, not a mandatory recruitment quota. The feasible target and recruitment period will be specified before recruitment using the verified eligible population and class inventory; achieved enrolment may differ because participation is voluntary. Any departure from the anticipated

range will be explained and reflected in feasibility precision and programme-specific interpretation.

➤ *Allocation and Comparison Condition*

The allocation route will be decided from a documented class inventory before recruitment. Class randomisation will be used only when at least eight eligible classes are available, with at least four per condition, delivery can be separated to limit contamination, and the instructor arrangement does not completely confound instructor with condition. This is a pragmatic design gate, not a guarantee of adequate power or reliable cluster-level inference. An independent researcher will generate a 1:1 class allocation sequence and conceal it until baseline assessment is complete. With fewer than eight classes, the study will use a non-randomised matched-class design if at least one comparable class per condition is available. Matching will consider competency, course level, schedule, instructor arrangements and baseline competency. If two comparable conditions cannot be delivered, phase-five recruitment will be postponed and a protocol amendment required. The comparison condition will receive existing demonstrations, practical time, workshop access, feedback and instructor support without the prototype. Teaching time, instructor overlap and contamination will be recorded. Outcome assessors will be blinded where feasible, with unblinding documented.

➤ *Intervention Duration and Fidelity*

The proposed intervention will span eight instructional weeks, with at least one device-supported practical cycle per week and a competency assessment four weeks after intervention completion. Before recruitment, the module manual will define session duration, device access and sharing, language options, exact task sequence, instructor prompts, permitted evidence capture, feedback source, and an offline fallback. Instructors will receive standardised orientation in operation, culturally responsive facilitation, safety, and privacy. Fidelity will be assessed using observation, logs, and exposure records for multilingual access, reviewed scenarios, guided practice, criterion-based feedback, and reflection. Adaptations, omissions, and technical downtime will be recorded by session.

Fixed intervention components are offline core access, a curriculum-aligned competency within each programme, technically reviewed demonstrations and safety instructions, guided practical rehearsal, criterion-based feedback, learner reflection, the eight-week schedule and assessment time points. Co-design may adapt language, narration, local scenarios, illustrations, accessibility settings and the form of permitted learner evidence. It may not remove mandatory safety requirements or change the competency rubric without a documented amendment. The registered module manual will distinguish the fixed core from adaptable elements and record the version used in each class.

➤ *Measures*

Table 5 Outcome and Process Measures

Construct	Measure and Source	Time	Quality Evidence
Feasibility primary	Recruitment, retention, delivery, acceptability, fidelity, safety, burden, and data completeness indicators	Recruitment through follow up	Multiple records reconciled against prespecified progression rules
Practical competency exploratory	Analytic performance rubric aligned to the selected competency module; two trained raters blinded where feasible	Pretest, posttest, delayed	Content review; preliminary consistency if defensible; larger-sample construct validation deferred
Engagement	Locally developed behavioural, emotional and cognitive engagement item pool informed by Fredricks et al. (2004); Appendix F	Pretest and posttest	Content review; preliminary consistency if defensible; larger-sample construct validation deferred
Skill self-efficacy	Separate task-specific capability item pool informed by Bandura (1997); Appendix F; exploratory item summaries	Pretest and posttest	Expert review, translation, cognitive interviews and pilot response patterns; no established validation claimed
Cultural relevance	Original perception item pool in Appendix A; descriptive item results only	Posttest, device-exposed learners only	Expert review, cognitive interviews, item completion, and response patterns; full construct validation deferred
Usability	Task completion, time on task, critical errors, help requests, and post use rating	Pilot and intervention	Observation protocol; log agreement checks
Implementation fidelity	Observation checklist, instructor log, and device usage summary	Weekly	Observer training; agreement on a subsample
Experience and mechanisms	Semi structured learner and instructor interviews; learner artifacts	Pilot, midpoint, and posttest	Reflexive thematic analysis and negative case review

The proposed culturally responsive perception items are an original research item pool, not a validated scale for this population. Prior measures (Chuang et al., 2020; Dickson et al., 2016) inform construct definitions, while local learners and experts will review wording and interpretation. With the proposed feasibility sample, analyses will prioritize item comprehension, completion, response distributions, and preliminary internal consistency where defensible. Confirmatory factor analysis and definitive construct validation will require a larger independent sample. Multiple sources will reduce reliance on self-report (Franco et al., 2024).

