TOOLS PREPARATION

in Educational Research

A practical study guide to selecting, developing, validating, piloting, and using research instruments

Includes: step-by-step procedures • instrument selection • questionnaire examples • interview and observation tools • validity and reliability • pilot testing • ethics • checklists

Prepared as an illustrative learning resource

Use the examples as templates. Adapt every instrument to your research objectives, population, language, context, and institutional requirements.

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Learning outcomes

After studying this guide, a learner should be able to explain what a research tool is, choose an appropriate instrument, draft clear items, seek expert feedback, conduct a pilot study, assess basic evidence of validity and reliability, and administer a tool ethically.

1. Meaning and Purpose of Research Tools

Research tool (also called a research instrument) is a planned means of collecting information relevant to a research question. It converts concepts—such as engagement, achievement, motivation, or teaching practice—into observable answers, scores, records, or descriptions.

In educational research, tools help researchers collect information systematically rather than relying only on memory, impression, or informal opinion.

Examples

- **Questionnaire:** collects written responses from many participants.
- **Interview schedule:** guides a structured or semi-structured conversation.
- **Observation checklist:** records whether specified behaviours or events occur.
- **Achievement test:** measures knowledge or skill against a planned content blueprint.
- **Rating scale:** records the degree or frequency of a characteristic.
- **Document-analysis form:** extracts consistent information from records, lesson plans, or policy documents.

Important distinction: a research method is the overall approach (for example, a survey or interview); a research tool is the specific instrument used to carry it out (for example, a questionnaire or interview guide).

2. Types of Tools Used in Educational Research

Tool	Best suited for	Typical output	Main caution
Questionnaire	Opinions, attitudes, self-reported practices	Closed or open-ended answers	Reading level, response bias, ambiguous wording
Interview schedule	Experiences, explanations, meanings	Audio/transcript or notes	Interviewer influence and confidentiality
Observation checklist	Visible classroom behaviours or events	Counts, ticks, field notes	Observer bias and unclear definitions
Achievement test	Knowledge or skills	Scores by item or domain	Content coverage and scoring consistency
Rating scale	Degree, frequency, or quality	Ordinal or numeric ratings	Anchors must be clear
Document review form	Existing school or policy records	Extracted fields and categories	Incomplete or inconsistent records

How to select a tool

- Start with the research question and objectives, not with a favourite instrument.
- Consider the type of evidence needed: numerical, descriptive, behavioural, or documentary.
- Consider participant age, literacy, language, accessibility, time, cost, and setting.
- Review whether a suitable published instrument already exists and whether permission is required.
- Use more than one tool only when the research design needs it and the extra burden is justified.

3. Steps in Preparing a Research Tool

Step 1 — Define the research problem

Write the central question and the specific objectives. Each tool should contribute evidence to at least one objective.

Step 2 — Identify constructs and variables

Define what will be measured. For example, 'study engagement' might include behavioural, emotional, and cognitive engagement. Use a clear operational definition.

Step 3 — Review literature and existing tools

Look for established definitions, relevant studies, and instruments. Record sources, target population, scoring, and evidence of quality. Do not copy protected material without permission.

Step 4 — Choose the tool type

Select a questionnaire, interview guide, observation form, test, or combination that fits the evidence required.

Step 5 — Prepare a blueprint

Map each objective or construct to indicators, item numbers, response formats, and planned analysis. For tests, include content areas and cognitive levels.

Step 6 — Draft items

Use one idea per item, familiar words, neutral phrasing, and response options that cover realistic answers.

Step 7 — Check language and accessibility

Review grammar, reading level, translation, cultural appropriateness, disability access, and whether any item may embarrass or stigmatize participants.

Step 8 — Seek expert review

Ask relevant subject, research-methods, measurement, and language reviewers to assess relevance, clarity, coverage, and possible bias.

Step 9 — Pilot test

Try the draft with people similar to the intended participants, but normally not part of the main sample. Check understanding, timing, missing responses, and practical problems.

Step 10 — Revise and document

Improve or remove weak items, record decisions, finalize instructions and scoring, and retain a version history.

Step 11 — Administer consistently

Use the same instructions, conditions, timing, and support as far as the design allows. Train any assistants.

Step 12 — Prepare data and evaluate

Create a codebook, check missing or invalid responses, score according to the plan, and assess appropriate evidence of validity and reliability.

4. Matching Objectives, Variables, and Items

A tool is stronger when every item has a reason to exist. The following alignment table is an example for a hypothetical study of mobile learning and study engagement.

