ABSTRACT
                The Hawkins-Stafford Education Improvement Amendments
of 1988 established the National Cooperative Education Statistics
System and directed the Commissioner of the National Center for
Education Statistics to support the development and implementation of
standards for education data collectior, processing, analysis, and
reporting. The Cooperative Education Data Collection and Reporting
Standards Project was initiated and a task force was formed to plan,
produce, review, and disseminate the standarGs, which are concerned
with processes, rather than results. This document was developed to
help improve the usefulness and timeliness of education data, but it
does not describe the types of data that should be collected.
Standards for Education Data Collection and Reporting (SEDCAR) are
developed and organized into the following phases of management of
data collection and reporting, design, data collection, data
preparation and processing, data analysis, and reporting and
dissemination of data. Each standard has at least four components:
(1) identification of the phase the standard falls under; (2) the
subject (topic) of the standard; (3) a statement of purpose; and (4)
guidelines to best practice. Some of the SEDCARs contain related
standards information and checklists of procedural steps.
Thirty-eight SEDCARs are outlined. Two appendices provide information
about related standards, and an index and glossary are included. A
14-item list of references is included. (SLD)

SEDCAR

(Standards for Education Data Collection and Reporting)

December 1991

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NATIONAL CENTER FOR EDUCATION STATISTICS

National Center for Education Statistics

"The purpose of the Center shall be to collect, and analyze, and disseminate statistics and cther data related to education in the United States and in other nations."—Section 406(b) of the General Education Provisions Act, as amended (20 U.S.C. 1221e–1).

December 1991

Preface

The Hawkins-Stafford Education Improvement Amendments of 1988 (P.L.100-297) established the National Cooperative Education Statistics System (Cooperative System), a joint program of the National Center for Education Statistics of the U.S. Department of Education and the states. The goal of the project is to improve the comparability, quality, and usefulness of data collected from states and other education entities on the condition of education in the nation. To help achieve this objective, the legislation directed the Commissioner of the National Center for Education Statistics to support the development and implementation of standards for education data collection, processing, analysis, and reporting.

The Cooperative Education Data Collection and Reporting (CEDCAR) Standards Project was initiated to produce these standards through the combined efforts of data providers, producers, and users at the local, state, and federal levels. This document, Standards for Education Data Collection and Reporting (SEDCAR), is the product of that cooperative effort.

A Task Force of data system professionals, drawn primarily from the membership of the National Forum on Education Statistics, assumed major responsibility for planning, producing, reviewing, and disseminating the Standards. A Task Group of subject-area specialists assisted the Task Force in drafting the document.

The CEDCAR Standards Project is a three-phase effort extending over a period of more than two years. During Phase 1 (July 1989-December 1989), the Task Force of local, state, and federal representatives began laying the foundation for the development of the Standards. The Task Force reviewed related standards, decided upon the most useful scope and format for the document, and created a plan for developing the Standards.

In Phase 2 (January 1990-December 1990), Task Force and Task Group members developed an initial draft of the Standards for review by state representatives of the Cooperative System and federal agency staff. Task Force members also designed the field review plan and informed intended audiences about the progress of the project.

Phase 3 (January 1991-September 1991) encompassed peer and field review of the draft Standards at the state and local levels, review by specialists in statistics and education research, revision of the document based on reviewers' comments, submittal of the Standards for endorsement by the National Center for Education Statistics and the National Forum on Education Statistics, and dissemination to intended audiences.

The entire planning, development, and review process of this project relied upon the active involvement of local, state, and federal members of the Cooperative System in an

iterative process intended to bring about consensus on the Standards. This broad-based participation was deemed critical to the creation of Standards that would meet the dual goals of technical excellence and usefulness.

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The following persons assumed the lead responsibility for developing specifications, drafting standards, and reviewing each revision as the Standards evolved:

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The Standards for Education Data Collection and Reporting (SEDCAR) set forth principles that represent best practice in the collection, processing, analysis, and reporting of education statistics. For the purposes of this project, a standard is defined as a principle commonly agreed upon by those engaged in education data collection and reporting for guiding and assessing the quality of individual data collection and reporting activities. The Standards are concerned with processes, not results.

This document was developed cooperatively, with contributions from a wide range of data providers, producers, and users, including advocates and professional researchers from local, state, and federal agencies and from the private sector. The Standards are intended to help improve the usefulness, timeliness, accuracy, and comparability of education data that inform key policy decisions at all levels of the U.S. education system, with the ultimate goal of improving education. Although the Standards were designed specifically for data that fall within the scope of the National Cooperative Education Statistics System, they are applicable to a broader range of education data collection and reporting activities. It is hoped that the Standards will be used by state and local education agencies, federal agencies, schools, research and professional organizations, academic researchers, and policymakers. Because they were developed initially for the National Cooperative Education Statistics System, however, they are most relevant to data collection activities within the Cooperative System.

The Standards do not attempt to describe the types of data that should be collected. For example, they do not specify what indicators the National Cooperative Education Statistics System should collect. Rather, the Standards are intended to serve as a guide to the key phases of data collection and reporting. They identify the qualities that characterize good measures and describe the process of selecting and evaluating appropriate measures that will result in data of the highest quality--data that provide useful, timely, accurate, and comparable information.

Data Collection and Reporting Phases

This document takes a comprehensive view of the processes that occur during each phase of data collection and reporting, once a data need has been identified. It guides the reader step by step through these processes, from the initial articulation of a data need through the fulfillment of the data requirement. The following six phases form the conceptual framework in which the Standards have been developed and organized:

- Management of Data Collection and Reporting
- Design
- Data Collection
- Data Preparation and Processing
- Data Analysis
- Reporting and Dissemination of Data

Within these phases, an attempt has been made to arrange individual standards in the order in which they would be performed in an actual data collection and reporting activity. Sometimes, though, the processes addressed in different standards may occur simultaneously.

Although the Standards are divided into distinct phases, the phases are interrelated. Individuals working on one phase should be familiar with the standards for other phases. The standards that guide earlier phases of a data collection activity are still relevant during later phases. For example, data processing staff may find it necessary to refer to the data collection standards for guidance on nonresponse followup activities. Similarly, standards in later phases are relevant during earlier phases of a data collection activity. For example, the data analysis standards should be considered during the design phase. Furthermore, individuals participating in different phases should communicate with each other throughout the data collection and reporting activities to ensure coordination and integration of the various tasks.

Guide to Readers

Some phases and standards in this document are more technical than others. The level of technical specificity appropriate for each standard differs by subject matter. Readers are encouraged to seek out supplemental resources if more general or specific guidance is needed in a particular area. Furthermore, some of the standards do not apply uniformly to all data collection activities. The amount of attention paid to each guideline will often be commensurate with the size and importance of the data collection activity.

Standards and Checklists

The Standards are composed primarily of standards for each major phase of data collection and reporting. Every standard contains a statement of purpose and a series of guidelines that describe the "best practice" for fulfilling the purpose of the standard. When appropriate, related standards and checklists are cited to provide additional guidance in an area addressed by one or more of the standards.

Each of the major phases addressed by the Standards begins with an introduction that includes a discussion of the scope of the phase, the underlying assumptions, and the intended audiences. Limitations and potential problems are also discussed.

Each standard has at least four components (two others are added when applicable) arranged in the following order (see sample standard format on page xiii):

- *Phase* - Identifies which of the six phases the standard falls under.

- *Subject* - Identifies the topic of the standard. Subjects are in chronological order within phases.

- *Statement of Purpose* - Provides the objective of the standard.

- *Guidelines* - Provides "best practice" procedures to be followed in order to achieve the objective identified in the statement of purpose. The guidelines are chronological steps within the standard.

Some standards contain one or both of the following:

- *Related Standards* - Reference other standards within the document that readers may consider when applying a standard.

- *Checklists* - Specify procedural steps to follow to help achieve the purpose of the standard. These steps may expand upon an individual guideline, or they may further develop the entire standard.

Numbering System

Phases are identified by one-digit numbers from one to six. Standards within each phase are identified by two-digit numbers--the first identifying the phase, the second identifying its order within the phase. Guidelines have three-digit numbers--the first two identifying the phase and the standard, the third identifying their order within the standard. Checklists also have three-digit numbers that correspond to the most relevant guideline upon which they are expanding.

Related Information

This document includes appendices, an index, references, and a glossary of technical terms to assist readers in using the Standards.

■ *Appendices* - Contain tables identifying standards developed by other agencies and organizations that were used in the development of particular standards in this document and that may be referred to for additional information.

■ *Appendix A* - Describes the seven sets of standards that were used as reference material throughout the six phases.

■ *Appendix B* - Describes the six sets of standards that were referred to for particular subject matter covered by one or more phase.

■ *Index* - Groups standards in different phases by key topic areas (e.g., management, training, documentation, confidentiality) for easy reference.

■ *References* - List sources used in the development of some standards. These sources may provide more extensive guidance in particular topic areas. Some of the references provide definitions beyond those included in the glossary of this document.

■ *Glossary* - Technical terminology has been avoided when alternative language could be used without a loss of accuracy. In some cases, however, technical terminology is necessary to signify the full meaning and intent of the Standards. These terms are defined in here. Terms covered by the glossary are printed in italics the first time they appear in the text of each standard.

Terminology

Throughout this document, specific terms are used to refer to key elements and participants in data collection and reporting activities.

■ *Data collection activities* - The Standards use this phrase to encompass all phases of data collection and reporting.

■ *Data requestor* - Agency or organization that requests or sponsors the data collection and reporting activity.

SAMPLE STANDARD FORMAT

Phase

Subject

3. DATA COLLECTION

3.2. Standard for Selecting and Training Data Collection Staff

Purpose

PURPOSE: To ensure that data collection staff are able to carry out the collection according to plan with a minimum of inaccuracies, intrusion, and burden.

3-Digit
Guideline
Number

Guidelines

3.2.1. Staff training should reflect the complexity of the project. For complex data collection activities, or those that require the collector to deviate from standard questions, training should include, at a minimum, a thorough explanation of the study goals, guidelines for deviating from or expanding on standard questions, and methods for documenting the collection activity. (See 3.2.1. Checklist for Training for Data Collectors.)

Guideline

3.2.2. Training should be designed based on the collection methodology to be used. For example, more extensive training is usually required for instruments with open-ended items.

3.2.8. Staffing resources should be sufficient to ensure that replacement personnel are available on an as needed basis.

Related
Standards

RELATED STANDARDS

3.3. Standard for Ethical Treatment of Respondents

3.4. Standard for Minimizing Burden and Nonresponse

SAMPLE CHECKLIST FORMAT

3. DATA COLLECTION

3.2. Standard for Selecting and Training Data Collection Staff

Checklist
(3-digit
checklist
number
corresponds
to guideline
number)

3.2.1. Checklist for Training for Data Collectors

Upon completion of training, data collectors should understand the following:

1. All definitions used in the collection instrument

2. The persons or records from whom/which the data are to be collected (e.g., which teachers will be interviewed? what classes will take the test? what records will be examined?)

3. The date, time, and duration of the test or data collection activity

■ *Data producer* - Agency or organization that carries out the actual study design, data collection, processing, analysis, and reporting. Encompasses all members of the project staff including *managers, data collectors, data processors, data analysts,* and *data reporters.*

(In some cases, the same agency or organization is both the data requestor and the data producer. In others, they are different entities.)

■ *Data provider* - Agency, organization, or individual who supplies data. For example, in a national education survey, data providers might include state education agencies, local education agencies, school districts, schools, teachers, students, and parents.

> *Respondent* - This term is used particularly in the standards for the Data Collection Phase referring specifically to the individual or agency who completes a survey (e.g., the person who marks the answers on a survey instrument or who provides answers verbally to a data collector).

■ *Data users* - Agencies, organizations, or individuals who use the data developed by the data producer. Although the term data user may refer to the data requestor--the entity that originally requested the data--it may also refer to other entities or individuals, including other agencies, individual researchers, the media, and members of the public, who utilize the results of a data collection activity in some way.

Best Practice

The Standards can be used to determine the differences between actual procedures used in a particular data collection and reporting activity and the recommended "best practices." The document also provides the material to stimulate a planned program of continuous professional growth.

The Standards are not intended, however, to be used to measure compliance with externally imposed requirements. Therefore, it is the intent of the authors that the adoption and adaptation of the Standards be voluntary. Readers, however, are urged to consider applying these principles in a systematic manner to their data collection activities. Those involved with the CEDCAR Standards Project believe that to do so will greatly enhance the accuracy and credibility of education data.

Comments and Suggestions

The Standards for Education Data Collection and Reporting are intended to stimulate an ongoing process of review and improvement of education data collection and reporting activities. In order for the Standards to serve as a useful guide in the data quality improvement effort, the experiences and opinions of users must be incorporated into future revisions of this document.

The best practices included in this document were suggested and refined by a group of experts in the collection and reporting of education data. A different group of experts may have arrived at a slightly different set of best practices. Users of this document are encouraged to contribute to the quality of the Standards by providing comments and suggestions on any practices that may have been omitted.

Please send comments on your experiences using the Standards or suggestions for improving the value and utility of the Standards to:

> NCES CEDCAR Standards Project
> 555 New Jersey Avenue, N.W.
> Room 410
> Washington, D.C. 20208-5651

If you are interested in adding your name to the list of persons receiving updated versions of the Standards, please write to the above address.

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PHASE 1. MANAGEMENT OF DATA COLLECTION AND REPORTING

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1.2.   Justifying Data Collection Activities

1.3.   Fostering Commitment of All Participants

1.4.   Creating an Appropriate Management Process

1.0. Introduction to Management of Data Collection and Reporting

Successful implementation of the standards and guidelines articulated in Phases 2-6 of the Standards (Design, Collection, Processing, Analysis, and Reporting) depends largely upon the creation of an organizational environment and organizational structures that encourage and fully support the production of high quality information.

Data are not free. Organizational resources must be devoted to the designing, collecting, processing, analyzing, and reporting phases of a data collection activity. Therefore, data-related activities must be managed and coordinated in order to focus available resources where they are most needed and in the most efficient and cost-effective manner.

The standards included in this phase are all based on a key assumption--that there is a clear and important information need that cannot otherwise be met. Therefore, at the most fundamental level, processes must be put into place that provide the foundation for sound management and policy decisions about which data collection and reporting initiatives to pursue. Such decisions must be based on adequate information and must include the timely involvement and participation of all interested parties.

The first standard in this phase describes the creation of an organizational culture that is conducive to a quality management philosophy. Within this environment, management procedures must be put into place to ensure successful implementation of data collection activities. The remaining three standards deal with justifying, supporting, and managing an individual data collection.

Words in italics are defined in the glossary.

1.1. Standard for Creating an Infrastructure to Manage Data Collection Activities

PURPOSE: To ensure the capability to guide decisions on data collection initiatives.