Engagement will be measured with a locally developed brief item pool covering behavioural participation, emotional involvement and cognitive effort, informed by the construct framework of Fredricks et al. (2004); it will not be described as an established validated scale. Appendix F specifies the proposed items, response options and scoring. Skill self-efficacy will use a separate task-specific capability item pool grounded in Bandura (1997), also presented in Appendix F. Appendix A measures perceived cultural and linguistic responsiveness only and will be administered after device exposure, not at baseline or to learners without device exposure. Feasibility analyses will emphasise item-level response patterns and missingness; any aggregate score will remain exploratory.

For each study language, two bilingual contributors will independently translate the source items, reconcile wording with an occupational instructor, and arrange an independent back-translation. A bilingual panel will compare conceptual meaning, task terminology, response anchors and reading burden. Cognitive interviews with approximately 5–8 learners per language will probe comprehension, recall and response choice; revised items will be rechecked before the usability pilot. The item-version log will document disagreements and revisions. Administration mode and language will be recorded. The feasibility sample will not establish statistical measurement invariance; pooled language comparisons will therefore be cautious and language-specific item summaries will be provided where disclosure risk permits.

➤ *Validity and Reliability Procedures*

Experts will rate device components, rubric criteria, and proposed survey items for relevance, clarity, cultural appropriateness, instructional alignment, accessibility, and safety. Aiken's V will summarize ordinal ratings (Aiken, 1985). For the content validity index, ratings of 4 or 5 on a five-point scale will count as relevant; item-level proportions and the specified scale-level aggregation will be reported (Lynn, 1986; Polit & Beck, 2006). Thresholds are revision guides, not proof of validity. All safety-critical objections and concerns about stereotypes or language will be resolved before learner use regardless of average score.

Where a coherent score is supported by the item content and response data, preliminary internal consistency will be reported with uncertainty; coefficient omega will be used only when its measurement-model assumptions are defensible, and alpha may be reported for comparison (Cronbach, 1951). The small pilot will not be used to claim a stable factor structure. Two trained raters will score a prespecified subset of recorded or live performances independently. The intraclass correlation model, unit of analysis, rater sample, and disagreement procedure will be fixed before scoring; a two-way random-effects, absolute-agreement model will be used only if its assumptions fit the rater design (Koo & Li, 2016).

➤ *Data Collection Procedure*

- Secure institutional permission, ethics approval, informed consent, and language appropriate participant information.
- Conduct needs analysis and co design activities, then document how each requirement changes or confirms the design.
- Complete expert validation, revise the prototype, and preserve a versioned change log.
- Pilot-test device tasks, instruments, timing, data capture, and rater procedures with participants outside the main feasibility sample.
- Finalise and prospectively register the feasibility-stage protocol, including the site, primary module, allocation route, outcomes, progression criteria, sample target, eligibility rules, and analysis plan before phase-five recruitment.
- Collect baseline information on language, prior experience, technology access, self-efficacy, engagement, and practical competency.
- Deliver the intervention and comparison conditions and track exposure, adaptations, contamination, technical problems, and adverse events.
- Collect posttest competency ratings, survey responses, usage records, observations, learner work, and interviews.
- Conduct the delayed competency assessment four weeks later and complete data close-out under the retention schedule.

➤ *Data Analysis*

Quantitative analysis will focus on feasibility. Indicators of recruitment, retention, delivery, acceptability, fidelity, safety events, burden and data completeness will be presented as proportions or means with 95% confidence intervals and evaluated against progression criteria. Reasons for non-participation, withdrawal, missed sessions, technical failures and incomplete assessments will be summarised. Progression decisions will take into account threshold results alongside any serious safety or cultural issues and qualitative findings.

Exploratory learning outcomes will be summarised by condition and time point with sample sizes, means, standard deviations and ranges. Class-level summaries will be reported to make the nesting visible. With fewer than eight classes,

analyses will remain descriptive without random-effects models or individual-level significance tests. With at least eight classes and at least four per condition, a baseline-adjusted exploratory model may be considered only after assessing class sizes, instructor confounding and model stability; cluster-adjusted uncertainty and the exact model will be reported. This minimum is a pragmatic gate and does not guarantee valid inference, so descriptive results will remain primary if a model is unstable. Standardised differences may inform future planning but will not establish effectiveness (Lakens, 2013). No mediation, moderation, confirmatory factor or superiority testing is planned. Competency summaries and any baseline adjustment will be conducted within programme only. Programme-specific estimates may be too small for modelling and will then remain descriptive.

