

EXPERIENCE EXCHANGE

Critical appraisal and selection of data collection instruments: A step-by-step guide

Kathleen N. Dunemn *, Carol J. Roehrs, Vicki L. Wilson

School of Nursing, University of Northern Colorado, Greeley, CO, United States

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ABSTRACT

It is essential that nurse researchers use the most precise and valid data collection instruments available to obtain trustworthy data when conducting research in education and practice. Today, there is a vast selection of existing quantitative data collection instruments from which to choose. Existing instruments can be located through reports of their use in the literature and at conferences, through internet searches and by word of mouth. Once the nurse researcher locates a potential data collection instrument for a given study, the instrument must be systematically appraised for use in that study. This article introduces a comprehensive Step-by-Step Guide that will enable users to quickly and thoughtfully appraise quantitative measurement instruments. The results from the use of this critical appraisal guide will assist researchers to objectively discuss, compare and make informed decisions before adopting a specific data collection instrument for use in a research study. The underlying principles of the Step-by-Step Guide for the Critical Appraisal and Selection of Data Collection Instruments are based on the tenets of measurement theory, literature, and experience of the authors in education and practice research.

Key Words: Data collection, Data collection instrument, Selection, Critical appraisal guide

1. INTRODUCTION

In the conduct of quantitative research in the areas of education and practice, nurse researchers examine a wide variety of phenomena, requiring an extensive array of quantitative data collection instruments. Quantitative measurement methods are those that assess data or information that can be measured with numbers such as height and weight. The common quantitative measurement approaches used in nursing education and practice research include physiological measures, observations, interviews, questionnaires, and scales.^[1-3] Over the last three decades, due to the lack of adequate reliable data collection instruments, healthcare and education researchers have made it a priority to develop and publish quality instruments to measure phenomena of interest. As a result, the

number of data collection instruments available has increased exponentially.^[2,3] Choosing the best and most appropriate data collection instrument to capture the phenomena of interest is a key and essential step in the research proposal development process.^[4,5]

Each data collection tool selected should undergo a comprehensive critical appraisal to assess not only the characteristics of reliability and validity, but to also assess the congruence of the measurement method with the research purpose, question(s), hypotheses, design, study population, study setting, conceptual and operational definitions of the planned study variables and the over-all measurement plans. Careful assessment of the subject matter alignment, measurement capabilities, and psychometrics of a data collection instrument

*Correspondence: Kathleen N. Dunemn; Email: Kathleen.dunemn@unco.edu; Address: School of Nursing, University of Northern Colorado, Greeley, CO, United States.

are critical tasks for researchers during the research proposal development stages.^[3,4]

Many journal articles and book chapters that focus on the critical appraisal of research reports exist, however there is a paucity of information available to guide researchers on how to critically appraise and specifically select data collection instruments. Thus, an organized step-by-step approach to guide the critical appraisal and selection of data collection instruments could not be located. Without a step-by-step comprehensive guide, students and new researchers are left to use incomplete appraisal guides when searching out, evaluating and selecting quantitative measurement instruments. The following is a description of the Step-By-Step Guide for the Critical Appraisal and Selection of Data Collection Instruments. The Guide was developed to assist nursing education and practice researchers as they journey through the steps of locating and selecting the most appropriate data collection instrument for a proposed study.

2. STEP-BY STEP GUIDE

The Step-by-Step Guide for the Critical Appraisal and Selection of Data Collection Instruments was developed by the authors based on the tenets of the scientific method, measurement theory, available literature, and the authors' experiences in nursing education and practice research. The Guide consists of four interconnected steps. These steps are: Step I. Conceptualize the Proposed Quantitative Research Project; Step II. Find an Existing Measurement Instrument for the Proposed Study; Step III. Critically Assess the Proposed Measurement Instrument; and Step IV. Select or Non-Select the Instrument for the Proposed Study. Each of the four steps are described below. The step elements and key questions to guide the researcher's over-all critical appraisal of a data collection instrument are included in a table describing each step. Although the steps for the Step-by-Step Guide are presented sequentially, the process of identifying and critically assessing an appropriate data collection instrument for a given study is seen as flexible, with iterative work likely among and within the steps. The step elements and questions can be considered comprehensive. However only those key elements and questions based on the best evidence available and the experiences of the authors were selected to be included in the Step-By-Step Guide for the Critical Appraisal and Selection of Data Collection Instruments.

Step I: Conceptualize the proposed quantitative research project

Without knowledge of the foundational elements of a proposed study, researchers would have great difficulty locating and selecting an appropriate existing instrument to evaluate for potential use.^[3,4] Step I begins with the researcher de-

scribing and discussing each of the basic elements of the proposed quantitative research project. The basic foundational elements include the study problem, review of the relevant literature, proposed design and methods; research objectives, questions and/or hypotheses; and the proposed study variables and their measurement.^[4] Questions and statement prompts have been developed to assist the researcher describe and discuss each of the key foundational elements as they relate to a proposed quantitative study (see Table 1).