GUIDELINES

1.1.1. Procedures should be implemented for routinely sensing the information needs of legislators, policymakers, practitioners, and the public.

1.1.2. Clearinghouses should be established and maintained for documenting reports, collection instruments, definitions, and records of available data.

1.1.3. Procedures should be developed for reviewing and approving data collection requests. Efforts should be made to coordinate federal, state, and local reviews, when feasible.

1.1.4. Advisory task forces or committees, comprised of data requestors, providers, producers, and users, should be established at every level (e.g., federal, state, local) to provide guidance on coordinating data collection activities.

1.1.5. Regular evaluations of ongoing data collections should be scheduled to:

■ Assess continuing need

■ Analyze accuracy

■ Examine utility

■ Review collector and provider burden and costs

■ Evaluate confidentiality procedures

■ Review propriety/appropriateness

1.1.6. Data producers and providers should adhere to standard definitions of data elements. Definitions of data elements should be periodically reviewed, published, and made available to data providers, data producers, and data users.

1.2. Standard for Justifying Data Collection Activities

PURPOSE: To ensure that a proposed data collection meets specified needs and minimizes cost and burden.

GUIDELINES

1.2.1. Data requestors should demonstrate that the data to be produced will be of sufficient value, applicability, and usefulness to justify the cost and burden. The specific cost of collection to both data producers and providers, as well as the burden imposed, should be identified. (See **1.2.1. Checklist for Justifying Data Collection Activities.**)

1.2.2. A determination should be made about whether the data can be obtained more appropriately from other sources within or outside the collecting agency. Reasons should be specified why similar available data cannot be used for the stated purposes.

1.2.3. An opportunity should be provided for comments by data providers and users on the proposed collection of information. Concerns should be documented, along with the responses to those concerns.

RELATED STANDARDS

2.4. Standard for Assessing the Value of Obtainable Data

1.2. Standard for Justifying Data Collection Activities

1.2.1. Checklist for Justifying Data Collection Activities

1. Document the circumstances that make the collection of information necessary, including any legal or administrative requirements.

2. Indicate as specifically as possible how, by whom, and for what purpose the data will be used.

3. Determine whether available data can be used to meet an emerging information need before initiating a new collection.

4. Identify required data collection activities, as well as the accuracy and specificity necessary to achieve collection objectives.

5. Analyze the costs and benefits of the proposed data collection to the producer and provider and, where appropriate, the costs of alternative strategies.

6. Review the terminology and data definitions to be used in the data collection to ensure that they conform to accepted usage. Any deviations from accepted usage should be explained. Definitions should conform whenever possible to nationally developed definitions to ensure that the data produced will be comparable to data produced by education agencies and organizations at the school, district, state, and federal levels.

7. Document data providers' concerns and data requestors' responses to those concerns.

1.3. Standard for Fostering Commitment of All Participants

PURPOSE: To ensure cooperation with and support for data collection activities.

GUIDELINES

1.3.1. Data requestors, users, and providers should be involved in planning data collection activities. Preliminary plans for data collection, processing, analysis, and reporting should be prepared for discussion with, and review by, these groups.

1.3.2. Efforts should be made to coordinate data collection activities that collect similar information (for the same or different purposes) at different governmental levels (federal, state, local) and within agencies at each level.

- Interagency and intergovernmental meetings should be conducted routinely to determine whether multiple agency data needs can be met by a single data collection and to encourage agencies to share appropriate information in order to reduce the burden on providers.

- General education statistical collections should be consolidated when possible with collections required for administrative or regulatory purposes.

- Education agencies should cooperatively explore and establish data systems that will expedite the exchange of information to meet federal, state, and local data needs.

1.3.3. Data collection activities should be scheduled in consultation with data providers at the local, state, and federal levels to accommodate annual planning, recordkeeping, and processing requirements. Early notification of plans and specifications should be provided for new or changing data collections that impact current computer or recordkeeping systems.

1.3.4. Data providers should receive training and technical assistance.

1.4. Standard for Creating an Appropriate Management Process

PURPOSE: To ensure the management and implementation of high-quality data collection and reporting.

GUIDELINES

1.4.1.   A description of the goals and objectives for the data collection activity should be developed and provided to all staff. Top management should demonstrate a continuing commitment to data collection by providing the resources, strategies, and related tools or methods necessary to achieve these goals and objectives.

1.4.2.   Specific responsibilities, along with commensurate authority to carry out these responsibilities, should be assigned to an individual or unit for management and coordination of the data collection activity.

1.4.3.   Orientation and training should be conducted for agency staff to ensure data quality consciousness, improve skills in producing high-quality data, and address standards of design, collection, processing, analysis, and reporting.

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PHASE 2. DESIGN

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2.0. Introduction to Design

Once an information need has been established, the project staff can begin to explore ways to gather the required data. Design is the process of formulating the study questions and developing and describing a plan for conducting the collection, processing, analysis, and reporting of data. If the data collection activity is well designed, the time and resources expended during the design phase will prevent costly mistakes later in the project. An effective design produces accurate and useful information, thus, increasing the credibility and generalizeability of the findings. An effective design also promotes timely and efficient data collection and provides methods for resolving both expected and unexpected problems that may arise during data collection and analysis. The study design should incorporate methods and procedures established in advance to control and resolve inaccuracies in the data.

The development of the design should be guided by the type of information to be collected, the unit of analysis, the types of analyses planned, and the purposes for which the data will be used. For example, the need to obtain highly personal or sensitive information will have an impact on the data collection methodology, instrument design, nonsampling errors, and virtually every other aspect of the activity. The design also depends, to some extent, on whether there is a need for descriptive, comparative, or cause-and-effect analyses.

In developing a design, decisions made at one stage may require reconsideration of decisions made at an earlier stage in the design process. Decisions about sampling may influence the formulation of the study questions and issues. For example, program compliance issues concerning participants may require data collection from all recipients. Thus, although these standards are presented chronologically, not every data collection activity proceeds in exactly this order. In fact, many of the steps or tasks described in this section occur simultaneously. Standards for certain steps can greatly enhance preceding or subsequent stages.

Words in italics are defined in the glossary.

2.1. Standard for Formulating and Refining Study Questions

PURPOSE: To ensure that the study questions are well chosen, well stated, and empirically answerable.

GUIDELINES

2.1.1. Study questions should be formulated to address the identified information needs.

2.1.2. Study questions should be clearly defined, articulated, and reviewed to ensure that they address all aspects of the issues under investigation. (See **2.1.2. Checklist for Formulating and Refining Study Questions.**)

2.1.3. The study questions should:

■ Reflect a knowledge of relevant literature

■ Anticipate and respond to unintended outcomes

■ Be capable of further refinement as research planning proceeds

■ Be clear in their meaning, implications, and assumptions

■ Eliminate bias as fully as possible to avoid any tendency to predispose the findings

■ Attempt to break down problems into their constituent parts

■ Be capable of being answered through practical data collection activities

■ Focus on the information needs

■ Be prioritized in order of importance

■ Be broad enough in scope to cover the needs of the data requestor and, when possible, the needs of secondary data users

2.1. Standard for Formulating and Refining Study Questions

2.1.2. Checklist for Formulating and Refining Study Questions

1. Ensure that study questions have the potential to address the data needs.

2. Ensure that each study question asks only one question.

3. Ensure that each study question does not beg another question, or set of questions, that must be resolved before the current question can be answered.

4. Ensure that study questions do not make false assumptions.

5. Ensure that study questions do not pose a false dichotomy (i.e., make sure that the possible alternative answers are truly different).

6. Ensure that study questions do not attempt to resolve nonempirical problems by empirical means.

7. Ensure that study questions are not merely semantic (solely about how terms ought to be used rather than about substantive issues or distinctions).

8. Ensure that study questions are not true or false by definition (tautological) and, therefore, unable to be answered empirically.

9. Ensure that study questions have the same meaning for different persons.

2.2. Standard for Choosing the Data Collection Methods

PURPOSE: To ensure the selection of the most appropriate and effective methods for answering the study questions.

GUIDELINES

2.2.1. The appropriate methodologies should be determined based on the information required to answer the study questions, on what will cause the least *burden* to data providers, and on the available resources.

2.2.2. The design must specify the following aspects in selecting a methodology: 1) the sources of the data; 2) when and how often data are to be collected; 3) the collection, processing, analysis, and reporting procedures to be used; and 4) the potential descriptive, comparative, or causal inferences to be made from the data.

2.2.3. Appropriate alternative data collection methods should be identified. These methods may include record *abstraction*, survey (mail, telephone, in-person), observation, experiments, and secondary data analysis. Consideration should be given to employing more than one method, where appropriate. (See **2.2.3. Checklist for Selecting the Appropriate Sources of Data** and **2.2.5. Checklist for Determining the Design Relative to Group Comparisons.**)

2.2.4. The design should address the issue of whether there is a need to measure and analyze change over time. The design should specify whether the data to be collected are to be cross-sectional (designed to measure only one point in time) or longitudinal (designed to study change over time). (See **2.2.4. Checklist for Determining the Design Relative to Analysis of Change.**)

2.2.5. The design should address the extent to which the data are to be used to make comparisons among groups or explore relationships among variables. The planned sample, data collection instruments, and analyses must be precise enough to support the planned comparisons and inferences. The design should specify the type of data collection activity to be conducted (e.g., descriptive, comparison group, normative, case controlled). (See **2.2.5. Checklist for Determining the Design Relative to Group Comparisons.**)

2.2.6. The design should include procedures for measuring the quality of the data to be collected.

RELATED STANDARDS

2.2.   Standard for Choosing the Data Collection Methods
2.7.   Standard for Minimizing Total Study Error (Sampling and Nonsampling)

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2.2.   Standard for Choosing the Data Collection Methods

2.2.3.   Checklist for Selecting the Appropriate Sources of Data

1.   To identify feasible sources of information, ask the following questions:

- Can the information be obtained through analysis of existing data?
- Are records available from which the information can be compiled?
- Are knowledgeable persons available from whom the information can be gathered and assembled?
- Must the information be generated by controlled observation or measurement?

2.   To determine whether existing data can be used to answer the study question, ask:

- Are data available that are relevant to the study question?
- Do available data meet the criteria of reliability, validity, and other aspects of required technical quality?
- Are the data structured in a manner that provides the appropriate unit of analysis and that allows appropriate investigation of relationships among variables?
- Are the data sufficiently current?
- If multiple sources of data are used, are the data sufficiently comparable?

3.   To determine whether administrative records can be used, ask:

- Are there administrative records that contain all the information needed (e.g., numbers and characteristics of students by race/ethnicity and gender) for the administrative unit/level required to address the study questions?
- Are there alternative methods of obtaining the records (once the administrative units in which the records are kept have been identified) that can accommodate different local recordkeeping, practices, and policies?
- Are the definitions and concepts employed by the various jurisdictions involved comparable and uniform? Be prepared to invest in methods (i.e., crosswalking) that attempt to make data comparable among various jurisdictions.
- Does an examination of the uses for which the records are kept reveal clues about possible distortions relative to the study questions? Administrative record data are no more immune to validity issues than data from any other source.

Continued

2.2.3. Checklist for Selecting the Appropriate Sources of Data

4.   To determine whether data can be collected from individual data providers, ask:

- Is there a person/position with access to the information being sought? If there is, can that person/position serve as data provider?

- Is the data provider being asked to obtain information from administrative records? If so, consider the administrative record study checklist above (item 3).

- Is the data provider being asked to report information about a group or organizational unit in the absence of records?

- Is the person from whom the data are being requested the most capable person to act as a data provider? If not, can a procedure be designed for choosing the best data provider?

5.   To determine whether data can be obtained from an observation study, ask:

- Is it feasible to train staff or to hire trained observers?

- Do standard protocols for observation exist, or can they be created?

- Can the observers be granted access to the phenomena of interest?

2.2.	Standard for Choosing the Data Collection Methods

2.2.4. Checklist for Determining the Design Relative to Analysis of Change.

1. Decide from the beginning which types of design are warranted in view of the need to measure or analyze change.

2. If the data are needed for a snapshot at one point in time (for example, determining how teachers choose to spend unplanned surplus supply budgets for the coming year), consider a cross-sectional design.

3. If the data are needed for looking at change over time, develop a longitudinal design. It is especially important to make sure that all aspects of the study are carefully tested prior to beginning data collection.

    ■ **Trend Design:** The data are needed for different samples at several points in time (for example, measuring county reading scores for third-graders over a number of years).

    ■ **Cohort Design:** The data are needed from the same group at points over time although different samples can be used (for example, comparing whether attitudes toward sex education have changed over time for different samples of those who were parents of first-graders in 1983).

    ■ **Panel Design:** The data are needed from the same sample over time (for example, following the same group of sixth-graders to observe the relationship between initial reading scores and gains in reading scores or educational persistence).

4. Consider burden, problems in maintaining participation, operational concerns, and necessary resources in designing the frequency of data collections.

2.2. Standard for Choosing the Data Collection Methods

2.2.5. Checklist for Determining the Design Relative to Group Comparisons

1.   Carefully consider the types of comparisons needed to answer the study questions. Consult available technical sources when considering which types of design allow for the planned comparisons.

Designs appropriate for group comparisons include:

- **Descriptive Design:** Sample is designed primarily to describe a total population and subpopulations. During analysis, comparisons are made among existing subgroups on descriptive data. (For example, compare the extent to which the percentage of colleges offering remedial courses varies across geographic regions.)

- **Normative Comparison Design:** Results of data collection are to be compared with data already available from other sources. (For example, compare county per-pupil educational expenditures with state and national averages.) Make sure the units and timeframes will be comparable (e.g., same grade levels and same year).

- **Comparison Group Design:** Groups are specifically created for comparison purposes. They are then compared based on other characteristics of interest.

  - **True experimental design:** Assignment to groups is random (e.g., comparing college persistence for students with similar college entrance test scores randomly assigned to groups that will or will not participate in student support services).

  - **Quasi-experimental design:** Assignment to groups is not controlled by data collector and is not random (e.g., comparing college persistence for students with similar college entrance test scores who have and have not participated in student support services). Make sure that there is statistical control for other factors that may influence entrance into the groups and that may influence outcomes to be studied.

  - **Case Control Design:** Groups are selected because they either have or do not have the condition being studied. They are compared with regard to other variables judged to be of relevance to the condition (e.g., comparing learning disabled students with those who do not have learning disabilities by birth weight, controlling for socioeconomic status).

2.   Consider combining designs (e.g., longitudinal and comparison group designs) to provide designs necessary to answer study questions.

3.   Make sure that the design chosen to make group comparisons is consistent with sample plans, form design, data collection procedures, and the analysis plan.

2.3. Standard for Developing a Sampling Plan

PURPOSE: To ensure that the data providers represent the population(s) of interest with a level of accuracy that allows for answering the study questions.