Missing feasibility data will be reported by variable, time point, and condition. Exploratory outcome summaries will state the analysis sample and reasons for missingness; sensitivity analyses will be prespecified if missing outcome data materially affect interpretation. Protocol deviations, contamination, exposure differences, and adaptations will be described explicitly.

Interviews, observations, and learner work will be analysed using reflexive thematic analysis (Braun & Clarke, 2006), allowing both anticipated and unexpected themes. Bilingual material will be coded in the original language where feasible, and translation choices will be documented. Coding and interpretation will include attention to disconfirming accounts and researcher position. A joint display will connect qualitative explanations with feasibility indicators, fidelity, and exploratory outcome patterns without treating themes as proof of causal mechanisms.

➤ *Ethics and Data Governance*

The study will collect only necessary usage records, performance ratings and optional audiovisual evidence. Coded research data will be stored on an institution-controlled encrypted server or encrypted institutional drive; prototype devices must use encrypted storage and authenticated access before learner recordings are enabled. Unencrypted devices may deliver content but must not retain identifiable learner evidence. Transfer will use an encrypted authenticated connection or an encrypted physical medium. Consent records and the identifier key will be stored separately, accessible only to the principal investigator and authorised data manager. Assessors will receive coded evidence and exports will exclude direct identifiers. Data will be retained for five years after the final study publication, unless ethics approval requires a different documented period; the approved period will be stated in participant information. Identifiable raw recordings will be deleted after rating and agreement checks, no later than six months after data close-out, unless separate consent authorises longer retention. Deletion will include working copies and scheduled backup expiry.

Learners retain authorship of their own images, videos and explanations; consent grants the research team limited

permission to use them for the approved study and does not transfer ownership. Images containing other people will be avoided unless those people separately consent. Audiovisual consent will be separate from study participation. Learners who decline recording will remain eligible and will be assessed through live observation by trained raters using the same rubric; the assessment mode will be recorded. Withdrawal of identifiable evidence will be honoured until anonymisation or integration into non-identifiable results makes removal impossible, with that boundary explained in advance. Publicity, sharing identifiable recordings or model training requires separate explicit consent and approvals.

Cultural harm will be treated as a study risk. Learners and community contributors will review examples for stereotypes, tokenism, deficit framing, unsuitable imagery, and exclusion of minority languages. Participants may report inaccurate, offensive, or inaccessible content without academic penalty. A serious cultural or safety concern will

pause the affected module until reviewed and resolved. When local practice conflicts with mandatory occupational or safety requirements, the module will distinguish the context-specific practice from the required standard.

➤ *Study Status and Protocol Amendments*

This proposed protocol identifies Central University of Haryana as the intended site, three B.Voc programmes, Hindi–English provision, and an anticipated sample of approximately 60–80 second-semester learners. The supplied sampling frame must be verified and dated. Institutional permission, ethics approval, the prototype, competency specifications and eligible class inventory remain to be confirmed. No participants have been recruited and no study outcomes are reported. Registration and safety review will precede the relevant study activities.

➤ *Proposed Study Schedules*

Table 6 Proposed Study Schedules

Period	Planned Activity	Decision or Output
Months 1 to 2	Institutional engagement, learner and instructor needs assessment, co design, and ethics preparation	Approved requirements and research permissions
Months 3 to 5	Content architecture, prototype development, module authoring, and internal safety testing	Functional minimum prototype
Month 6	Expert review of content, culture, pedagogy, technology, safety, accessibility, and assessment	Validated revision priorities
Month 7	Usability testing with approximately 12 to 20 learners and iterative refinement	Usable prototype and finalized procedures
Months 8 to 10	Two-group feasibility evaluation with an anticipated sample of approximately 60–80 second-semester B.Voc learners across the three programmes, followed by four-week delayed assessment	Feasibility and preliminary outcome dataset
Months 11 to 12	Integrated analysis, progression decision, reporting, and protocol for a later definitive trial	Proceed, modify, or stop decision

➤ *Progression and Interpretation Rules*

The progression thresholds are pragmatic operational targets for an eight-week feasibility evaluation, not validated universal cut-offs. Recruitment at 70% tests whether the planned intake is attainable; 80% posttest and 70% delayed retention test follow-up burden; 80% delivery and fidelity test whether most planned exposure is achieved; 75% acceptability tests whether use is acceptable to a clear majority; and 85% completeness tests whether core information can support later planning. The steering group will interpret the estimates and their uncertainty rather than equating a threshold crossing with proof of success.