Objective	Construct / indicator	Possible item or evidence	Planned analysis
Describe mobile-learning use	Frequency and duration	How many days per week do you use a learning app for schoolwork?	Frequency and percentage
Describe behavioural engagement	Task completion	I complete school tasks assigned through the learning platform.	Item distribution; scale summary if justified

Objective	Construct / indicator	Possible item or evidence	Planned analysis
Explore perceived benefits	Perceived usefulness	What, if anything, helps you learn when using a mobile device?	Thematic coding
Observe classroom practice	On-task behaviour	At each interval, record whether the learner is on the assigned learning task.	Counts or proportions

Do not assume that one question can measure a complex construct adequately. Define the construct first, use several suitable indicators where appropriate, and explain how the evidence will be combined.

5. Sample Questionnaire

Illustrative topic: Mobile Learning Use and Study Engagement among Grade 9 Students in a Selected Secondary School in Bangladesh.

Participant note: This sample is for learning and must be reviewed and adapted before real data collection. For minors, obtain required school/institutional permission and parent/guardian consent and student assent as applicable.

Section A — Background information

- A1. Grade: ■ 8 ■ 9 ■ 10 ■ Other: ____
- A2. Do you have regular access to a mobile device for learning? ■ Yes ■ No ■ Sometimes
- A3. In a typical week, on how many days do you use a digital device for school learning? ■ 0 ■ 1–2 ■ 3–4 ■ 5–7

Section B — Example rating items

Instruction: Choose one response for each statement. These are example items, not a validated scale.

Statement	Strongly disagree	Disagree	Not sure	Agree	Strongly agree
B1. I use digital resources to understand school lessons.	1	2	3	4	5
B2. I stay focused when completing a learning activity on a mobile device.	1	2	3	4	5
B3. I complete learning tasks assigned through digital resources.	1	2	3	4	5
B4. Technical problems make it difficult for me to finish digital learning tasks.	1	2	3	4	5

B4 is negatively phrased relative to a positive engagement score. If items are combined into a scale, reverse-coding may be needed according to the scoring plan. Never combine items automatically without evidence that doing so is meaningful.

Section C — Open-ended questions

- C1. What is the most useful thing about using digital resources for learning?
- C2. What difficulties do you face when using a mobile device for schoolwork?
- C3. What change would make digital learning more helpful for you?

Example codebook

Variable	Meaning	Coding example
device_access	Regular learning-device access	1 = Yes; 0 = No; 2 = Sometimes
days_use	Days of learning-device use per week	0, 1–2, 3–4, 5–7 as categories

Variable	Meaning	Coding example
engage_focus	Self-reported focus item	1 = Strongly disagree to 5 = Strongly agree
tech_barrier	Reported technical barrier item	1–5; consider reverse-coding only for a justified composite

6. Sample Interview Schedule

Purpose: explore students' experiences with mobile learning in their own words. Use open questions and neutral follow-up prompts.

Main question	Possible neutral probes
Tell me about a recent time you used a mobile device for school learning.	What were you trying to learn? What happened next?
What helps you concentrate during digital learning?	Can you give an example?
What makes digital learning difficult?	Is the difficulty related to access, connectivity, content, or something else?
How do teachers support learning with digital resources?	What kind of support was useful?
If you could change one thing, what would you change?	Why would that help?

Interviewer reminders: explain the purpose; ask permission before recording; avoid leading or judgmental wording; allow participants to decline any question; protect identities; and separate direct quotations from the researcher's interpretation.

7. Sample Observation Checklist

Use a clearly defined observation period and consistent recording rules. The example below is for an approved classroom observation; it is not a judgement of an individual learner.

Indicator	Yes	No	Not observable	Notes
Learning task and instructions are visible or clearly stated.	■	■	■	_____
Teacher demonstrates how to use the learning resource.	■	■	■	_____
Students have an opportunity to ask for help.	■	■	■	_____
Observed device use is related to the assigned task.	■	■	■	_____
Connectivity or equipment problems interrupt the activity.	■	■	■	_____

Operational definition example: 'on-task device use' means the observed screen or activity is related to the assigned learning task at the specified observation moment. Define the sampling interval in advance and train observers to apply the rule consistently.

8. Preparing an Achievement Test

When the instrument is a test, begin with a table of specifications (test blueprint) to ensure the questions represent the intended curriculum and learning outcomes.

Content area	Remember / understand	Apply / analyse	Total items
Topic A	3	2	5
Topic B	2	3	5
Topic C	2	3	5
Total	7	8	15

This is only a sample blueprint. Adjust item counts and cognitive levels to the syllabus, objectives, test length, and intended interpretation of scores.