GUIDELINES

2.3.1. A determination should be made about whether it is necessary to obtain data from every member of the population of interest to meet the needs of the data requester or whether sampling methods can be employed. (See **2.3.1. Checklist for Choosing Between Universe and Sample Surveys.**)

2.3.2. The development of a sampling plan for any data collection should be considered an integral part of the design, not a separate stage undertaken after the design has been developed.

2.3.3. The design should include a written, detailed sampling plan to ensure that the characteristics of the sample relative to the population under study are known and that the magnitude of *sampling error* in the estimates of population parameters can be assessed. (See **2.3.3. Checklist for Identifying Sampling Plan Contents.**)

2.3.4. The availability and quality of lists that cover and count the population of interest (population or universe frames) and the availability of budgeted funds are important factors that should be considered in developing the sample plan.

2.3.5. Estimates of sampling error for the key statistics based on known or estimated distributions should be calculated during the sample design.

2.3.6. Special designs should be considered to ensure that there is an adequate number of respondents to represent small subpopulations of interest (e.g., racial. or ethnic groups, groups of schools defined by size or some other quality).

2.3.7. If the study has multiple questions that would require different sampling designs for getting the best estimates, a design should be developed that represents the best compromise within the range of tolerable sampling errors, costs, burden, and other considerations.

2.3.8. If a *panel design* is chosen, procedures to maintain contact with subjects should be designed. To ensure the usefulness of the data, sample attrition rates should be included in all estimates of sample size.

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2.3. Standard for Developing a Sampling Plan

2.3.1. Checklist for Choosing Between Universe and Sample Surveys

1. If data must be reported for each member of the target population to answer the study questions, a sample will not be useful. For example, if a measurement must be reported to the public for each school district, data must be collected from every district. However, district data may sometimes be based upon a representative sample of its schools.

2. Determine whether the population whose characteristics are to be reported can be described by measurements of a sample. Determine if the precision provided by a sample survey will meet the information requirements.

3. Develop estimates of the aggregate respondent burden associated with universe versus sample surveys.

4. Consider the special burden that recurring surveys may impose on data providers who are already required to report administrative data in different ways to other sources.

5. Develop estimates of the costs of administering and analyzing alternative universe and sample surveys. The characteristics of the sample employed in these estimates are dictated by the precision required.

6. Determine whether resources will be freed by using a sample rather than a universe survey and consider devoting some of these resources to reducing nonsampling error by using techniques such as improved measurement, more intensive interviewing and interviewer training, nonresponse followup, and alternative measurement techniques. Expected reductions in inaccuracy or errors resulting from the use of these procedures should be taken into account when choosing between universe and sample surveys.

2.3. Standard for Developing a Sampling Plan

2.3.3. Checklist for Identifying Sampling Plan Contents

1. Define the target population as completely as possible.

2. Describe the *sampling frame* with regard to the source, reference date, number of units, and quality of the frame (e.g., coverage of population of interest, completeness).

3. Describe the nature of the proposed sampling--*probability* versus *nonprobability*. (If nonprobability sampling is used, explain the implication for the accuracy of population estimates.)

4. Specify and justify the sampling technique (e.g., simple random, systematic, matrix, stratification, multistage, cluster, probability proportional to size).

5. Describe any stratification and clustering procedures.

6. Specify the units selected or planned for the sample at each stage.

7. Justify the proposed sample size and describe the effects of sample size on the precision of the population estimates required to satisfy the information needs.

8. Describe the procedures for allocating the sample size at each stage.

9. Specify the number of sampling units selected at each stage.

10. Describe any measures of size that are stated for sampling with "probability proportionate to size" and the types of estimates that are likely to be more precise as a result.

11. Develop procedures for dealing with nonresponse and describe the likely impact of nonresponse on population estimates.

12. Specify the nature of sample weights to be applied, if any.

13. Give estimates of expected sampling errors based on known or estimated distributions.

14. Specify clear, detailed operational procedures for drawing the sample.

2.4. Standard for Assessing the Value of Obtainable Data

PURPOSE: To determine whether the data that can be collected within the constraints of time, staff resources, and budgets will be of sufficient quality and benefit to justify the required expenditures.

GUIDELINES

2.4.1. The value and usefulness of the data collection activity that is actually feasible should be reassessed and weighed against the resulting response burden and financial costs.

2.4.2. Tradeoffs between utility and data accuracy should be evaluated in view of the uses to which the data will be applied.

2.4.3. In planning the data collection activity, sampling and nonsampling error for the key statistics should be estimated to determine whether the data collection activity that is feasible is worth undertaking.

2.4.4. Regardless of whether action will be taken or policy formulated on the basis of the data to be collected, consideration should be given to other benefits of having empirical answers to the study questions (e.g., credibility, impartiality, efficiency, chances of success, informed decisionmaking).

2.4.5. As the design of the data collection proceeds, the value of obtainable data should be assessed regularly and alternative approaches considered.

RELATED STANDARDS

1.2. Standard for Justifying Data Collection Activities

2.5. Standard for Transforming Study Question Concepts into Measures

PURPOSE: To ensure that measures of the concepts of interest are reliable and valid.

GUIDELINES

2.5.1. An *operational definition* should be developed and should describe in a concrete and specific manner precisely how to obtain a measurement of a concept so that anyone could repeat the steps and obtain the same measurements.

2.5.2. An operational definition should be consistent with standard data element definitions where appropriate.

2.5.3. Where possible, more than one measure of a key concept should be developed and used.

2.5.4. A measure should be tested to ensure that it is *reliable*; that is, it produces consistent results and does not fluctuate in an uncontrolled way from one trial to the next. (See **2.5.4. Checklist for Determining the Reliability and Validity of Measurements.**)

2.5.5. A measure should be tested to ensure that it is *valid* for the intended purpose; that is, it measures what it is intended to measure. (See **2.5.4. Checklist for Determining the Reliability and Validity of Measurements.**)

2.5.6. A measure should assess a single dimension.

2.5.7. The levels of measurement should be related to the analytical plan. Measures can be nominal (response categories are qualitatively different), ordinal (response categories can be ranked on a continuum), interval (response categories represent equal quantities of the variable measure), or ratio (response categories represent quantities that can be multiplied).

2.5.8. A scale or index should be developed when the variable is best measured by a set of categories or a range of scores.

2.5.9. All measurement tools and procedures should be pretested under the same conditions that will be present during the main data collection.

2.5.10. For continuing, long-term data collection activities, pretests should incorporate evaluation studies to demonstrate whether key items are reliable, valid, and unbiased measures of the concepts of interest.

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2.5. Standard for Transforming Study Question Concepts into Measures

2.5.4. Checklist for Determining the Reliability and Validity of Measuren.ents

1. Use more than one of the following tests to determine a measure's reliability. Responses will be the same (positively correlated) for a reliable item.

    ■ Administer the same item twice to the same persons or groups and compute the correlation between the two scores.

    ■ Correlate the results obtained from two halves of the same set of items.

    ■ Correlate each item with the total score and then average those correlation coefficients.

    ■ Correlate each item with every other item and then average those coefficients.

2. Use more than one of the following tests to determine a measure's validity.

    ■ When appropriate, review literature that evaluates the validity of existing instruments.

    ■ Assess each item to determine whether experts, data providers, and users believe that the item measures what it is intended to measure.

    ■ Assess each measure to determine whether the item can distinguish known differences (i.e., administer the measure or instrument to individuals who are known to differ on the characteristic and compare the results).

    ■ Assess each measure to determine whether the item produces results that are similar to the results produced by other measures attempting to measure the same construct. (For example, do students taking a new achievement test have scores similar to their scores on other achievement tests that have been validated?)

    ■ Where appropriate, assess each measure to determine whether it has the ability to identify future behavior or change.

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2.6. Standard for Designing the Data Collection Instrument

PURPOSE: To ensure that the data collection instrument promotes effective communication between the data providers and the data collectors in order to obtain accurate information.

GUIDELINES

2.6.1. The data collection instrument should reflect the study questions and objectives.

2.6.2. Throughout the development of the data collection instrument, attention should be given to meeting the requirements of the analysis plan while minimizing burden.

2.6.3. The data collection instrument should be refined and evaluated throughout the design and pretest phase.

2.6.4. The data collection instrument should provide *reliable* and *valid* information on the specific questions to be answered or objectives to be achieved. Items should have the same meaning to all data providers, should fall within the language and knowledge capabilities of all data providers, and promote accurate responses. (See **2.6.4. Checklist for Designing the Data Collection Instrument.**)

2.6.5. The format of the instrument should minimize errors (e.g., coding, keying, skip-pattern). For example, precoding information on the instrument itself should be considered when practical and where it does not compromise the accuracy of results, unduly increase burden, or reduce data provider motivation to supply the information.

2.6.6. An outside review of the instruments should be conducted.

2.6.7. The language and format of the data collection instrument should be appropriate for the targeted data providers.

2.6.8. Consideration should be given to a variety of available media (e.g., in-person, mail) during the design of the data collection instrument.

RELATED STANDARDS

2.5. Standard for Transforming Study Question Concepts into Measures
2.8. Standard for Reviewing and Pretesting Data Collection Instruments, Forms, and Procedures

2.6. Standard for Designing the Data Collection Instrument

2.6.4. Checklist for Designing the Data Collection Instrument

1. Provide clear and sufficient instructions for completing the data collection instrument. Provide detailed instructions for individual items when necessary.

2. Make definitions of data elements consistent with standard definitions for those data elements, when possible.

3. Provide definitions for any words in the data collection instrument whose meaning may be ambiguous.

4. Examine each item in the data collection instrument to make sure that the information is needed for the purpose of the data collection.

5. Make sure that the purpose of each item on the instrument is understandable to the data provider. Explain to data providers why questions are included that have no apparent connection to the topic of the data collection. (For example, background questions might be asked in order to identify connections between people's backgrounds and their views on teacher competency testing.)

6. Ensure that the requested information can be provided by the data providers.

7. Minimize the amount of time data providers will need to complete the data collection form.

8. Wherever possible, use units of measurement that are familiar to the data providers.

9. Use standard language and avoid jargon and abbreviations. Make sure that the technical terms used are appropriate to the data providers. Review questions for clarity. Keep questions short and simple.

10. Design the item sequence of the data collection instrument to increase the data provider's ability to complete the data collection. Keep topic-related questions together and provide transitions between topics. Ensure that the item sequence does not influence responses to later questions.

11. Determine the item format that will provide the type of measurement necessary to answer the study question (e.g., multiple choice, check list, rankings, ratings, open-ended).

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2.6.4. Checklist for Designing the Data Collection Instrument

12. Make sure that the items on the data collection instrument place the least possible burden on the data providers. Find out how data providers usually keep or process the information being requested. (For example, if a school usually keeps its budget data in only absolute numbers, rather than percentage allocations among functions, the data collector should ask for the absolute numbers and then calculate the percentages.)

13. Make sure that items do not combine two separate ideas inappropriately (e.g., double-barreled questions) and that they ask for a single response.

14. Use an initial screening item to ensure that another item does not make unwarranted assumptions. (For example, before asking whether students are given access to computers during nonschool hours, ask whether the school has computers for student use. Only those schools that respond affirmatively to the first question should be asked the question of interest.)

15. When a possible response to an item may be considered somewhat socially undesirable, try to phrase the question and/or response categories in a way that makes the data providers more comfortable about giving that reply. Providing response categories may be preferable for very sensitive questions because categories do not specifically identify the data provider and appear less personal. (For example, under certain conditions income may be asked in terms of response categories or ranges rather than as an open-ended item that requires an exact amount.)

16. Make categories as concrete as possible. Use simple and exact terms. Replace vague quantifying words (frequently, often, sometimes) with specific numerical ranges whenever possible.

17. Make sure that words and phrases that may bias the responses are avoided. Be aware of your own biases toward the subject.

18. Be aware that the choice of responses provided for in the data collection instrument can influence the responses themselves.

19. When possible, conduct cognitive research (e.g., cognitive labs and/or focus groups) as a component of the pretest to help ensure that respondents comprehend key terms and phrases, have access to the information requested, and are motivated to participate honestly.

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2.7. Standard for Minimizing Total Study Error (Sampling and Nonsampling)

PURPOSE: To ensure that potential sources of error arising from the data collection design and procedures are identified and reduced.

GUIDELINES

2.7.1. Attention should be paid not only to identifying potential sources of error but also to reducing *total error* (sampling and nonsampling errors) in the design phase. (See **2.7.1. Checklist for Designing to Reduce Nonsampling Error.**)

2.7.2. Potential sources of constant error (bias) and variable error (variability) should be identified in the design phase of the data collection activities. (See **2.7.2. Checklist for Identifying Types and Sources of Study Error.**)

2.7.3. Attention should be paid to identifying, measuring, and reducing nonobservation and observation errors.

2.7.4. Among the nonobservational sources of error to which attention should be paid are errors of coverage, *unit* and *item nonresponse*, and sampling.

2.7.5. Among the observational sources of error to which attention should be paid are interviewer, instrument, data provider, modes of data collection, and data processing.

2.7.6. Consideration should be given to building evaluation studies of the methodology and data elements into the data collection design. For example, ask a portion of the items twice to a subsample of respondents (*reliability*); check the correctness of responses by obtaining *verification* from an independent source (*validity*); study the characteristics of nonrespondents to determine if they differ from those of respondents; and experiment with changes in instrument wording or item order.

2.7.7. Quality control procedures should be developed and budgeted in the design phase.

2.7.8. Nonresponse followup and item *imputation* procedures should be planned to reduce error resulting from unit (total) nonresponse and item (partial) nonresponse. (See **2.7.8. Checklist for Minimizing Unit and Item Nonresponse.**)

2.7. Standard for Minimizing Total Study Error (Sampling and Nonsampling)

2.7.1. Checklist for Designing to Reduce Nonsampling Error

1. Ensure that data providers fully understand the instructions and instrument items.

2. Choose data collectors who are credible to data providers when issues of credibility might result in biased results.

3. Choose data collectors who are familiar with the population from whom data will be collected.

4. Avoid sensitive or invasive questions where possible. When such items are necessary, careful wording and placement should be considered.

5. Develop clear and concise instructions for data providers and data collectors to eliminate inconsistent responses caused by ambiguous instructions. Instructions should be pretested along with the data collection instruments.

6. Use commonly accepted definitions and terminology so that all items, instructions, and other materials can be easily understood.

7. Develop and implement training, monitoring, and refresher training for personnel to reduce inconsistencies in the implementation of procedures by interviewers, data entry personnel, coders, and other project staff.

8. Design manual and machine edit checks with verification of values that are invalid or are out of expected range to detect and eliminate systematic mistakes in scoring, data entry, coding, tabulating, machine editing, and other processes.