Before moving on to Step II, it is suggested that the researcher summarize their responses to Step I elements and questions by developing an initial draft abstract for the proposed study. This abstract should not only include narratives from each of the foundational elements, listed in Step I but also include a measurement plan. This measurement plan should include not only what variables the researcher plans to measure but what the proposed measurement approaches are (e.g., physiological, questionnaire, interview and/or observation guide, scale, etc).^[3]

Step II: Find an existing instrument for the proposed study

Once the key elements of the proposed study have been conceptualized and one or more proposed measurement approaches determined (e.g., physiological, questionnaire etc) the next step is for the researcher to seek out and locate potential measurement instruments to critically evaluate for use in their study. Therefore the purpose of Step II is to locate an existing instrument that may align with the key elements of the proposed study identified and summarized in Step I.

To locate existing measurement instruments one can begin by: 1) searching computerized databases such as Medline or CINAHL; 2) searching journals that are devoted specifically to measurement, e.g., Journal of Nursing Measurement; 3) identifying publications in which relevant instruments are used and then using citation indices to locate other publications that used them to access the computer database, the Health and Psychological Instruments Online (HAPI) (this database can be searched for instruments that measure a particular concept or for information on a particular instrument); 4) accessing the Rand Health website (http://www.rand.org/health/surveys_tools.html) - this website lists many surveys (available without charge) that would be of interest to nurse researchers; 5) reviewing one or more of the many reference books that contain published measurement instruments, for example *Measuring Health, A Guide to Rating Scales and Questionnaires*^[10] and *Instruments for Clinical Health-Care Research 3rd Edition*;^[11] 6) reviewing Dissertation Abstracts online; and 7) networking and communicating by word-of-mouth with other researchers.^[1,3]

Table 1. Step I: Conceptualize the proposed quantitative research project

Elements & Questions
<p>Problem</p> <ul style="list-style-type: none"> Name and briefly describe the overall phenomenon of interest for the proposed study. (e.g., Depression, Healthcare and the Elderly, etc) Summarize, what is the problem of interest related to your phenomenon of interest.^[6] What aspect of the identified problem do you plan to address?
<p>Literature Review-Work Done on the Problem</p> <ul style="list-style-type: none"> What are the words you used to search relevant databases? What databases did you search (e.g., PubMed, CINAHL, etc)? What are the shortcomings in the work done to date? Develop the short summary of what is known about the research problem and what are the knowledge gaps that exist.
<p>Proposed Design & Methods</p> <ul style="list-style-type: none"> What is the proposed study design (e.g., descriptive, correlational, quasi-experimental, experimental, mixed methods, etc.)? Describe the proposed study setting and sample. If your proposed study has an intervention, describe the comparison and control group.
<p>Research Objectives, Questions or Hypotheses</p> <ul style="list-style-type: none"> Does the proposed study include objectives, questions and/or hypotheses? If so: <ul style="list-style-type: none"> What are the objectives? What are the research questions? What are the hypotheses?
<p>Proposed Study Variables & Their Measurement</p> <ul style="list-style-type: none"> List each of the study variables you plan to measure. List a definition (a word picture or mental image) for each proposed study concept. Provide an operational definition (i.e., define each concept in terms of the observations and/or activities that measure it) for each variable to be measured. What is the proposed measurement approach for each variable (physiological, questionnaire, scale, etc)? Will the variable need to be measured continuously or at a particular point in time? Are you considering repeated measures in your design? Will certain characteristics of the population under study place limits on the measurement approaches that can be used^[3]? If so, list the characteristics and the associated limits. (Examples of certain characteristics are: age, ethnicity, diagnosis, language, etc.) Is more than one measurement approach (i.e., physiological, questionnaire, etc) available to measure each variable^[7]? If so list them. Identify the measurement approach and method for each variable that is the most accurate and precise for the population you are studying.^[8, 9] Is it possible for the proposed study to be designed to include more than one measurement method for each of the variables being studied^[8]? If so list them.