Test-writing checklist

- Each item measures a stated learning outcome.
- The wording is age-appropriate and unambiguous.
- Multiple-choice options are plausible, and only one answer is best unless stated otherwise.
- Marks and time are proportionate to item difficulty.
- A marking scheme or answer key is prepared before scoring.
- Items are checked for cultural, linguistic, gender, disability, or socioeconomic bias.
- Secure storage and fair administration procedures are in place.

9. Validity and Reliability

Validity: evidence supporting the interpretation and use of results

Validity is not simply a permanent label attached to a questionnaire. Researchers build an argument using different kinds of evidence that the scores or findings are appropriate for the intended purpose and context.

- **Content-related evidence:** do the items adequately cover the relevant domain and objectives?
- **Response-process evidence:** do participants understand and answer items as intended?
- **Internal structure:** where relevant, do relationships among items support the proposed structure?
- **Relations to other variables:** are results related to other measures in ways theory predicts?
- **Consequences and fairness:** could the tool systematically disadvantage groups or encourage harmful interpretations?

Reliability: consistency of measurement

Reliability concerns the consistency or precision of results under specified conditions. The suitable check depends on the tool and data.

Approach	Useful when	Caution
Internal consistency (e.g., alpha or omega)	Several items are intended to reflect a common construct	A high coefficient does not prove validity or unidimensionality
Test–retest	The construct should be reasonably stable over time	Real change can reduce agreement
Inter-rater agreement	Observers or scorers classify the same material	Training and clear rules are essential
Scoring consistency	Tests or open responses require judgement	Use a rubric, sample scoring, and moderation

Do not report a reliability coefficient unless it was calculated from appropriate data and the method is explained. There is no single threshold that makes every instrument acceptable in every context.

10. Expert Review and Pilot Testing

Expert-review form

Criterion	Reviewer rating (1–4)	Comments / suggested revision
Relevance to the objective	1 2 3 4	_____
Clarity of wording	1 2 3 4	_____
Coverage of the construct	1 2 3 4	_____
Language and age appropriateness	1 2 3 4	_____
Potential bias or discomfort	1 2 3 4	_____

Suggested rating guide: 1 = major concern; 2 = needs substantial revision; 3 = acceptable with minor revision; 4 = clear and suitable. Add a 'not applicable' option when needed. These ratings organize feedback; they do not by themselves establish validity.

Pilot-test procedure

- Select a small group similar to the target population, consistent with the study's practical needs.
- Explain that the pilot tests the instrument and process, not the participants.
- Record completion time, skipped items, requests for clarification, and technical difficulties.
- Ask which questions were confusing, sensitive, repetitive, or hard to answer.
- For interviews, check question flow and recording quality; for observations, check whether definitions can be applied consistently.
- Revise the instrument, then document what changed and why.

A pilot sample is not automatically large enough to estimate reliability or conduct factor analysis. Sample size for psychometric analysis should be justified separately.

11. Translation, Administration, and Data Preparation

Translation and adaptation

- Translate for meaning, not word-for-word similarity alone.
- Have a qualified bilingual reviewer check terminology and cultural fit.
- Where appropriate, use independent review or back-translation as one quality check—not as a guarantee of equivalence.
- Pilot the translated version with people from the target group and document changes.

Standardized administration

- Prepare consistent instructions, time limits, materials, and support procedures.
- Train data collectors and explain how to handle questions without influencing answers.
- Provide accessible formats and reasonable accommodations where possible.
- Record deviations from the planned procedure and explain their possible effects.

Data preparation

- Create a codebook listing each variable, its meaning, allowed values, and missing-data code.
- Check for duplicate records, impossible values, skipped items, and inconsistent responses.
- Keep identifiers separate from research data whenever feasible.

- Store data securely and restrict access to authorized people.
- Predefine scoring, reverse-coding, exclusions, and missing-data handling rather than deciding after seeing results.

12. Research Ethics and Participant Protection

- Obtain ethics approval or institutional permission when required before recruitment or data collection.
- Explain the purpose, procedures, expected time, foreseeable risks, benefits, confidentiality limits, and voluntary nature of participation.
- For children or other participants requiring additional safeguards, follow applicable consent/assent and safeguarding procedures.
- Avoid collecting personal or sensitive information unless necessary and justified.
- Do not promise absolute confidentiality if legal or safeguarding exceptions may apply.
- Make clear that participation or refusal will not affect grades, services, or teacher relationships.
- Use neutral wording and provide a safe way to skip questions or withdraw, subject to the consent terms and study design.

For a Bangladesh-based school study, check your institution's ethics procedures, relevant education-sector permissions, and applicable local requirements. This guide is educational and not a substitute for formal ethical review.