9. When possible, identify errors using outside resources including:

    ■ Comparisons with data from other sources or previous collections (to detect implausible consistency or inconsistency)

    ■ Analyses seeking implausible patterns associated with processing steps, particular field sites, periods of collection, etc.

    ■ Outside reviews to ensure that analyses and interpretations are examined critically

    ■ Analyses of quality control practices

2.7. Standard for Minimizing Total Study Error (Sampling and Nonsampling)

2.7.2. Checklist for Identifying Types and Sources of Study Error

1. Check the study design for error using an error classification scheme.

2. One classification scheme identifies errors by the variability of error. To follow this scheme, check the study design for constant (bias) and variable error.

    ■ **Constant Error or Bias:** These are errors that affect the statistics in all implementations of the study design. Bias is a constant over all data collections using the same instrument.

    ■ **Variable Errors:** These are errors that vary over each data collection using the same design. The phrase "level of precision" usually refers to the sum of the variable errors. High precision means low variability.

        ■ **Sampling variance:** Denotes changes in the values of a statistic during possible replications of a survey where the sample design is fixed but different individuals are selected for different samples.

        ■ **Response variance:** Denotes variation in answers to the same question if repeatedly administered to the same person over different trials or replications (reliability).

3. Errors are also identified by their source--that is, nonobservation and observation errors. These types of error can be sources of both constant (bias) and variable error.

    ■ **Nonobservation Errors:** These are errors that arise because measurements were not taken on part of the population.

        ■ **Coverage errors:** Errors that occur because some persons are not part of the list or sampling frame used to identify members of the population.

        ■ **Nonresponse errors:** Errors that occur because some persons on the sampling frame cannot be located or refuse to provide information. (See **2.7.8. Checklist for Minimizing Unit and Item Nonresponse.**)

        ■ **Sampling errors:** Errors that occur because the statistic is computed for a sample of the population rather than for the entire population of interest.

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2.7.2. Checklist for Identifying Types and Sources of Study Error

■ **Observation Errors:** These are deviations in the answers of data providers from their true values on the measure.

■ **Interviewer errors** are associated with effects on data providers that stem from the differences in interviewers and the ways that they administer the data collection instrument.

■ **Instrument errors** are effects that stem from the wording or flow of the data collection instrument.

■ **Data provider errors** are effects that stem from differences in cognitive abilities, availability of information, and motivation to answer questions among data providers.

■ **Mode of data collection errors** are associated with the type of collection (e.g., answers provided over the telephone may be shorter than answers given in face-to-face interviews).

■ **Data processing errors** are errors associated with the coding and editing of data (e.g., errors in coding open-ended questions or key punch errors).

2.7. Standard for Minimizing Total Study Error (Sampling and Nonsampling)

2.7.8. Checklist for Minimizing Unit and Item Nonresponse

1. Make minimizing *nonresponse* a key consideration, beginning with the design phase. Use careful planning to avoid nonresponse problems.

2. Assess the data availability and/or the data providers' expected willingness and interest to provide the data.

3. Select the data provider group best able to give correct information with the least amount of burden.

4. Estimate response *burden* for each item of the data collection instrument based on a pretest and, where possible, the response burden imposed by related collections.

5. Ensure that the response burden does not exceed a reasonable level and is justified by the intended use of the data. Avoid requesting information that may be available elsewhere, that is of marginal use to study purposes, or that imposes a heavy burden.

6. Ensure that data collection forms are clear, use language and units that are familiar to the intended data providers, and conform as much as possible to the way in which the data or information are kept or processed by the data provider.

7. Whenever possible, determine and specify expected and acceptable response rates prior to conducting the data collection. Acceptable response rates vary with the type of data collected, how respondents differ from nonrespondents, and the degree of precision required.

8. Before collecting data, determine a realistic level of effort, budget, and time needed to achieve the necessary responses.

9. Provide for adequate nonresponse followup in the budget and time schedule. Achieving a high response rate nearly always requires considerable followup with data providers. For example, national mail surveys typically require considerable telephone followup, often involving nearly half of all data providers.

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2.7.8. Checklist for Minimizing Unit and Item Nonresponse

10. Ensure that there are adequate directions for mail surveys or other self-administered data collection instruments.

   ■ Make instructions clear, concise, and easy to read.

   ■ Provide uniform explanations and definitions so that data providers are able to understand the data items and provide accurate responses. Make sure data providers have a clear idea of inclusions and exclusions.

   ■ Provide instructions for the mechanical steps needed to respond or to provide an answer (e.g., "Mark an X in the appropriate box for each item."). Provide an example of the desired response technique on the survey form or electronic medium (e.g., include an illustration of a pencil marking the letter X).

   ■ Use attractive designs and incentives (e.g., a willingness to share results) to encourage responses.

   ■ Provide adequate time for data providers to complete data collection forms.

   ■ Make sure that the due date for completed data collection forms and the address and telephone number of the data collector are included in the directions. Provide a postage-paid return envelope and a telephone number to accommodate data provider inquiries.

11. Make provisions to monitor unit response rates by key strata throughout the data collection.

12. To lower unit nonresponse, develop concrete plans for obtaining data that are not supplied initially by data providers. During the design phase of a mail data collection, telephone followups should be included in the budget. The followups should be carried out when needed during the data collection phase. Keep a log of all telephone and mail followup efforts, and record reasons for nonresponse.

13. Identify key items for nonresponse followup in the survey design. Provide for field or office response edits and telephone followup of key item nonresponse.

14. Prepare a training manual for data collectors. Ensure that interviewers selected for nonresponse followup are well trained and capable of effectively communicating the importance of the data collection activities. Monitor interviews.

15. Develop plans to identify the characteristics of nonrespondents for use in weighting and imputation.

16. Plan to report response rates along with the data. For data to be weighted to national estimates, response rates should be calculated on weighted data.

Continued

2.7.8. Checklist for Minimizing Unit and Item Nonresponse

17.   Plan to report item response rates. Items with unacceptable levels of nonresponse ordinarily should not be reported in the findings. If such items are reported, point out that they are based on low response rates and provide appropriate cautions.

18.   If aggregated totals are to be reported and there are missing data, make provisions to impute the missing data from available sources such as previous years' data or through the use of techniques such as nearest neighbor imputation.

19.   Make plans to flag data that have been imputed on the data file and to describe the imputation process. (See **5.3.8. Checklist for Imputing for Item Nonresponse.**)

PURPOSE: To ensure that potential problems with data collection instruments and procedures are detected and that ways to correct them are identified.

GUIDELINES

2.8.1. A review of data collection forms, tests, interview schedules, and/or other data collection instruments and procedures should be conducted by both the design staff and by individuals who were not involved in the development of the materials.

2.8.2. A pretest should be conducted to help the design staff determine which items to use in the actual data collection and to make decisions about the utility of estimates derived from a particular design. All instruments, instructions, and procedures should be pretested.

2.8.3. Pretest procedures and conditions should be the same as those planned for the actual data collection.

2.8.4. Careful attention should be paid to the clarity of the text, appropriateness of the language, grouping and sequencing of items, skip patterns, instructions, and the estimated response time.

2.8.5. The size of the pretest should be determined by the burden, cost, and complexity of the data collection plans. The number sampled should be large enough to provide reliable information on the instruments and procedures. New large-scale data collections that are to be repeated over time should be preceded by a full-scale pretest. For less complex one-time data collections, a small, well-conducted pretest is often sufficient.

2.8.6. A pretest sample should be selected that approximates as closely as possible the sample to be used in the data collection activity itself. Any problems in selecting the desired sample should be identified during the pretest so that they can be avoided or addressed in the actual data collection activity.

2.8.7. The pretest should allow for the debriefing of data providers and data collectors to obtain their views on the adequacy of the instruments and procedures.

2.8.8. Provision should be made for additional pretests in the event that the initial pretest points out major problems that require substantial modifications in the data collection instruments and/or procedures.

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2.8. Standard for Reviewing and Pretesting Data Collection Instruments, Forms, and Procedures

2.8.9. Pretest results should provide information on the following:

■ Data collection instruments, including the reliability and validity of measures and instructions

■ Data collection procedures

■ Organization/institution liaison and scheduling procedures

■ Interviewer/data collector training and quality control

■ Data provider burden

■ Nonresponse and adjustment procedures

■ Receipt control and data processing

■ Aspects of the proposed data analysis and reporting

RELATED STANDARDS

3.1. Standard for Preparing for Data Collection

2.9. Standard for Preparing a Written Design

PURPOSE: To ensure that the key elements of the planned data collection are addressed and that the design is adequately evaluated before the data collection is conducted.

GUIDELINES

2.9.1. A written design should be prepared during the initial planning of a data collection. (See **2.9.1. Checklist for Preparing a Written Design.**)

2.9.2. The written design should be reviewed at early stages by the data requestor and other decisionmakers to ensure that they approve of the instruments, procedures, resource requirements, budget, and timelines.

2.9.3. The design should include a clear and specific description of the methodologies selected to address the study questions and the rationale for using the proposed methodologies.

2.9.4. The sample design, if applicable, should be clearly described. (See **2.3.3. Checklist for Identifying Sampling Plan Contents.**)

2.9.5. The design should include a clear description of data elements, data collection instruments, and data collection procedures (e.g., administrative records, mail surveys, interviews, or observations). This description should include definitions of data elements or items. The design should also describe procedures for contacting and communicating with data providers and for selecting and training data collectors.

2.9.6. The design should specify clearly how the instruments and procedures will be pretested and used in a data collection. The design should also specify the criteria for evaluation, as well as mechanisms for revising or improving the plan.

2.9.7. The design should specify procedures for data collection, processing, analysis, and reporting. The design should reflect input from data collectors, processors, analysts, and reporters, as well as informing them of their responsibilities.

2.9.8. The data collection plan should provide for identification of potential sources of and reduction of total study error (sampling and nonsampling).

2.9.9. A time schedule should be specified for major events, as well as procedures for corrective action if major milestones are missed.

2.9.10. In all cases, the design should provide for evaluation of the data collection activities to determine the extent to which major goals and milestones have been achieved and to identify areas where changes are needed.

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2.9. Standard for Preparing a Written Design

2.9.11. The design should be kept current and should document changes and modifications in the plan.

RELATED STANDARDS

    2.7.   Standard for Minimizing Total Study Error (Sampling and Nonsampling)
    3.1.   Standard for Preparing for Data Collection
    4.1.   Standard for Planning Systems Requirements
    4.5.   Standard for Planning for Data Preparation
    5.1.   Standard for Preparing Analysis Plan
    5.4.   Standard for Estimating Sampling and Nonsampling Errors

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2.9. Standard for Preparing a Written Design

2.9.1. Checklist for Preparing a Written Design

The written design should include the following:

1. Identification of policy considerations, program goals, and problem areas that the data collection activities are intended to address

2. Summary of relevant literature and related issues

3. Identification of primary target audiences

4. Articulation of basic assumptions

5. Statement of the study questions

6. Description and justification of methodologies or design

7. Definitions of relevant concepts; descriptions of how terms are operationalized and measurement scales selected

8. A detailed sampling plan that includes a description of the sampling frame, design, and procedures (See **2.3.3. Checklist for Identifying Sampling Plan Contents.**)

9. Description of procedures for collecting data and for developing or selecting data collection instruments; citation of existing information sources

10. Description of the evaluation or pretest and its design

11. Description of the data processing plan

12. Description of planned analyses and reports

13. Time schedule

14. Budget

PHASE 3. DATA COLLECTION

3.0. Introduction to Data Collection

The collection of education-related statistics frequently depends upon the efforts of individuals for whom assembling data is a minor portion of their responsibilities. For the collection phase to be a success, data collectors must enlist the cooperation of these data providers, establish a communications channel, conform to local and state collection regulations and protocols, and minimize the burden and intrusiveness of the data collection activities. Data collectors must effectively handle myriad management activities, communicate with data providers at different locations and organizations, schedule data collection activities that may involve hundreds of people, and provide for the manual or electronic transfer of data from numerous collection sites across the country.

The structure of the American education system creates unique data collection considerations. For example, the federal government collects data from state education agencies which, in turn, rely on local school systems to gather data from students and teachers within schools. Thus, the many operational and authority levels through which data must pass, along with the need to recognize legal and ethical obligations, add to the complexity of data collection and the need for collection standards.

The standards contained in this phase encompass key principles associated with the data collection process. The standards are intended to address all types of data collections; however, individual standards may apply to some types of activities more than others.

Words in italics are defined in the glossary.

3.1. Standard for Preparing for Data Collection

PURPOSE: To ensure that data collection activities are administered efficiently and effectively.

GUIDELINES

3.1.1. Data collectors should participate in the development of a data collection plan and schedule during the design phase. The data collection plan should include:

■ Rationale for data collection

■ All data collection instruments and the instructions for completing them

■ A list or description of the target population, including information for locating each selected data supplier or unit (e.g., mailing address, telephone number, identification number)

■ A description of the sampling design, when appropriate

3.1.2. The plan should also describe all administrative steps used in each data collection activity, including:

■ Distributing the data collection forms and instructions

■ Recording data on the forms or other media (e.g., floppy disks, magnetic tape)

■ Returning the forms

■ Keeping a record of each time a form is returned

3.1.3. Data collectors should consider alternative approaches to collecting data (e.g., technologies, media, procedures).

3.1.4. Pretest results should be reviewed to determine if the data collection plan needs modification.

3.1.5. Procedures should be developed to monitor data collection activities.

3.1.6. Data collectors should contact appropriate individuals before initiating data collection to:

■ Explain the purposes of the data collection activity

■ Obtain appropriate authorization and clearances

■ Review any relevant laws, regulations, or administrative procedures that may affect the data collection activity

■ Agree on data collection dates and milestones

■ Establish a means of communication (e.g., contact person)

■ Identify the most appropriate and knowledgeable data providers

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3.1. Standard for Preparing for Data Collection

3.1.7. Materials for training data collection staff should be developed.

3.1.8. An adequate supply of data collection instruments, instructions, and administrative guides, including alternative forms for special populations, should be made available at each site before beginning the data collection.

3.1.9. Procedures should be implemented to ensure that data collection forms (or electronic formats) are received by the intended data providers. These procedures may include calling a small sample of data providers to verify receipt, providing a postcard to be returned by data providers when they receive the forms, or using electronic mail.

3.1.10. Data collectors should develop and implement recordkeeping plans, including maintaining a log noting return of forms or electronic media.

3.1.11. Data collectors should develop and implement security plans for handling and storing confidential or sensitive documents or electronic media.

