

Introduction to Qualitative Research in STEM Education

Graduate Course for PhD Program in Science Education

2026-2027 Semester I (Aug-Dec 2026)

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Course Topic	Research Methodology: Qualitative Methods in Science & Mathematics Education Research
Core/FE/Elective	Core
Course Code	SCE111.2
Course Credits	2
Course Duration	14 weeks (2 hours per week)
Day and Time	Friday, 10:00 – 12:00

Course Description

This course introduces qualitative research as a methodology and design in STEM Education. It outlines key paradigms, and theoretical frameworks to position research questions. The course covers different methodologies, sampling techniques, and core data collection methods. Students will learn to develop and administer instruments, apply coding, build codebooks, interpret data, construct themes, and report findings. The course would help cultivate a reflexive research practice, emphasizing trustworthiness and ethical rigor followed in qualitative research. The course will incorporate examples from research studies in STEM/DBER. There will be illustrations on using software, ethically guided uses of AI with data-safety and standards. The coursework includes assignments, proto-research, and presentation.

Course Outcomes

- Understand: Core concepts of qualitative methodology, paradigms, theoretical frameworks
- Practice: Administer interviews/observations and manage artifacts using instruments
- Analyze: Code data, build a codebook, and generate themes
- Interpret: Connect themes to framework, research questions, articulate implications for teaching and learning
- Create: Write a qualitative study report based on proto-research and present it
- Apply tools: Use of software and AI responsibly with data-safety protocols

Course Outline

- Week 1: The Relevance of Qualitative Research in STEM Education
- Week 2: Theories and Frameworks, Ethics and IRB
- Week 3: Designing Qualitative Research
 - Assignment 1
- Week 4: Types of Qualitative Research Methodologies – I
- Week 5: Types of Qualitative Research Methodologies – II
- Week 6: Review, Documentation
- Week 7: Data Collection Methods and Data Types
 - Assignment 2
- Week 8: Coding Methods and Constructing Themes
- Week 9: Interpretation and Analysis of Data
- Week 10: Visualization of Findings
 - Assignment 3
- Week 11: Reliability, Validity, Trustworthiness
- Week 12: Data Management, Software Tools
- Week 13: Using AI Tools
- Week 14: Student Presentations of Proto-Research
 - Term paper

Detailed Course Outline

Week 1: The Relevance of Qualitative Research in STEM Education

Understanding research as a process, identifying a research problem, distinguishing between quantitative and qualitative research. Familiarization of different paradigms for positioning research for conducting qualitative study. Exploring reflexive practices, focusing on self, interpersonal groups.

Week 2: Theories and Frameworks, Ethics and IRB

To know how to apply theoretical and conceptual frameworks and their constructs for framing research study. To review literature, identify gaps. To know about ethics approval and writing IRB protocol. To introduce IRB/ethics basics for classroom research: consent, anonymity, data security, for writing IRB protocol.

Week 3: Designing Qualitative Research

To understand how to translate a broad topic into a clear, qualitative research question aligned with the literature gap and conceptual framework. To justify research design, sampling methods. To read and discuss literature in STEM education research.

- **Assignment 1:** Review the recent literature in prominent journals. Identify at least 3 qualitative studies and state the objectives, identify gaps, research questions.

Week 4: Types of Qualitative Research Methodologies – I

To understand various methodologies such as content analysis, thematic analysis, narrative analysis, discourse analysis, that can be applied for doing qualitative research.

Week 5: Types of Qualitative Research Methodologies – II

To understand ethnography, phenomenography, case study approaches and their purpose.

Week 6: Review, Documentation

Review key concepts. Use of tools for literature review, creating references, etc.

Week 7: Data Collection Methods and Data Types

Know different types of data collection methods such as interviews, questionnaires, focus group discussion, observation protocol, field notes. Identify how to select an instrument and administer it for data collection. To decide primary source and secondary source of data for triangulation. To know about various data types such as verbal, audio-visual, textual, etc.

- **Assignment 2:** To design an instrument for proto research. You may choose to design an observation based protocol for classroom study, or a questionnaire for interviews, focus group discussion.

Week 8: Coding Methods and Constructing Themes

To understand inductive and deductive methods of coding by revisiting the frameworks and constructs. To understand basics of coding, categorizing, constructing themes and patterns.

Week 9: Interpretation and Analysis of Data

To organize/transcribe raw data, decide when to use manual methods or software tools to analyze the data. To understand procedures for coding, reviewing, refining, categorizing, creating themes, reporting, etc. To write analytical memos, codebooks, visually represent the themes, and create reports.

Week 10: Visualization of Findings

To know about displaying, ordering, tabulating, data. To create matrices, networks, for mapping themes

- **Assignment 3:** Coding and creating themes, linking codes to themes and further to frameworks and research questions.

Week 11: Reliability, Validity, Trustworthiness

To ensure accuracy, credibility, authenticity through inter-coder agreement, triangulation of data. To know about reliability as replicability, inter-rater reliability, trustworthiness in qualitative data analysis.

Week 12: Data Management, Tools

To introduce various software for documentation, coding, creating themes, visualizing findings, etc.

Week 13: Using AI Tools

To be aware about ethical use of AI, about data safety and data standards, integrating AI responsibility while protecting privacy. Know about institutional standards, AI-use standards for journals, conferences.

Week 14: Term Paper Submission and Student Presentations

Students will submit term paper and present it as a proto-research. Details will be provided during the course.

Assessment/Grading Scheme:

- In-class participation: 10%
- Assignment 1: 10 %
- Assignment 2: 10%
- Assignment 3: 10%
- Term Paper: 40%
- Presentation: 20%

References (if any):

- Cohen, L., Manion, L., & Morrison, K. (2017). *Research Methods in Education* (8th ed.). Routledge. <https://doi.org/10.4324/9781315456539>
- Cresswell, J. (2012). *Educational Research – Planning, Conducting, and Evaluating Quantitative and Qualitative Research* (Fourth). Pearson Edition Inc.
- Lincoln, Y. S., & Guba, E. G. (1985). *Naturalistic Inquiry*. Sage. [https://doi.org/10.1016/0147-1767\(85\)90062-8](https://doi.org/10.1016/0147-1767(85)90062-8)
- Miles, M., Huberman, A. M., & Saldana, J. (2014). *Qualitative Data Analysis: A Methods Sourcebook* (3rd ed.). SAGE Publications.
- Saldana, J. (2013). *The Coding Manual for Qualitative Researchers* (Second). SAGE Publications.