Table 2. Step II. Finding an existing instrument for the proposed study

Elements & Questions
<p>Identify an Instrument</p> <ul style="list-style-type: none"> What is the name of the selected instrument? What is the measurement approach of the instrument (i.e., physiological, questionnaire, etc)? What variable(s) does the proposed instrument measure? Are these variables similar or the same as those in the proposed study? What sources, databases etc did you search to locate this instrument? (Describe the journey you took to find this instrument). What is the citation or other needed information for locating this instrument (for all but physiological measurement)? Were there several instruments of interest to your study for you to select from (or was this one the only one you could locate)? Why did you select this instrument? For questionnaires, scales etc do you have access to a complete copy of the instrument? Of note, access to a full copy of the instrument is necessary to be able to complete Steps III–IV of this guide. <p>Physiological Measurement Approaches</p> <ul style="list-style-type: none"> Is this instrument accessible to you for your study? Where is this instrument located? What are the steps to obtain this device for use in your study? Of note, either a picture with a full written description of the instrument or access to the instrument is necessary to be able to complete Steps III & IV of this guide.

Table 3. Step III. Critical assessment of the proposed measurement instrument

Elements & Questions
<p>Instrument Availability & Access</p> <p><i>Non-Physiological Measurement Instruments</i></p> <ul style="list-style-type: none"> Is a full copy of the instrument available? If a full copy of the instrument is not available why not? <p><i>(Of note, the researcher must have access to a full copy of the instrument in order to critically assess the instrument.)</i></p> <ul style="list-style-type: none"> Does the instrument have a copyright or is it open to free access (public domain)? If not open to free access, is there a fee associated with the use of the instrument? If there is a fee, what is it? Is the fee for one time use or is there a fee per subject? Will the fee be reasonable in the context of your study? <p><i>Physiological equipment/instruments:</i></p> <ul style="list-style-type: none"> Is this equipment (instrument) available to be used by the researcher in the proposed study? Are there restrictions on where and how this equipment can be used? <p><i>(Of note, the researcher must have access to the equipment or to a picture [or drawing] and an in-depth description of the equipment in order to critically assess the equipment/instrument for the proposed study.)</i></p> <ul style="list-style-type: none"> Are there equipment/instrument availability and access issues? If so, provide a summary and list the strategies that you propose for working thorough these availability and access issues. <p><i>All measurement instruments:</i></p> <ul style="list-style-type: none"> Is there a requirement that the researcher (or user) receive “special” training or be certified to use this instrument?
<p>Instrument Background</p> <p><i>Purpose</i></p> <ul style="list-style-type: none"> For what purpose was the instrument developed? What population(s) was/were the instrument developed for (i.e., age group, disease or injury categories, ethnicity, culture, language, etc)? If the instrument was developed for reasons other than research, is there at least one research study that has used this instrument? Is the stated purpose of the instrument similar to or different than the purpose of the instrument needed for your proposed study? If the purpose of the instrument is different than the requirements for your study, discuss how these differences may be compensated for in your proposed study. <p><i>Authors/Developers</i></p> <ul style="list-style-type: none"> Who are the author(s) or developer(s) of the proposed instrument? <p><i>Historical Background</i></p> <ul style="list-style-type: none"> What year was the instrument first developed and/or used? Has this instrument been used consistently in patient care, education and/or research since it was first developed? Describe when and how. Has the instrument been modified (or is it considered an original instrument? Yes or No. If the instrument has been modified, discuss each modification indicating what was changed, when, why and by whom? Were studies conducted after each modification to re-establish the psychometrics (internal consistency, reliability or precision; validity or accuracy) of the instrument? Have there been published research using the instrument following each modification? What was the design of previous studies that utilized this instrument? <p><i>Content (Non-Physiological Instruments)</i></p> <ul style="list-style-type: none"> Does the instrument appear to measure what it is reported to measure? Yes or No. If not why not? If this instrument will be used with special populations such as children or immigrants, what kind of cultural (and language) adaptations/modifications will you need to make prior to use? <p><i>Reported Internal Consistency, Reliability & Validity</i></p> <ul style="list-style-type: none"> What are the reported internal consistency, reliability and validity (content, construct, criterion) of the instrument ^[5, 14]? What population(s) (i.e., age group, disease or injury categories, ethnicity, language, etc.) were used to assess internal consistency, reliability and validity of this instrument?
<p>Data Ownership</p> <ul style="list-style-type: none"> Who owns the data collected with this instrument? The researcher or the “owner” or author of the instrument?
<p>Variables Previously Measured</p> <ul style="list-style-type: none"> What were the variables measured in prior studies that used this instrument? Are these variables, as defined in the research report, similar or different from the variables of your proposed study? If different, how are they different?
<p>Sampling</p> <ul style="list-style-type: none"> In prior studies featuring this instrument, what were the characteristics of the sample population, size of the sample and sample characteristics (demographics)? Are the sample populations used with this tool in prior research similar to the sample for your proposed study? If there are differences what are they? Have techniques of statistical power analysis, sample size estimation and confidence interval estimation been conducted in any of the prior studies that featured this instrument? If so, what were the results?
<p>Measurement & Analysis</p> <ul style="list-style-type: none"> What does the instrument measure (e.g., height, weight, pain, quality of life, etc)? What is/are the level of the data collected (nominal, ordinal, interval or ratio)? Does the instrument assess one time measures or can the instrument assess repeated measurements over time? How sensitive is the instrument to detecting small differences in the phenomenon that it is reported to measure (if the effect size is known, what is it)? Were the results obtained in prior studies expected or not expected results? Explain if there were results obtained that were not expected.
<p>Other Considerations</p> <ul style="list-style-type: none"> What is the reported respondent burden (amount of time it takes for a subject to complete the questionnaire or to have the physiological measurement(s) taken)? In your opinion can the instrument be used ethically in a research study? If no, why not. In your opinion can the instrument be used ethically in a research study with a vulnerable population (e.g., children, pregnant women, incarcerated individuals etc)? If no, why not?