3.1.12. Arrangements for delivering data should be coordinated with data processing and analysis staffs and analysts.

RELATED STANDARDS

2.2. Standard for Choosing the Data Collection Methods
2.5. Standard for Transforming Study Question Concepts into Measures
2.6. Standard for Designing the Data Collection Instrument
2.7. Standard for Minimizing Total Study Error (Sampling and Nonsampling)
2.8. Standard for Reviewing and Pretesting Data Collection Instruments, Forms, and Procedures
3.2. Standard for Selecting and Training Data Collectors

3.2. Standard for Selecting and Training Data Collectors

PURPOSE: To ensure that the persons responsible for collecting and reporting data have the knowledge and skills to conduct the planned activities.

GUIDELINES

3.2.1. Data requestors should identify any special knowledge, experience, certification, or training required for data collectors.

3.2.2. Selection and training should reflect the complexity of the project. For complex data collections, training should include, at a minimum, a thorough explanation of the goals of the data collection activities, instructions for deviating from or expanding on items, and methods for documenting the collection activity, including any problems encountered. (See **3.2.2. Checklist for Training of Data Collectors.**)

3.2.3. Training should be designed based on the collection methodology to be used. For example, more extensive training is usually required for instruments with *open-ended* items.

3.2.4. Personnel selected and trained to evaluate programs should not be part of the staff or management of the program being evaluated.

3.2.5. A contact person should be available to answer questions from data collectors before and during the data collection.

3.2.6. Data collectors should be sensitive to data provider characteristics that may influence the data collection. Training of data collectors should address cultural, ethnic, and other population characteristics that may affect the data collection.

3.2.7. Staffing resources should be sufficient to ensure that replacement personnel are available on an as-needed basis.

3.2.8. Data collectors should practice with the data collection instrument (administer the test, conduct the interviews, transcribe the record). When the instrument requires data collectors to make judgments or interpretations, staff training should ensure reliability of responses among data collectors.

3.2.9. A review should be conducted regarding problems encountered by data collectors throughout the data collection phase, and provisions should be made for followup training.

RELATED STANDARDS

3.3. Standard for Ethical Treatment of Data Providers
3.4. Standard for Minimizing Burden and Nonresponse

3.2. Standard for Selecting and Training Data Collectors

3.2.2. Checklist for Training of Data Collectors

Training should be designed to ensure that data collectors understand:

1. All definitions used in the data collection instrument

2. The persons from whom or the records from which the data are to be collected (e.g., Which teachers will be interviewed? What classes will take the test? What records will be examined?)

3. The date, time, and duration of the data collection activity

4. The required procedures for administering the data collection activity

5. Ethical and legal responsibilities to prevent unauthorized use or disclosure of data (If the data are particularly sensitive, it may be appropriate to require data collectors to sign statements affirming that they recognize their responsibilities and agree to preserve confidentiality.)

6. Procedures for obtaining explanations or help during the data collection

7. Limits on acceptable deviation from specified procedures

8. Methods for reporting data

9. Methods for reporting occurrences during the data collection that may affect data quality or other aspects of the findings

10. Appropriate ways of collecting data to avoid influencing responses

11. The need for sensitivity to characteristics of data providers that may influence the data collection (e.g., culturally sensitive issues)

3.3. Standard for Ethical Treatment of Data Providers

PURPOSE: To ensure that data collection activities are carried out with respect for the rights and dignity of the respondents.

GUIDELINES

3.3.1. Data collection activities should be carried out in a manner that minimizes embarrassment or inconvenience and avoids harm to data providers and other participants (e.g., students, teachers, education administrators). When personal questions must be asked, data collectors should arrange for data providers to respond in private.

3.3.2. Data collection activities should be conducted in a manner that results in minimal disruption of data provider activities.

3.3.3. When a data collection activity provides a benefit for one group of data providers, consideration should be given to providing an equal benefit to any control group (e.g., students should not be intentionally deprived of educational benefits).

3.3.4. Data providers or their legal guardians should be notified in advance whether participation is mandatory or voluntary. If participation is mandatory, data collectors should discuss the relevant statutory and regulatory citations with data providers and explain the meaning of these citations in clear language. If participation is voluntary, data collectors should assure data providers or their legal guardians that they will not be penalized for declining to participate. At the time of the data collection, data collectors should remind data providers of the purpose of the study and whether participation is voluntary.

3.3.5. Data collection procedures should ensure that respondents have the opportunity to provide accurate answers regardless of their cultural or educational backgrounds.

3.3.6. Appropriate provisions should be made for participants who are physically disabled or who require other special considerations.

3.3.7. Data collectors should explain the extent to which answers will be kept confidential. Promises of confidentiality should not be made if statutory, regulatory, or administrative procedures require or permit disclosure.

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3.3. Standard for Ethical Treatment of Data Providers

3.3.8. Data collectors should ensure that the confidentiality of data is protected

- Data collectors should not discuss confidential aspects of the data collection activity with unauthorized individuals.

- Copies of records, test scores, and other data should be kept in a secure place and delivered promptly to the appropriate location or person.

- Notes and other documentation kept during the data collection activity should not contain identifying information that is not expressly required by the research design.

- Data collection activities should be carried out in compliance with applicable federal, state, and local laws concerning privacy and confidentiality.

- Records should be destroyed upon completion of requirements for the data collection activity.

3.4. Standard for Minimizing Burden and Nonresponse

PURPOSE: To ensure that data collections are minimally intrusive and that the data collected are representative of the population being studied.

GUIDELINES

3.4.1. Data collectors should secure the cooperation of appropriate individuals and organizational levels before beginning data collection and should follow accepted administrative protocols (e.g., states should be contacted before school districts; superintendents should be consulted before school principals).

3.4.2. Data collectors should take steps to minimize the time, cost, and effort required of data providers (e.g., providing self-addressed stamped envelopes for return of forms).

3.4.3. The data collection should be scheduled, to the extent possible, at the convenience of the data providers and with appropriate lead time. Established schedules should be adhered to strictly unless data providers request a justifiable change.

3.4.4. Data collectors should contact data providers and the heads of their organizations before the collection to confirm that appropriate arrangements have been made for the data collection.

3.4.5. Endorsements of the goals of the data collection activities by the data providers' peers and constituent organizations should be obtained, when appropriate, and made available to the data providers.

3.4.6. Data collectors should give data providers the following information when requesting that they participate in a data collection activity:

- Purpose and need for data
- Estimated time and burden imposed
- Importance of data providers' participation
- Confidentiality of response

3.4.7. Local flexibility in the data collection plan should be permitted whenever feasible.

3.4.8. Trained personnel should be available to answer data providers' questions. Persons who want more information prior to responding to the data request should be able to reach trained personnel by telephone (the telephone number should be given to all data providers).

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3.4. Standard for Minimizing Burden and Nonresponse

3.4.9. Data collectors should offer data providers an opportunity to request a summary of the study findings when feasible.

3.4.10. Data collections should be monitored to ensure that data collection procedures are followed.

3.4.11. The design, budget, and schedule should provide for *nonresponse* followup (including identifying reasons for nonresponse). Those responsible for conducting followups should be trained in techniques for soliciting study participation.

RELATED STANDARDS

2.6. Standard for Designing the Data Collection Instrument

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3.5. Standard for Implementing Data Collection Quality Control Procedures

PURPOSE: To ensure that collected data are accurate and complete.

GUIDELINES

3.5.1. Procedures should be implemented to review returned data collection forms for completeness and consistency.

3.5.2. Specifications should be established for acceptable *range checks*, *valid code checks*, and *logic* or *consistency edits*. Related data should be reviewed to help determine appropriate edits.

3.5.3. Data collection procedures should include verifying a subsample of data for accuracy and completeness (e.g., recontact a selected number of data providers; review a subsample of administrative records).

3.5.4. Followup procedures should be implemented to ensure that unit and item response rates meet design specifications.

3.6. Standard for Documenting Data Collections

PURPOSE: To ensure that events and conditions affecting the data collection are documented.

GUIDELINES

3.6.1. Data collectors should record any problems in the data collection instruments, instructions, or administration identified during the pretest or data collection.

3.6.2. Data collectors should record any deviations from the data collection plan and the reasons for the deviations.

3.6.3. Data collectors should record instances of unit and item nonresponse and the reasons for their existence (e.g., the number of illegible or missing records).

3.6.4. Data collectors should record information concerning each contact with data providers and other appropriate individuals including the purpose of the call and the resolution or action taken.

3.6.5. Field notes should be submitted and reviewed immediately after a data collection for completeness, accuracy, and potential bias. Appropriate feedback should be given to the data collector.

3.6.6. A summary of factors encountered during the data collection that may influence interpretation of the data should be included in the final documentation.

PHASE 4. DATA PREPARATION AND PROCESSING

4.0.   Introduction to Data Preparation and Processing

4.1.   Planning Systems Requirements

4.2.   Desi.jmg Data Processing Systems

4.3.   Developing Data Processing Systems

4.4.   Testing Data Processing Systems

4.5.   Planning for Data Preparation

4.6.   Preparing Data for Processing and Analysis

4.7.   Maintaining Programs and Data Files

4.8.   Documenting Data Processing Activities

4.9.   Evaluating Data Processing Systems

4.0. Introduction to Data Preparation and Processing

The standards in this phase cover the process of transforming raw data into a format that can be analyzed and the system by which this transformation is accomplished. The standards can be used to guide an agency's in-house data preparation and processing activities or to provide specifications to an outside data processing contractor to help ensure that its procedures meet the agency's requirements. These standards can also provide staff in other phases of the data collection activity with an insight into data processing activities.

Data processing systems may be manual or automated and may be operated on microcomputers, minicomputers, or mainframe computers. Although reference is often made in this phase to automated systems, these standards can be adapted for any data processing system. The standards are intended to guide data preparation and processing efforts for individual data collection activities. Although applicable to automated data processing as general principles, the standards are not intended to provide a complete description of all systems development, programming, or hardware requirements necessary for the efficient operation of a computing facility. The data processing standards of the American National Standards Institute (ANSI) or the Federal Information Processing Standards (FIPS) should be consulted for technical systems development.

The first four standards in this phase address the development of an information processing system in four stages: Systems Requirements, Design, Development, and Testing. The next two standards cover preparing data for processing, which means converting data appearing on data collection instruments into useable computer data files. Attention should be given to data preparation activities during the early stages of systems development. The final three standards address system maintenance and operations and data management. Taken together, the standards in this phase serve as a management tool for reviewing data processing plans, costs, and progress.

As noted in several of these standards, it is essential to establish and maintain effective communication between the data processors and other staff members during the entire period in which the data collection activities are in operation. Prior to establishing a budget, the data processing staff should discuss the project requirements with other staff members to determine if any additional data processing personnel are needed.

Because of their intertwined responsibilities, communication between the data processing and data collection staffs is particularly important during data preparation. Data collection forms move between collection staff and processing staff as they are received, logged, manually coded and checked, sent for followup efforts, key entered, and machine edited. Indeed, collection staff at some agencies handle several of the data preparation activities discussed in the data processing standards.

Words in italics are defined in the glossary.

4.1. Standard for Planning Systems Requirements

PURPOSE: To ensure that there are specified objectives and expected outcomes for data processing systems.

GUIDELINES

4.1.1. Data requestors, producers, and users should work as a team throughout the design phase to create clear and unambiguous specifications that define the needs of the data requestors and provide guidelines for data *processing*.

4.1.2. In determining the requirements for the data processing system, data requestors and data processors should consider the acceptable level of accuracy, the complexity of the data analysis, and the format and media for delivering the final data.

4.1.3. The first step in the development of an information system should be the *Systems Requirements Stage*, which defines the scope of the system.

4.1.4. During the Systems Requirements Stage, the requestor of the automated system should provide a written statement describing the problems or needs that the system will address and the expected outcomes.

4.1.5. Data processing staff should meet with other project members to specify and define system requirements, including:

■ Proposed benefits

■ Cost

■ Timelines

■ Resource requirements

■ General constraints

■ Alternative systems (including cost benefits)

■ Measurable objectives to be obtained

■ Recommendations for system development

Continued

4.1. Standard for Planning Systems Requirements

4.1.6. Specifications to meet systems requirements should include, as appropriate, guidelines for the following:

- Methods for collecting the data

- Instruments to be used for data collection

- Time period during which the data should be collected

- Time period for data preparation activities

- Reporting deadlines

- *Imputation* methodology

- General guidelines for data conversion and processing

- Magnetic storage specifications

- Preliminary layout for final data files

- Preferred formats for output reports

4.1.7. A system description should be prepared of the tasks and timelines required for data input, processing, and output for each function and process in the automated system (using data flow diagrams and system flowcharts).

4.1.8. Preliminary examples of reports or other data presentations (such as tables) should be developed to demonstrate the types of information the system is expected to produce and to ensure that the proposed system will provide the desired results.

4.1.9. Before leaving the Systems Requirements Stage, data processors and others involved in the data collection activity, including the systems requestors and the design and analysis staff, should agree on all specifications.

RELATED STANDARDS

4.5.   Standard for Planning for Data Preparation

4.2. Standard for Designing Data Processing Systems

PURPOSE: To develop a systems design that is consistent with systems specifications.

GUIDELINES

4.2.1. The *Systems Design Stage* should build upon the system requirements specified in the *Systems Requirements Stage*, proceeding from statements about what the system will do to descriptions of how the system will accomplish these goals.

4.2.2. System specifications should include *file* descriptions that identify and describe *data elements*, *record format*, and *file design*.

4.2.3. A preliminary list and description of the data elements that will be used in the automated system should be included in a *data dictionary*.

4.2.4. The systems design should specify control features that will help to ensure the accuracy and completeness of each *input*, process, and *output*. These features may include audit trails, control totals, status flags, system performance statistics, audit and error reports, and system interrupt and restart procedures.

4.2.5. The systems design should address data security and confidentiality issues.

4.2.6. Design specifications should be written for all computer programs needed for the operation of the system. Each program should be designed to perform a single function or several closely related functions.

4.2.7. Specifications for a computer program should describe how the program will accomplish its stated purposes, the processes the program will perform, the file and record formats to be used, and the logic to be employed. The specifications should be written so that they can be translated into computer program code.

4.2.8. The data processing staff should consider the needs of those who will use the data when determining the content, format, and media for presenting final data. The likelihood that there will be future requests for data or analysis should be taken into account in the data processing systems specifications.

4.2.9. The criteria and method to be used for evaluating how well the data processing system performs should be determined.

4.2.10. A plan should be developed for testing the system that specifies the functions to be tested, the data required to test the program functions, and the expected test results.

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4.2. Standard for Designing Data Processing Systems

4.2.11. Staff from all phases of the data collection activity should understand and approve the design specifications before the *Systems Development Stage* begins.

4.2.12. All tasks that are part of the Systems Design Stage should be fully documented to meet the needs of potential users as well as of programmers who may be required to modify the system for future use.