The steering group will include the principal investigator, a vocational instructor, a learner representative, a cultural or language reviewer and an independent methods adviser. An unresolved serious safety, cultural or privacy concern overrides all other indicators and prevents progression. Otherwise, all-green results permit progression with minor refinements; any amber result and no red result require a documented modification plan. Any non-safety red result requires modification and a targeted repeat feasibility check, rather than immediate progression to a definitive trial; if the cause cannot be remedied, progression stops.

Acceptability is green at 75% or higher, amber at 50–74%, and red below 50%, subject to the harm override. Decisions will be sought by consensus; unresolved disagreement defaults to the more cautious category. Minutes will record denominators, uncertainty, qualitative findings, dissent, corrective actions, responsible persons and conditions for reassessment. Exploratory learning differences will not override feasibility or safety decisions.

Expected contributions if the study is conducted:

- A traceable account of how culturally responsive principles were translated into requirements and reviewable features in a selected Indian vocational setting.
- A documented offline-first prototype architecture, contingent on development and review.
- Preliminary evidence on the suitability of performance assessment, learner report, observation, records, and interviews for a later study.
- Feasibility estimates and a documented progression decision for a possible definitive study.
- Design principles that could be tested, rather than presumed transferable, across other trades, languages, institutions, and regions.

➤ *Limitations and Risk Mitigation*

Table 7 Limitations and Risk Mitigation

Likely Limitation	Threat	Mitigation and Reporting
General framework tested with few modules	Findings may not transfer across trades	Describe each module and context precisely; test the architecture across additional competencies before broad claims
Intact class allocation	Selection bias and confounding	Match classes, collect baseline measures, use adjusted models, and avoid causal language beyond the design
Teacher delivered intervention	Teacher enthusiasm or expertise may drive effects	Standardize orientation, monitor fidelity, model instructor or class effects, and collect teacher interviews
Novelty and device attention	Short term engagement may not persist	Use delayed retention, document prior technology experience, and avoid equating usage with learning
Self-report outcomes	Social desirability and common method bias	Use performance, observation, log, and interview evidence in addition to surveys
Cultural localization	Examples can become stereotyped or outdated	Use plural examples, community review, feedback mechanisms, and versioned revision
Connectivity and power	Unequal access or interrupted learning	Keep core functions offline, provide charging plans, record technical downtime, and retain nondevice access to essential instruction

➤ *Reporting and Publication Plan*

Before phase-five recruitment, the stabilised protocol will specify the setting, primary module, feasibility outcomes, progression criteria, allocation route, sample justification, eligibility rules, and analysis plan, and will be registered prospectively. Amendments will be documented. The final report will use the CONSORT extension for pilot and feasibility trials if classes are randomised; otherwise, it will transparently report the matched-class design and its limitations. Intervention and comparison conditions will be described using TIDieR, with relevant SPIRIT 2025 items used to check protocol completeness (Chan et al., 2025; Eldridge et al., 2016; Hoffmann et al., 2014). The device version and module content will be archived in sufficient detail for replication, subject to privacy and cultural ownership restrictions.

IV. CONCLUSION

This protocol proposes development and feasibility evaluation of a culturally responsive device for approximately 60–80 second-semester B.Voc learners at Central University of Haryana across Biomedical Science, Industrial Waste Management, and Retail and Logistics Management, with Hindi and English provision. Programme-specific simulations and competency assessments require review before recruitment. The study will inform a proceed, modify or stop decision and will not establish effectiveness or generalisability beyond the selected sample.

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APPENDICES

➤ *Appendix A Proposed CRT Skill Learning Device Perception Scale*• *Purpose:*

This original item pool measures learners' perceptions of cultural and linguistic responsiveness in the device supported module. It is a proposed research instrument and must undergo expert review, cognitive interviewing, pilot testing, and construct validation before scores are interpreted. Response options are 1 strongly disagree, 2 disagree, 3 neither agree nor disagree, 4 agree, and 5 strongly agree.