Once a measurement instrument for a proposed study has been located, the next step is for the researcher to document the basic information about the instrument such as the name of the instrument and where the instrument can be located. Table 2 shows the elements and their questions to guide the discussion for Step II.

Prior to beginning Step III, it is suggested that the researcher develop a summary of their responses to Step II elements. The summary of Step II should then be added to the draft abstract for the proposed study developed in Step I. The combined draft abstract and Step II summary will form the foundation for Step III of this guide, critical assessment of the proposed measurement instrument.

Step III: Critical assessment of the proposed measurement instrument

Once an instrument has been located and before a decision can be made about the selection of the instrument for use in a proposed study, the instrument must be critically assessed. The purpose of this critical assessment process is to determine the strengths and weaknesses of the selected data collection instrument and to ensure that the make-up of the instrument aligns with the needs of the proposed study.^[5,12,13] Thus, the critical assessment of this potential research instrument must occur within the backdrop of the proposed study articulated in Step I.

To begin, instrument availability and access must be explored followed by a discussion of the instrument background, data ownership, variables previous measured, sampling, measurement and analysis, and other considerations. To complete Step III for non-physiological instruments the researcher must have access to a copy of the instrument. If the instrument collects physiological data, then the researcher must have access to the equipment or to a picture (or drawing) and an in-depth description of the equipment (see Table 3).

Before moving forward to Step IV, the researcher should highlight their concerns about the use of the instrument in their proposed study and summarize their responses to each section in Step III. This synopsis should be added to the draft abstract for the proposed study developed in Step I and the summary from Step II. That is the information gathered in Steps I–III which is critical to address the elements and questions in Step IV. The decision to select or non-select the proposed data collection instrument for the study of interest will be made in Step IV based on Steps I–III.

Step IV: Decision to select or non-select the data collection instrument for the study of interest

Step IV summarizes the information gathered and assessed during Steps I–III and assists the researcher with justifying and making an informed decision to select or non-select the data collection instrument for use in their proposed study. Table 4 guides the researcher through this step.

Table 4. Decision to select or non-select the data collection instrument for the study of interest

Elements & Questions
<p>Instrument Strengths</p> <ul style="list-style-type: none"> In your opinion, what are the strengths of the measurement instrument? (Strengths would be reasons why you should select the data collection instrument for your study of interest)
<p>Instrument Weaknesses</p> <ul style="list-style-type: none"> What are the weaknesses of the measurement instrument? (Weaknesses would be reasons why you would not select the instrument for your study of interest)
<p>Do you plan to use the instrument in the proposed study?</p> <ul style="list-style-type: none"> If yes, why, what is your rationale, be specific? If no, why not?
<p><i>If you do not plan to use this instrument what are your plans for locating another instrument?</i> <i>Would you refine your search for a new instrument based on the findings from this search and critical assessment?</i></p>
<p>Do you plan to modify this instrument for the proposed study?</p> <ul style="list-style-type: none"> If no, why not? If yes, what would be the suggested modifications? In your discussion provide a justification for each of the modifications. If you modify the instrument are you prepared to conduct a pilot study of the psychometric properties of the modified instrument prior to use in the proposed study? If no, why not?

3. CONCLUSIONS

It is essential that nurse researchers use the most precise and valid measurement instruments available to obtain trustworthy data when conducting research in education and practice. Prior to adopting a data collection instrument, researchers are called upon to critically examine and evaluate all of the characteristics and dimensions of the instrument. The Step-By-Step Guide for the Critical Appraisal and Selection of Data Collection Instruments prompts the researcher to collect pertinent in-depth information about the data collection

instrument, critically assess and summarize the information gathered, and make an informed decision to select or not select the measurement instrument for a proposed study. If the researcher decides to modify an existing instrument, the information gathered by the Step-By-Step Guide provides a foundation for the justification for the modification as well as areas of suggested modification.

CONFLICTS OF INTEREST DISCLOSURE

The authors declare that they have no competing interests.

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