RELATED STANDARDS

4.4. Standard for Testing Data Processing Systems
4.7. Standard for Maintaining Programs and Data Files.
4.8. Standard for Documenting Data Processing Activities
4.9. Standard for Evaluating Data Processing Systems

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4.3. Standard for Developing Data Processing Systems

PURPOSE: To develop computer programs that adhere to the systems design and specifications.

GUIDELINES

4.3.1. In the *Systems Development Stage*, systems design specifications should be converted into written computer programs.

4.3.2. Programmers and data processors should adhere fully to the agreed-upon specifications and consult with data requestors if there appears to be a need for any departure from the specifications.

4.3.3. The data producer should determine whether ad hoc requests for data or analysis not specifically envisioned in the systems design can be handled in a cost-effective manner. The data processing staff should specify the cost and effort required to fulfill ad hoc requests.

4.3.5. All programs should be fully documented to meet the needs of system users and of programmers who may be required to modify the system.

RELATED STANDARDS

4.8. Standard for Documenting Data Processing Activities

4.4. Standard for Testing Data Processing Systems

PURPOSE: To ensure that all computer programs perform under the specified conditions.

GUIDELINES

4.4.1. Before any system is considered ready for operation, all programs should be tested during the *Systems Testing Stage* (individually and as a complete system) in accordance with the system test plan developed during the *Systems Design Stage*.

4.4.2. Final testing should be performed by the data requestor or producer.

4.4.3. All program and system test results should be documented in a test report that specifies each function tested, the test data used, and the expected and actual results. Any unexpected findings should be explained and errors corrected, as appropriate.

4.4.4. Computer program changes should be documented internally (within the programs).

4.4.5. The appropriate members of the data producer's staff should review and approve test results before concluding the Systems Testing Stage.

RELATED STANDARDS

4.2. Standard for Designing Data Processing Systems
4.8. Standard for Documenting Data Processing Activities

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4.5. Standard for Planning for Data Preparation

PURPOSE: To develop all materials necessary for preparing for processing.

GUIDELINES

4.5.1. Planning for data preparation should begin during the early stages of a data collection activity. Specific factors to examine when developing the plan include:

- Type of data to be collected

- Type of edit checks needed

- Method for receipt control

- Computer system to be used for the study

- Timing and volume of data retrieval

- *Sample* size

4.5.2. A detailed schedule should be developed of data preparation tasks, and copies should be provided to all appropriate staff including data processors. Schedule items include:

- Dates that training sessions will be held for manual coding and editing

- Date that edit specifications will be submitted to data processors

- Date that edit program will be tested and ready to run

- Dates that test data and actual data will be submitted to data entry

- Date that a clean file will be available

4.5.3. The data processors should be consulted throughout the planning stages of a data collection activity and fully informed about the types of support they will be asked to provide during the activity. Data processors should receive a copy of the proposed project schedule.

4.5.4. The data preparation and processing staffs should jointly determine the machine editing system to be used. A plan should be developed to familiarize data preparation staff with the different machine editing systems that are available.

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4.5. Standard for Planning for Data Preparation

4.5.5. Training materials for manual or on-line coding and editing (including a *codebook* and sample forms) and data entry instructions should be prepared.

4.5.6. *Range checks* and *logic* or *consistency edits* should be established. An edit program should be created to detect *out-of-range* or invalid *responses* and key-entry errors.

4.5.7. Procedures for reviewing and coding the data should be clear and complete. (See **4.6.2. Checklist for Coding Data**.) Coding staff should be trained to follow the procedures and to document problems.

4.5.8. When *imputation* is requested, data processors should check with the data analysts to determine the appropriateness of imputing data for some instances of *item nonresponse*. The need for and type of imputation depends upon the type of collection and analysis activity and the type of data. (See **5.3.8. Checklist for Imputing for Item Nonresponse**.)

4.6. Standard for Preparing Data for Processing and Analysis

PURPOSE: To ensure that data are accurately converted and prepared for processing and analysis.

GUIDELINES

4.6.1. When data are received (either on forms or electronically), receipt should be logged on computer or in a log book so that all data forms or files can be tracked from their date of receipt through data followup and final key entry. (Electronic files should contain both transmittal and run dates, as well as other critical information identifying the data provider.)

4.6.2. All forms should be reviewed for completeness. (See **4.6.2. Checklist for Coding Data.**) Forms with items that have not been completed or forms with *out-of-range* or invalid *responses* should go to the data collection staff for followup. When there are out-of-range or invalid responses, the data collection staff should receive an explanation of the reasons that the responses are unacceptable.

4.6.3. Data forms from out-of-scope providers or forms that are still missing key items or a significant number of items after data followup should be evaluated for rejection in accordance with specified criteria.

4.6.4. Whether data are entered into an automated system from data collection forms, electronically, or directly into a *computer assisted telephone interviewing* (CATI) system or a *computer assisted personal interviewing* (CAPI) system, data should be thoroughly checked for key-entry errors. *Range checks* and *logic* or *consistency edits* programmed into CATI or other automated systems can flag values that do not fall within the specified range of possible values; however, these checks and edits cannot detect values that are within range but still inaccurate.

4.6.5. In order to verify that data are being entered correctly, a reasonably sized sample or all of the forms should be keyed twice (by different staff). Differences between data files keyed from the same data collection forms should be resolved by referring to the original forms.

4.6.6. When data are entered through machine-readable techniques (e.g., bar-coding, optical scanning), a sample set of data should be verified periodically to ensure accurate conversion.

4.6.7. After the data are edited, an error report or electronic file should be produced listing data that were flagged as invalid--with explanations for why they were flagged (i.e., which range check or logic edit has not been met). This report or electronic file should be reviewed, the errors checked against the original data collection forms, and corrections entered.

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4.6.   Standard for Preparing Data for Processing and Analysis

4.6.2. Checklist for Coding Data

1.   Determine in advance all acceptable responses to each *closed-ended* item on the data collection form and, if appropriate, assign numerical values or codes to each response.

2.   Assign consistent numerical values to responses so that a given response always has the same value and no other response has that value. Assign values or codes for blanks or missing data.

3.   Maintain complete and detailed *codebooks* with the following information:

   ■   Columns occupied by each variable in the data file
   ■   Variable names
   ■   Values assigned to each variable

4.   Make multiple copies of the codebook and keep them in secure places.

5.   Stamp the date on incoming data collection forms when they are received at the project site and log them in on computer or in a log book.

6.   Review data collection forms as they are received to confirm that all necessary codes have been created. Add additional codes as required in order to eliminate the need for data entry staff to make decisions while entering data.

7.   Keep a log of all *coding* decisions to ensure that coded data can be interpreted in the future.

8.   Note on the data collection form the value assigned to each response unless codes are preprinted on the data form.

9.   Identify the coder of each form (e.g., write initials in corner) and note in the log book where or to whom the form is being sent (e.g., to data collection for followup or to data entry).

10.   Perform systematic quality control on coders' work for accuracy and intercoder reliability. Review a high percentage of work initially and move to a lower percentage as acceptable levels of accuracy are reached. Have a second person code a portion of each coder's forms.

4.7. Standard for Maintaining Programs and Data Files

PURPOSE: To ensure that authorized persons can easily access current, accurate data.

GUIDELINES

4.7.1. Procedures should be developed for ensuring that data are properly protected at all phases of data preparation and processing. This holds true whether the data are being processed manually or by an automated system. (See **4.7.1. Checklist for Backing Up Programs and Data Files.**) Procedures for automated systems should include backing up at each step, beginning with the initial data collection process and continuing through the final analysis of data and publication of reports.

4.7.2. Data preparation and processing staff should be trained in the policies and procedures for proper backup of data *files*. Staff awareness should be maintained by periodically scheduling simulated test disasters.

4.7.3. Data processing staff should obtain information from other staff members about the requirements for maintaining historical data files or programs for audit purposes. Data files or programs that are used for allocating funds are often subject to specified retention periods. File *archives* should be considered for any systems that have a high volume of transaction processing. (See **4.7.3. Checklist for Retaining Programs and Data Files.**)

4.7.4. Data processing staff should meet with other project staff to identify applicable federal, state, and local laws and policies regarding the confidentiality of data and the limitations on access to those data by unauthorized persons. At the same time, data should be made available to researchers and the public in keeping with applicable laws governing access to public records.

4.7.5. Persons hired or recruited to process or otherwise work with data should meet applicable confidentiality and access guidelines. They should have a reasonable disinterest in or be unfamiliar with the individuals or entities from whom the data are being collected, and they should participate in training and orientation programs designed to ensure that they understand, accept, and follow these and all related guidelines.

4.7.6. Data processing staff should store data using procedures that minimize the potential for accidental loss or damage (e.g., appropriate labeling to reduce the likelihood that paper or film documents will be destroyed or misfiled) and that enable the staff to access or recover data within a reasonable time and at a reasonable cost.

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4.7. Standard for Maintaining Programs and Data Files

4.7.7. The medium used for storing data should be chosen based on the needs of users who will access the data and the size of the project. Storage media include:

- Original data collection forms (e.g., in a file cabinet)

- Magnetic tape

- Microfiche/microfilm

- Hard disk

- Floppy disk

- *CD ROM*

- Optical disk

4.7.8. Access methods should be chosen based on the number of persons who will access the data, the locations and processing capabilities of these individuals, frequency of access, and requirements for simultaneous access. Data can be accessed through:

- Hard copy reports

- Direct connections to mainframe computer facilities

- Local/wide area network attachments

- Modem access to mainframe computers and network systems

- Stand-alone microcomputers

Data can be accessed in the following types of file structures:

- Database management system

- Fiat *file* on a floppy disk

- Indexed file

4.7.9. Staff should develop a priority list of functions that are critical to the data processing system and determine how these functions would be carried out within a reasonable time period if computer equipment went down or data files were lost.

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4.7. Standard for Maintaining Programs and Data Files

4.7.10. The following items should be duplicated and stored offsite:

- A catalog of the automated system and a description of the application (with the name and telephone number of a contact person)

- A log with the location of backup software and program files and a priority list for restoration of service

- Telephone numbers of software maintenance providers

- Special setup instructions, if any, for configuring software

RELATED STANDARDS

6.3. Standard for Releasing Data

4.7. Standard for Maintaining Programs and Data Files

4.7.1. Checklist for Backing Up Programs and Data Files

1. Develop a schedule that specifies when to create backup *files*. The backup schedule depends upon factors such as how often data files are updated, the consequences of losing data, and the cost of recovering lost data.

2. Create a backup copy of each computer program every time a change is made in the program code to ensure that data can be reconstructed.

3. Place identification numbers, including the date and time the last change was made, on each version of a computer program. Consider placing an identification flag on records to indicate which version of a program was used to process the data. The version flag can be used to select for regeneration records that have been processed by a faulty version of a computer program.

4. Back up *transaction files* generated by data entry or interactive system logs and *master files* for possible system or *file regeneration*.

4.7.5. Checklist for Retaining Programs and Data Files

1. Determine by checking with other project staff if data *files* are subject to state or federal retention laws and, if so, comply with retention period requirements for *file recovery* or system restart procedures for automated or manual systems.

2. Determine the number of *records*, files, and programs that need to be retained.

3. Establish a procedure and schedule for storing historical copies of files or programs in a secure location.

4. Determine the life expectancy of the storage media that are being used and schedule regeneration of copies prior to the expiration dates.

5. Keep multiple copies of historical files as backups in case some files are corrupted or damaged during storage.

6. Develop a file-naming convention to identify files stored at the off-site facility.

7. Develop a plan for documenting the retention of data files and programs. Use a tape-labeling system to clearly identify the contents and the intended destruction dates (if any) of data files in order to prevent accidental erasure or destruction of files.

8. Store hard copy documentation of historical files in at least two locations to project against loss or destruction.

9. Develop a procedure for producing archive files after each *transaction* or *master file* update (or within a reasonable timeframe for a particular processing facility).

10. Document archival procedures and include archival files in backup and disaster recovery procedures.

4.8.   Standard for Documenting Data Processing Activities

PURPOSE: To ensure that data processing system components, development, modifications, and uses are adequately described for system development, maintenance, and enhancements.

GUIDELINES

4.8.1.   A complete set of documentation for the requirements, design, development, testing, and use of the data processing system should be kept in a central, safe location. A note should be made of the location of any documentation stored elsewhere.

4.8.2.   Systems and/or program planning and design activities should be documented. Typically, these documents consist of systems and program requirements, specifications, preliminary and detailed design documents, database specifications, program specifications, test plans, and test analysis reports. (See **4.8.2. Checklist for Writing Software Documentation.**)

4.8.3.   Process descriptions should explain the purpose of the process, the approach, the process flow (including net *inputs* and *outputs*), and the staff skill levels required to perform the process.

4.8.4.   Hardware documentation should be adequate to permit the staff to use the equipment efficiently and effectively. Overly technical descriptions, however, should be avoided. The documentation should identify the hardware model, capabilities (main memory, speed, and compatibility with other hardware), operating system, operating instructions, communication requirements, and limitations. A list should be kept of those who use the documentation, and special maintenance requirements should be noted.

4.8.5.   User documentation should enable the staff to access and use computer programs and data *files* effectively. The documentation should be written in nontechnical language and should not include detailed technical descriptions of computer programs. (See **4.8.5. Checklist for Writing User Documentation.**)

4.8.6.   A consistent format should be used to label and document tapes for release.

4.8. Standard for Documenting Data Processing Activities

4.8.2. Checklist for Writing Software Documentation

1. Provide a general information section in the software systems documentation that describes:

   ■ The hardware environment

   ■ Support software such as the operating system and compilers

   ■ The programming languages

   ■ Computer memory requirements

   ■ Storage media such as magnetic tape or floppy diskette

   ■ The system libraries and data-set naming conventions

   ■ The sequence of software operations

   ■ System maintenance procedures

2. Depict the sequence of operations, including input and output files and tables, in a *system flowchart* and specify the names and locations of program listings and file layouts.

3. Document each discrete module separately:

   ■ List all program inputs

   ■ Describe the *processing* logic

   ■ Define program variables

   ■ Explain algorithms

   ■ Identify and describe unusual programming approaches

   ■ Describe the program run procedures, including required parameters

   ■ Identify and define output files

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4.8.2. Checklist for Writing Software Documentation

4.   Provide comments as part of each computer program that are sufficient to enable a person other than the original programmer to modify the program with little or no difficulty. Include an introductory paragraph describing the purpose of the program and giving the date the program was created or modified. Introduce each major processing routine with a brief explanation of its purpose.