Item	Dimension	Statement
1	Language access	I could understand the device's words, explanations, or narration.
2	Language access	The device helped me connect occupational terms with language I already use.
3	Language access	I could choose a form of explanation that worked for me.
4	Contextual relevance	The examples were connected to situations I recognize.
5	Contextual relevance	The module showed how the skill can be used in my community or work setting.
6	Contextual relevance	The examples respected differences within the community instead of treating everyone as the same.
7	Representation	People and work settings shown in the module felt realistic and respectful.
8	Representation	The module avoided jokes, images, or statements that made a group seem inferior.
9	Learner agency	The device asked me to make decisions instead of only watching information.
10	Learner agency	I could use my previous experience when solving the task.
11	Learner agency	I had a meaningful choice in how I explained or documented my work.
12	Collaboration	The activity helped me learn from classmates with different experiences.
13	Collaboration	I could share a local example or another way to approach the task.
14	Assessment fairness	The assessment criteria were clear before I performed the task.
15	Assessment fairness	The assessment focused on competence rather than accent, background, or familiarity with the device.
16	Feedback	The feedback referred to actions I could improve.
17	Feedback	The feedback helped me repeat the task more independently.
18	Overall relevance	Using the device made the skill feel more meaningful to me.

➤ *Appendix B Practical Skill Competency Rubric Template*

The rubric must be adapted and reviewed for the selected trade and task. Each criterion is scored from 1 (beginning) to 4 (independent). Safety-critical behaviours must have a separate pass requirement so a high total score cannot compensate for unsafe performance.

Criterion	1 Beginning	2 Developing	3 Competent	4 Independent
Planning and preparation	Cannot identify the goal, sequence, or required resources	Identifies part of the sequence with substantial prompting	Plans the sequence and resources with minor omissions	Independently plans a complete and efficient sequence and explains choices
Tool and material selection	Selects unsuitable items or requires full correction	Selects some suitable items but misses important specifications	Selects suitable items with minor prompting	Independently selects and checks suitable items and explains alternatives
Safety and care	Performs a critical unsafe action or ignores required protection	Follows some precautions but needs repeated reminders	Follows required precautions with one minor prompt	Consistently anticipates hazards, follows precautions, and protects people and materials
Procedure and technique	Cannot complete essential steps	Completes steps inconsistently with substantial prompting	Completes the procedure competently with minor errors	Completes the procedure accurately, fluently, and independently
Quality checking	Does not check the output or misreads criteria	Checks only after prompting and misses defects	Uses the stated criteria and identifies most defects	Systematically checks, explains evidence, and corrects defects
Explanation and transfer	Cannot explain actions or another application	Gives a partial explanation tied only to the practiced example	Explains key decisions and one relevant application	Explains decisions clearly and transfers the skill to a new local or occupational context

➤ *Appendix C Validation Form*

Experts rate each component from 1 not relevant or unacceptable to 5 highly relevant or fully acceptable and provide a required comment for ratings of 1 or 2. Safety critical concerns override average scores and must be resolved before piloting.

No	Criterion	Rating Statement
1	Competency alignment	Content and practice correspond to the intended occupational competency.
2	Procedural accuracy	Demonstrations, instructions, and feedback are technically accurate.
3	Safety	The device communicates mandatory precautions and does not normalize unsafe shortcuts.
4	Cultural relevance	Examples and scenarios are meaningful in the intended context.
5	Cultural respect	Language, imagery, roles, and narratives avoid stereotypes and deficit assumptions.
6	Linguistic clarity	Instructions are understandable while preserving accurate occupational terminology.
7	Instructional quality	The sequence supports demonstration, practice, feedback, and independent performance.
8	Assessment alignment	Assessment criteria capture observable competence and permit fair demonstration.
9	Accessibility	Learners can perceive, navigate, and respond to content through feasible alternatives.
10	Technical usability	The interface, offline operation, and evidence capture are dependable in the intended setting.
11	Data protection	The prototype collects only necessary data and communicates access and retention clearly.
12	Overall suitability	The component is suitable for pilot use after the stated revisions.