13. Common Mistakes in Tool Preparation

Mistake	Why it is a problem	Better practice
Writing questions before defining objectives	Items may not answer the research question	Create an objective–indicator–item map first
Double-barrelled item	One answer may refer to two different ideas	Split it into separate items
Leading or loaded wording	Can push participants toward an answer	Use neutral language
Vague time frame	Respondents may interpret it differently	Specify a period, such as 'in the past 7 days'
Overlapping response options	Responses become hard to classify	Make categories mutually exclusive where appropriate
No pilot test	Confusion and practical problems remain hidden	Pilot and revise before the main study
Claiming validity from expert approval alone	One source of feedback is insufficient	Build a broader evidence argument
Changing scoring after results are seen	May introduce bias and weaken transparency	Plan scoring and document justified changes

14. Worked Example: From Objective to Tool

Research title: Teachers' Use of Formative Assessment in Secondary Classrooms.

Component	Example
Research objective	Describe the formative assessment strategies teachers report using.
Construct	Reported use of formative assessment
Indicators	Questioning, feedback, peer assessment, exit tickets
Tool	Teacher questionnaire plus a classroom observation checklist

Component	Example
Example questionnaire item	During the past two weeks, how often did you give students feedback they could use to improve their work?
Response options	Never / Rarely / Sometimes / Often / Very often
Observation evidence	Observer records whether feedback includes a specific next step, using a pre-defined rule.
Quality checks	Expert review, teacher cognitive feedback, pilot test, observer training
Analysis	Summarize response distributions; compare with observation descriptively if the design and sample support it.

The questionnaire captures teachers' reports; the observation captures visible classroom practice. Neither automatically proves the other is accurate. Differences may be meaningful and should be interpreted carefully.

15. Ready-to-Use Preparation Checklist

- ■ Research questions and objectives are explicit.
- ■ Constructs and variables are operationally defined.
- ■ Each item is mapped to an objective or indicator.
- ■ The tool type fits the evidence needed.
- ■ Instructions and response options are clear.
- ■ The language is appropriate for the participants.
- ■ Existing tools and permissions have been checked.
- ■ Expert feedback has been considered and documented.
- ■ Pilot testing has been completed and revisions recorded.
- ■ Scoring and coding rules are written down.
- ■ Validity and reliability plans are appropriate to the tool.
- ■ Ethical approval, consent, and safeguarding arrangements are addressed.
- ■ Data storage, access, and retention plans are ready.
- ■ The final version has a date/version number.

16. Questions for Examination or Viva

What is a research tool?

Model answer: A structured instrument used to collect evidence relevant to a research question.

What is the difference between a method and a tool?

Model answer: A method is the overall data-collection approach; a tool is the instrument used within it.

What are the main steps in preparing a tool?

Model answer: Define objectives, identify constructs, review literature, select a tool, draft items, review, pilot, revise, administer, and evaluate.

Why is a pilot study needed?

Model answer: To find confusing items, timing problems, missing response options, and practical or procedural difficulties before the main study.

What is validity?

Model answer: Evidence that supports the intended interpretation and use of the information or scores produced by a tool.

What is reliability?

Model answer: The consistency or precision of results under specified conditions.

Does expert review alone prove validity?

Model answer: No. It can contribute useful content and clarity evidence, but other evidence may also be needed.

Why should a questionnaire be linked to objectives?

Model answer: To ensure the collected information can answer the research questions and avoid irrelevant items.

Why are ethics important in tool preparation?

Model answer: Items and procedures can affect privacy, comfort, autonomy, and the safety of participants.

What is a codebook?

Model answer: A guide that defines variables, codes, allowed values, and missing-data conventions.

17. Suggested Reading

Use current editions and follow the referencing style required by your institution. Verify publication details and access requirements before citing.

- Creswell, J. W., & Creswell, J. D. — *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches.*
- Cohen, L., Manion, L., & Morrison, K. — *Research Methods in Education.*
- DeVellis, R. F., & Thorpe, C. T. — *Scale Development: Theory and Applications.*
- AERA, APA, & NCME — *Standards for Educational and Psychological Testing.*
- Boateng, G. O., et al. (2018). Best practices for developing and validating scales for health, social, and behavioral research: A primer. *Frontiers in Public Health, 6*, 149. https://doi.org/10.3389/fpubh.2018.00149

Final reminder: a well-prepared tool is aligned with the research purpose, understandable to participants, ethically administered, tested in context, and transparently documented. No template should be described as validated until appropriate evidence has been gathered.