5.   Document program maintenance procedures for systems and programs that will be in use long enough to make modification likely. The documentation should include:

   ■   A description of programming conventions

   ■   Program testing and correction procedures

   ■   Special maintenance requirements such as table updates or security provisions

   ■   The location of program listings

   ■   Typical program execution time

   ■   Data-set naming conventions

6.   Cross-reference and index all documentation.

4.8. Standard for Documenting Data Processing Activities

4.8.5. Checklist for Writing User Documentation

1. Include the following information in program documentation for users:

   ■ Intended audience

   ■ Program name

   ■ Location (appropriate library or directory reference)

   □ Run instructions, including parameters required for successful execution

   ■ Typical run time

   ■ Identification and description of *files*, reports, and other program outputs

2. Specify the following:

   ■ Directory or library name

   ■ Data set name

   ■ Recording medium (e.g., tape, disk)

   ■ *Record* length

   ■ File size in the data file documentation

3. List each *data element* by its mnemonic name and meaning, starting position on the file, length in characters, and data type (alpha or numeric).

4. Use a comments field where appropriate to provide additional information about a data element. This information may include the element's permissible values and meanings, the composition of derived elements, and the format of specific elements such as dates.

5. Make sample output formats available for reference, training, and comparisons to actual output.

6. Walk through documentation with potential program users and modify as necessary.

4.9. Standard for Evaluating Data Processing Systems

PURPOSE: To ensure that data processing systems function as intended.

GUIDELINES

4.9.1. Data producers should periodically review the evaluation criteria and methods developed during the *Systems Design Stage*.

4.9.2. Evaluation of automated systems should focus on the accuracy of the data, adequacy of the controls and security procedures, performance of hardware and software, and the degree to which the expected outcomes and costs are attained.

4.9.3. A procedure should be developed to evaluate the handling of problems encountered during automated *processing*. (See **4.9.3. Checklist for Documenting Data Processing Problem Resolution.**) The procedure may be manual or automated depending on the complexity of the system and the volume of transactions.

4.9.4. Evaluation of data preparation should address the overall flow of data collection forms through the system, as well as the percentage of forms verified and the accuracy rates for *coding* and key entry.

4.9.5. Data processing staff should meet periodically with staff from other phases of the data collection activity to evaluate how well systems requirements are being met and the extent to which expected outcomes are being achieved.

RELATED STANDARDS AND CHECKLISTS

4.1. Standard for Planning for Systems Requirements
4.2. Standard for Designing Data Processing Systems
4.3. Standard for Developing Data Processing Systems
4.6. Standard for Preparing Data for Processing and Analysis

4.9. Evaluating Data Processing Systems

4.9.3. Checklist for Documenting Data Processing Problem Resolution

1. Maintain a problem documentation log to record automated system malfunctions.

2. Design problem-handling procedures that require a user or operator to complete a problem report form or that specify an automated report *file* that catalogs problem reports generated by either the computer system or a system operator.

3. Include sufficient information about a problem to enable an analyst, computer programmer, or system operator to follow up on the problem. Such information may include:

   ■ Name of individual discovering the problem

   ■ Program or procedure name

   ■ Job step where program problem is found

   ■ Program address within job step

   ■ Names of files being processed

   ■ Date and time problem occurred

   ■ Description of problem

   ■ Copies of error messages or listings

   ■ Suggested resolution

   ■ Action taken

4. Make problem documentation available to systems programmers, operators, and data users. This documentation is particularly important to data users because problems encountered during processing may affect the integrity of the data or suggest problems with the data collection methodology.

5. Incorporate problem reporting procedures into the *Systems Development Stage* in order to ensure effective communication among users, programmers, and operators.

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PHASE 5. DATA ANALYSIS

5.0. Introduction to Data Analysis

Data analysis is the process by which information generated by the design, data collection, and data processing is brought together and used to answer the original study questions. The precise sequence of steps involved and the particular analytic techniques employed may vary greatly depending on a study's purpose and design. For example, some studies require weighting of data and attention to sampling errors--others do not. Thus, different groups of standards included in this phase apply to different types of analyses.

The decision made during the design phase about whether to use a sample or universe of the population being studied determines, in part, the types of analyses that will be required and the standards that will apply. For example, standards for dealing with sampling errors and significance tests do not apply to most universe studies. By definition, the use of a universe precludes the possibility of sampling errors (because the entire population, not a representative sample, is being studied). Weighting of data for universe studies is done only to compensate for unit nonresponse. When data are collected from a sample of a population, provisions are needed for sampling errors, significance tests, and weighting of data to make generalizations about the entire population.

Although many of the standards included in this phase are geared specifically toward analysis of survey data, the principles apply to all types of data analyses. Certain basic issues and questions (e.g., What cautions must be observed? What types of remarks should be avoided?) need to be raised regardless of the type of analysis.

Words in italics are defined in the glossary.

5.1. Standard for Preparing an Analysis Plan

PURPOSE: To ensure that the proposed analyses will address the study questions and purposes.

GUIDELINES

5.1.1. In most data collection activities, formal, written analysis plans should be prepared at three points:

- A preliminary analysis plan should be developed during the design phase (a) as a check on the completeness, adequacy, and internal consistency of the study questions, methodology, sample design, and measurement instruments, and (b) as a guide for planning of data collection and data processing activities.

- An expanded analysis plan should be prepared after the design has been finalized and data collection has begun. The expanded plan should incorporate any significant design or implementation changes that occurred after the preliminary plan was developed and should expand upon the preliminary plan by providing detailed specifications for the development and statistical treatment of all analysis variables.

- A final analysis plan should be prepared after the data processing has been completed and the analysis variables have been constructed and documented. The final plan should present the results of the analysis variable development and should incorporate any changes in the substantive analyses required by data problems or other unexpected discoveries at the variable development stage.

5.1.2. At each stage of development (preliminary, expanded, final), written analysis plans should be organized around the study questions. For each question, the plan should specify:

- The general form of the comparisons or tabulations that will be performed to answer the question, including the unit of analysis (e.g., student, school, district), the *analytic techniques* to be employed, and the anticipated sample sizes that will be involved.

- The variables that will be used in the analysis.

- How each of the analysis variables will be derived--what source data will be used (e.g., what items on the data collection instrument, what achievement tests) and how the variable will be constructed and evaluated prior to use in substantive analyses.

- (Expanded and final plans only): The specific statistical analyses that will be performed (e.g., the table shells to be used in crosstabulations; the specific tests of statistical significance of time trends or group differences), including the software to be used.

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5.1. Standard for Preparing an Analysis Plan

5.1.3. Since analysis plans constitute a blueprint and a guide for the anticipated future direction of the study, they should be shared with and reviewed by all pertinent members of the data production team and, as appropriate, with data requestors, outside advisors, and data users who may be able to offer constructive suggestions.

RELATED STANDARDS

2.1. Standard for Formulating and Refining Study Questions
5.2. Standard for Developing Analysis Variables

5.2. Standard for Developing Analysis Variables

PURPOSE: To ensure that the statistical properties of analysis variables are consistent with their intended uses in the analysis.

GUIDELINES

5.2.1. Response rate information (number of cases sampled, number of responses obtained, and response rate) should be presented for all analysis variables in order to evaluate possible *bias due to nonresponse*. For complex variables created from several data elements, response rate information should be presented for the component elements of the variable.

5.2.2. Missing values should be imputed for all analysis variables, using a method of imputation that is unlikely to bias the results. (See **5.3.8. Checklist for Imputing for Item Nonresponse.**)

5.2.3. For *categorical variables* (school control, student ethnicity, etc.), all of the categories should be fully defined, and the number of cases in each category should be reported. When samples are involved, both sample sizes (unweighted frequencies) and estimated population totals (weighted frequencies) should be presented for all categories in order to evaluate the adequacy of sample sizes for individual categories and to verify the absence of *out-of-range* values or other anomalies.

5.2.4. For *continuous variables* (e.g., enrollment size, family income), basic response distribution information should be provided (e.g., score range, median, mean, and standard deviation) for the population represented in the study and for all subpopulations being compared on the variable, in order to evaluate the suitability or limitations for use in further analyses.

5.2.5. For complex or judgmental variables where response consistency is a particular concern (e.g., student test scores, teacher ratings of student aptitudes, interviewer ratings of respondent attitudes), quantitative indices of response *reliability* should be obtained and reported. The design should provide for the collection and computation of appropriate reliability indices, unless adequate reliability information is available in the literature. To be adequate, secondary source reliability information should have been recent, should have been replicated (i.e., more than one previous study should be cited), and should involve measures and populations identical or very similar to those in the current data collection activity.

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5.2. Standard for Developing Analysis Variables

5.2.6. For complex or judgmental variables where there is a particular concern about whether or how well the variable actually measures what is intended (e.g., student test scores, teacher ratings of student aptitudes, interviewer ratings of respondent attitudes), documentai on of adequate response *validity* should be obtained and reported. The study design should pri vide for the collection and/or the computation of appropriate validity evidence, unless adequate validity information is available in the literature. To be adequate, secondary source validity information should be recent, should have been replicated (i.e., more than one previous study should be cited), and should involve measures, purposes, and populations that are identical or very similar to those in the current data collection activity.

RELATED STANDARDS

2.5.	Standard for Transforming Study Question Concepts into Measures
5.4.	Standard for Estimating Sampling and Nonsampling Errors
6.1.	Standard for Presenting Findings
6.5.	Standard for Preparing Documentation and Technical Reports

5.3. Standard for Applying Appropriate Weights

PURPOSE: To ensure that the results of the data collection activities can be generalized to the entire population from which the sample was selected.

GUIDELINES

5.3.1. Data should be weighted when a *sample* is selected randomly with known probabilities of selection at each stage of sampling--either when different sampling rates are used for subgroups of the population or when aggregate population totals are needed. The use of *weighted estimates* should be agreed to at the onset of the design process in order to allow adequate planning time.

5.3.2. Analyses should employ estimates of *sampling errors* and *confidence intervals* that are appropriate to the design and procedures used.

5.3.3. A recordkeeping system should be adopted that will guarantee that all information required for weighting will be available when needed.

5.3.4. A data *file* should contain each component weight and a base weight for all respondents and nonrespondents. The *component weight* for each stage of sampling is equal to the reciprocal of the probability of selecting the unit at that stage. The *base weight* is a composite of all the component weights, and it accounts for all the stages of sampling of units.

5.3.5. If the unit response rate is less than 100 percent, adjusting the base weights for *nonresponse* to reduce *bias* should be considered. (See **5.3.5. Checklist for Weighting for Unit Nonresponse.**) *Nonresponse bias* occurs when respondents differ as a group from nonrespondents on a survey item. (For example, if respondents have a higher dropout rate than nonrespondents, an estimated dropout rate based only on respondent data, unadjusted for nonresponse, will be biased upward: the actual dropout rate of the survey *population* will be overestimated.)

5.3.6. If independent and accurate estimates of population totals are available from an outside source, using *poststratification adjustments* to reduce bias and variance should be considered. Poststratification adjustments are weight adjustments which force survey estimates to match independent population totals with selected poststrata. (See **5.3.6. Checklist for Making Poststratification Adjustments.**)

5.3.7. The final adjusted weight should be used for making estimations. The final adjusted weight is a composite of all base weight components, nonresponse adjustments, and the poststratification factor, if any.

5.3.8. If the item response rate is less than 100 percent, imputing for missing values or weighting should be considered. (See **5.3.8. Checklist for Imputing for Item Nonresponse.**)

5.3.5. Checklist for Weighting for Unit Nonresponse

1. If there is any unit nonresponse, assume that respondents differ from nonrespondents and that nonresponse bias exists. Make weighting adjustments for *unit nonresponse* to reduce nonresponse bias. Calculate *variances* of *weighted estimates*.

2. In preparing to weight for unit nonresponse, define subclasses of units so that data providers and nonproviders within a subclass are as similar as possible with respect to the variable of interest. The similarity between data providers and nonproviders is increased when the characteristic used to define the subclass is strongly related to the variable being analyzed (e.g., in a school-wide student achievement test, subclasses could be defined by student age and grades).

3. The variables used in sampling define one type of subclass often used for adjusting for unit nonresponse because these variables are usually defined in relation to the study variables of greatest interest. To adjust for nonresponse within a subclass, multiply the responses (inflated by sampling weights) by the nonresponse adjustment (the ratio of the selected sample size to the number of data providers).

4. *Poststratification* is recommended for adjusting for unit nonresponse if accurate and usable population data are available from a source outside of the study. (See **5.3.6. Checklist for Making Poststratification Adjustments.**)

5. Make sure each subclass defined for weighting contains at least 20 units; if it does not, the variance of the estimate from that subclass will be unduly increased. If a subclass has fewer than 20 units, combine it with another similar subclass having relatively few data providers. (Note that although increasing the number of subclasses tends to reduce nonresponse bias, there is little benefit in using more than four or five classifying variables to define subclasses.)

6. Examine the ratio of the largest nonresponse weight to the smallest. If the ratio exceeds three to one, consider collapsing cells to keep from unduly increasing the variance of estimates.

5.3. Standard for Applying Appropriate Weights

5.3.6. Checklist for Making Poststratification Adjustments

1. Use analysis variables available from the independent estimates of the *population* to define groups of units (adjustment cells) for the population.

2. Be careful not to define cells so precisely that the representation of the *sample* in any cell is too sparse.

3. Obtain independent totals for each cell once the adjustment cells have been defined.

4. Use the nonresponse-adjusted *base weights* to make study estimates for the same cells.

5. Divide the independent estimate by the study estimate to create the poststratification factor for each cell.

6. Examine the poststratification factors for extreme values. If extreme values are found, determine whether sample estimates correspond with independent estimates. Reduce extreme values, for example, by collapsing cells so that the sample size in the cells is large enough (i.e., greater than 20).

7. Combine the nonresponse-adjusted weight for each unit by the appropriate poststratification factor to create the *final weight*.

5.3.8. Checklist for Imputing for Item Nonresponse

1. Compare item respondents with item nonrespondents on the basis of other survey variables *correlated* with the item in question. *Imputation* may not be necessary if the differences are minor.

2. If appropriate unit-level data are available fro.· external sources, such as administrative records, consider substituting them for the missing values. Such data, however, are often unavailable or are in a format that does not make them useful for imputation.

3. Several imputation methods are available. The one that is most appropriate depends on the intended analysis:

   ■ If the goal of the analysis is to produce statistical estimates of aggregates, such as *population totals*, consider substituting the mean of respondents within a subclass for the missing values in the subclass. This method keeps the *variance* of the estimate relatively small.

   ■ If the goal of the analysis is to study relationships among variables, consider forming subclasses correlated with the variables of interest and then duplicating randomly selected case values within the subclasses. Ensure that the number of values duplicated equals the number of missing values. A method often used instead of random selection is the selection of the next case in the computer file after the missing value (once the file is sorted in order by the subclasses). This is referred to as *"hot deck" imputation.*

   ■ If the research involves analysis of a few variables of critical importance, and if time and resources permit, *regression* or other multivariate analyses may be used to impute missing values. Study variables that best predict the critical values of respondents can then be used to generate values for nonrespondents. This method can minimize the *bias* of population estimates. Use caution, however, in any subsequent multivariate analyses of these types of imputed variables, especially if they are used as outcomes, because an artificial relationship between the outcome and explanatory variables has already been built in.