➤ *Appendix D Interview Guides*• *Learner Interview*

- ✓ Describe one moment when the device helped you understand or perform the skill.
- ✓ Describe one moment when the language, example, image, or instruction did not fit your experience.
- ✓ How did the device affect the way you practiced, asked for help, or worked with classmates?
- ✓ Did the module allow you to use knowledge from home, community, or previous work? Give an example.
- ✓ Was any example inaccurate, disrespectful, stereotyped, or difficult to relate to?
- ✓ How useful and fair were the assessment criteria and feedback?
- ✓ What did you still need from the instructor that the device could not provide?
- ✓ What should be changed before another learner uses this module?

• *Instructor Interview*

- ✓ Which device features changed your teaching or assessment practice, if any?
- ✓ Which local examples or language supports were useful, and which required correction?
- ✓ How did learners with different prior skills or language profiles use the device?
- ✓ Which parts supported independent practice and which created dependency or distraction?
- ✓ What adaptations did you make, and why?
- ✓ Did the device affect safety, time on task, feedback quality, or workshop management?
- ✓ What evidence would convince you to continue or discontinue its use?
- ✓ What should be revised in the content, interface, training, or implementation plan?

➤ *Appendix E Feasibility Reporting Checklist*

- Participant flow by condition, including consent, allocation, follow up, exclusions, and analysis sample.
- Site, class, instructor, language, prior experience, and baseline outcome characteristics.
- Device version, selected module, exposure, technical downtime, adaptations, and fidelity by condition.
- Recruitment, retention, delivery, acceptability, fidelity, data completeness, burden, and safety estimates with confidence intervals.
- Each progression criterion, supporting qualitative evidence, and the resulting proceed, modify, or stop decision.
- Validity evidence and expert concerns for device components, rubrics, and scales, including how each concern was resolved.
- Reliability estimates with confidence intervals and the exact model used for interrater reliability.
- Exploratory learning outcomes with model specification, assumptions, effect sizes, confidence intervals, and sensitivity analyses.
- All prespecified exploratory and delayed outcomes, including null or unfavorable estimates without confirmatory efficacy claims.
- Missing data by outcome and condition, reasons for missingness, prespecified sensitivity analyses where needed, and the observed analysis sample; no automatic imputation.

- Qualitative themes with disconfirming cases and clear links to implementation or outcome patterns.
- Harms, privacy incidents, culturally inappropriate content reports, conflicts of interest, funding, data availability, and protocol deviations.

➤ *Appendix F Exploratory Engagement and Skill Self-Efficacy Items*

These are proposed original items informed by the cited construct frameworks, not reproduced validated scales. Expert review, language adaptation, cognitive interviews and usability testing will precede use. Bracketed task wording will be replaced with the selected competency before registration.

- *Skill Self-Efficacy*

✓ *Prompt at Baseline and Posttest:*

How confident are you that you can do each of the following for [selected task]? Rate 0 (cannot do at all) to 10 (highly certain I can do). Items refer to the same competency and assessment conditions at each time point.

Item	Proposed Skill Self-Efficacy Item
1	Plan the steps and select suitable tools and materials.
2	Recognise the main hazards and follow required safety precautions.
3	Carry out the essential steps without step-by-step help.
4	Check the finished work against the stated competency criteria.
5	Identify an error and make a safe correction.
6	Explain the procedure and apply it to a comparable unfamiliar situation.

✓ *Scoring:*

Report each item descriptively. An exploratory mean may be calculated when at least five of six items are answered and content review supports a coherent capability construct; no validated cut-off or confirmatory interpretation will be used.

- *Engagement*

✓ *Prompt:*

Think about practical learning in this module during the past seven days. Rate 1 (never), 2 (rarely), 3 (sometimes), 4 (often), or 5 (almost always). The same wording will be used in both conditions at baseline and posttest.

Item	Dimension	Proposed Engagement Item
1	Behavioural	I took part in the practical activities.
2	Behavioural	I continued practising when the task was difficult.
3	Emotional	I felt interested in the practical work.
4	Emotional	I looked forward to learning the skill.
5	Cognitive	I tried to understand why each step was needed.
6	Cognitive	I checked my understanding and changed my approach when necessary.

✓ *Scoring:*

Items 1–2 describe behavioral engagement, 3–4 emotional engagement, and 5–6 cognitive engagement. Item summaries are primary; exploratory dimension means require both items answered. No validated overall engagement score or language equivalence is claimed.