4. Flag imputations on computer *files*.

5.4.   Standard for Estimating Sampling and Nonsampling Errors

PURPOSE: To ensure that an estimate of the variability in the study estimates resulting from data having been collected from a probability sample rather than from the entire population of interest is known; to ensure that measures of the level of errors due to major sources of nonsampling errors are known.

GUIDELINES

5.4.1.   Methods should be determined for computing *sampling errors* that are appropriate given the procedures that will be used to select the *sample*. (If commercially available software packages are used, analysts should ensure that default methods are appropriate. If not, analysts should develop procedures for computing sampling errors early in the project.)

5.4.2.   If *replication techniques* are used for estimating sampling errors, replicates should t, formed at the time of sample selection. Replicate weights should be developed simultaneously with the ordinary full-sample weights used for estimation. *Nonresponse* adjustments, *poststratification*, and any other weight adjustments should be recomputed for replicate weights using the same methods used for the full-sample weights.

5.4.3.   *Modelling* the sampling errors (e.g., calculating an average *design effect* or using *regression* to fit a curve) should be considered as an alternative to producing a separate estimate of sampling error for every published statistic. Modelling can be done for different subclasses of the population.

5.4.4.   Major sources of *nonsampling error* should be investigated, and rules should be developed for dealing with incomplete or inconsistent data (e.g., under what circumstances will data providers' responses be included or excluded from some or all analyses).

5.4.5.   Error rates in processing (scanning and data transcription) should be quantified.

5.4.6.   Descriptive statistics for each of the variables and important combinations of variables should be examined to detect *outliers* (e.g., minimum and maximum values, mean, and *variance*). A policy dealing with outliers should be formulated.

5.4.7.   Reasonableness and consistency checks should be performed throughout the data analysis process.

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5.4. Standard for Estimating Sampling and Nonsampling Errors

5.4.8. Comparisons of estimates from the data collection activity with estimates from reliable independent sources should be considered for key variables.

RELATED STANDARDS

    6.1.   Standard for Presenting Findings
    6.5.   Standard for Preparing Documentation and Technical Reports

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5.5. Standard for Determining Statistical Significance

PURPOSE To ensure that statistical analyses can be properly interpreted.

GUIDELINES

5.5.1. *Confidence intervals* should be included for all key statistics.

5.5.2. Significance levels for the results of statistical tests should be specified before inferences are made. The probability of *type I* and *type II errors* should be considered when conducting significance tests.

5.5.3. Selection of levels of statistical significance should be based upon substantive factors in the data collection activities. For example, when the consequences of being wrong are severe, a higher level of significance should be used.

5.5.4. Because not all statistically significant results have practical significance, the practical significance of statistical comparisons should be described.

5.5.5. For analyses designed to examine issues for which specific *hypotheses* were not prescribed prior to looking at the data, it should be noted that significance levels and confidence intervals are merely indicators of the potential existence of relationships.

5.5.6. For analyses designed to test hypotheses that were developed prior to reviewing the data, errors associated with making several simple comparisons simultaneously should be addressed. *Multiple comparison procedures* should be used to reduce the probability of making incorrect statements.

RELATED STANDARDS AND CHECKLISTS

6.1. Standard for Presenting Findings
6.5. Standard for Preparing Documentation and Technical Reports

PHASE 6. REPORTING AND DISSEMINATION OF DATA

6.0. Introduction to Reporting and Dissemination of Data

Most data collection and analysis efforts culminate in one or more reports on the findings. The standards included in this phase are designed to ensure that reports are prepared, documented, and reviewed in a manner that enhances their accuracy, credibility, and usefulness. The standards also address the release and dissemination of data. When databases are accessible to the public, the relevant standards-- particularly those related to confidentiality--should be considered.

The standards for reporting and dissemination of data make a distinction between substantive reports that describe *study findings* and technical reports that document *study procedures.* Most substantive reports, however, contain some methodological information; thus, many of the standards for technical reports apply to substantive reports as well. For the purposes of these standards, a technical report includes comprehensive documentation and evaluation of data collection, processing, and analysis procedures.

When preparing a report for a professional journal, a private organization, or a government agency, those who use these standards should determine if there are additional guidelines that must be followed.

Words in italics are defined in the glossary.

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6.1. Standard for Presenting Findings

PURPOSE: To ensure that results are communicated in an objective, accurate, and useful manner.

GUIDELINES

6.1.1. Planning for a report on the results of data collection activities should take place during the design phase of the project. (See **6.1.1. Checklist for Planning the Report.**)

6.1.2. Reports should include major sections on the following topics: background and purpose, study questions and *hypotheses*, methodology (design, data collection, processing, and analyses), findings, conclusions, and recommendations for further investigation.

6.1.3. Reports should include a summary of the results, with emphasis on key findings and conclusions (e.g., executive summary).

6.1.4. Reports should describe the rigor of the methodology and quality control procedures used in the data collection activities--as well as the *validity*, *reliability*, and context of the data--to enable readers to judge the credibility of the findings. (See **6.1.4. Checklist for Describing the Rigor of the Methodology and Quality Control Procedures.**)

6.1.5. Reports should be complete and concise, focusing on the topic at hand and addressing only issues that relate directly to the data being reported. (See **6.1.5. Checklist for Developing a Complete, Concise, and Focused Report.**)

6.1.6. Information should be presented in a manner that is appropriate for the intended audiences, without jeopardizing accuracy through oversimplification. (See **6.1.6. Checklist for Presenting Findings in a Manner that is Appropriate for the Intended Audiences.**)

6.1.7. Tables and graphs should be accurate, complete, and easy to interpret. Each table and graph should be able to stand alone. (See **6.1.7. Checklist for Presenting Data in Tables and Graphs.**)

6.1.8. Reports should be organized and written with a clear understanding of the potential impact they may have. Authors should be aware of the range of actions available to the *audiences*.

■ Reports should clearly identify the year or other time period the data cover and distinguish between that time period and the year in which the report was released.

■ Reports on studies should make a clear distinction between research findings and the policy implications that may be inferred from these findings.

Continued

Continued

6.1. Standard for Presenting Findings

6.1.9. Reports should be prepared in a timely fashion to ensure that they have an impact on decisions that the information could plausibly affect.

RELATED STANDARDS

5.5. Standard for Determining Statistical Significance

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6.1. Standard for Presenting Findings

6.1.1. Checklist for Planning the Report

The plan for producing a report should include the following steps:

1. Ensure that adequate resources are available for preparing and disseminating the report

2. Ensure that realistic timeframes are set for producing the report

3. Identify intended audiences

4. Determine the audiences' information needs

5. Assess the audiences' level of technical knowledge

6. Identify the appropriate media for presenting findings to the intended audiences

6.1. Standard for Presenting Findings

6.1.4. Checklist for Describing the Rigor of the Methodology and Quality Control Procedures

1. Review the report to ensure that it is free of bias in content, style, and tone.

2. Establish credibility by providing a balanced presentation of differing perspectives and a fair and impartial reporting of all data.

3. Present study results in a manner that enables the reader to distinguish clearly between objective findings and opinions, judgments, and speculations.

4. Describe potential data limitations and discuss how the data and findings may and may not be used. This discussion should address the degree to which the study findings and inferences can be generalized based upon sampling and other areas of the design and methodology.

6.1. Standard for Presenting Findings

6.1.5. Checklist for Developing a Complete, Concise, and Focused Report

1. Provide sufficient depth and breadth to give a full and accurate description of the data collection activities and the conclusions that were drawn. Present conclusions within the context of the strengths and weaknesses of the data and methodology.

2. Clearly identify the types of conclusions that can be supported by the findings. In particular, caution readers not to infer causality from descriptive findings and not to interpret *correlation* as proof of a cause-and-effect relationship.

3. To assist readers in interpreting the data, describe how the data collection activity compares with others with respect to theory, methodology, limitations, and findings.

4. Where appropriate, propose areas for additional study and relate the findings and conclusions to other pertinent research and relevant information.

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6.1. Standard for Presenting Findings

6.1.6. Checklist for Presenting Findings in a Manner that Is Appropriate for the Intended Audiences

1. Consider producing separate reports for selected audiences.

2. Make reports prepared for the public attractive and interesting as well as technically accurate.

3. Write in straightforward, nontechnical language to the degree that the subject matter permits. Jargon, regional terms, and the like should be avoided.

4. If diverse audiences are expected to read a report, use subheadings and summary data to assist the various audiences in locating salient information.

5. Consider using a variety of methods for communicating information about the data collection activities. Brochures, fact sheets, videotapes, and slides may be used in addition to or in place of the traditional narrative report.

6.1. Standard for Presenting Findings

6.1.7. Checklist for Presenting Data in Tables and Graphs

1. Clearly label the data shown in tables and graphs.

2. Explain tables and graphs in the text of the report.

3. Number or letter tables and graphs to correspond to explanations in the text.

4. Clearly label axes to indicate categories and variables.

5. If data from sources other than the report are presented in tables and graphs, these sources should be clearly cited.

6. Design all graphs and charts (including proportions chosen) to ensure that they accurately and visually reflect the data being presented.

7. Include presence-of-error information (e.g., standard errors, frequency of missing data) in tables and graphs or in additional cross-referenced tables.

8. Use footnotes or other annotations for clarification when rounded totals are inconsistent with unrounded displayed data (e.g., figures in columns or rows do not add up to the rounded totals).

9. When percentages or rates are presented in tabular form, provide the actual number of units on which the percentages or rates are based.

10. Include *standard errors* or *confidence intervals* on statistics calculated on data presented in tables. Include this information in the table being displayed or in the text of the report.

6.2. Standard for Reviewing the Report

PURPOSE: To ensure that the report is technically accurate, complete, and useful.

GUIDELINES

6.2.1. Before a report is prepared, a review plan should be developed that includes the following information:

- How reviewers will be selected

- Resources needed for performing the review

- Timelines for completing the review and making subsequent revisions

- Adjudication procedures for responding to reviewers' critiques

- Sign off by reviewers

- How respondents and other affected parties will have the opportunity to assess the accuracy of data and appropriateness of analysis

6.2.2. Reports should be reviewed by experts in the subject matter and in relevant areas of design and methodology, by representatives of the intended audiences, and, where appropriate, by the reporting agency's information officers.

6.2.3. Reviews should address all areas that may affect the quality and usefulness of the report to ensure that:

- Background and purpose of the study are described

- Target population of the data collection is clearly identified

- Scope of the collected data is appropriate to the purpose of the study

- Methods and procedures used to collect the data and the timeframe of the collection are described

- The data collection instrument is appended to the report, when possible

- Sampling methods and size are described, when applicable

- Data processing and quality control procedures are detailed

Continued

Continued

6.2. Standard for Reviewing the Report

■ Methods of analyzing the data are described

■ Errors, biases, omissions, and limitations in the data collection processes and analyses are described

■ Conclusions, interpretations, and recommendations are consistent with the nature of the data and their analyses

■ Format and presentation of the data are useful and understandable for the intended audiences and uses

■ All graphs and tables used in the report present the data in a straightforward manner, without distortion

■ Distinctions are mad between differences that are statistically significant and those that are not

6.2.4. The review process should adhere to the planned schedule to ensure the timely release of data.

6.3. Standard for Releasing Data

PURPOSE: To ensure the maximum feasible access to data while safeguarding confidentiality and individual privacy rights.

GUIDELINES

6.3.1. Data should be released in a carefully planned and systematic manner that provides for full disclosure while protecting the confidentiality and rights of data providers and ensuring the timely receipt of data by all affected parties.

6.3.2. Data providers who might be affected by the release of data should receive special notification of the date and method of release. When possible, they should receive advance copies.

6.3.3. In cases where data providers will be identified, they should have an opportunity to verify the accuracy of the data to be released and should receive copies of the data if desired and not otherwise prohibited.

6.3.4. The identity of data providers, if confidential, should be protected throughout the data dissemination process. Particular attention should be paid to confidentiality when data are released through electronic means because of the increased potential for accidental disclosure.

6.3.5. Distribution of draft reports and initial data should be carefully monitored and controlled.

6.3.6. Procedures for release of data should be reviewed to ensure compliance with all federal, state, and local statutes, rules, and regulations that apply to the release of data.

6.3.7. All identified *audiences* should be informed (in advance, if possible) about the procedures and schedule for releasing data and about the availability and distribution of any related documents and/or data tapes.

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6.4. Standard for Disseminating Data

PURPOSE: To ensure that information reaches intended audiences in a useful format and within a reasonable time.

GUIDELINES

6.4.1. A dissemination plan and schedule should be formulated during the design phase.

6.4.2. A dissemination method should be selected which ensures that information reaches the intended audiences in a timely manner. Multiple methods of dissemination are often desirable.

6.4.3. Dissemination schedules should adhere to pre-established timetables to ensure that the primary users obtain the data on schedule.

6.4.4. Those involved in data dissemination should be aware of the school-year cycle and legislative or other policy formulation schedules. They should attempt to release and disseminate data during the time when the information will be most useful.

6.4.5. The timing of data dissemination for recurring data collection activities should be consistent from one year to the next.

6.4.6. Dissemination methods and procedures should be designed to maximize appropriate use of the data.

6.4.7. News releases or announcements should be prepared to encourage appropriate use of the data. When appropriate, authorities on the data collection activities should brief the news media in person.

6.4.8. Each product to be disseminated (e.g., reports, tabulations, news releases) should clearly state the time period covered by the data collection so that this time period is not confused with the release date of the data.

6.4.9. Provision should be made for timely responses to inquiries regarding the data. Appropriate contact names, telephone numbers, and mailing addresses should be clearly and prominently included in reports and other materials.

6.5. Standard for Preparing Documentation and Technical Reports

PURPOSE: To ensure that data collection and analysis procedures are described in sufficient detail to permit them to be evaluated and replicated.

GUIDELINES

6.5.1. Technical reports should describe the original design, including the data collection, processing, and analysis procedures.

6.5.2. Technical reports should also describe the actual procedures used to collect, process, and analyze data. Reports should describe all procedures used to ensure that the data were collected in a uniform or consistent fashion from each sampled unit.

6.5.3. Discrepancies between the design and the actual procedures used to collect, process, and analyze the data should be described and justified in technical reports.

6.5.4. *Reliability* and *validity* estimates for all variables included in the data collection activities should be presented in technical reports.

6.5.5. Technical reports should document all procedures employed to ensure that the rights, welfare, dignity, and worth of individuals data providers have been protected in a manner that is consistent with the assurances given them and ethical practice.

6.5.6. Technical reports should document procedures used to obtain independent review of the data collection activities and to secure informed consent of the affected parties when adverse effects or risks are involved.

6.5.7. Procedures used to ensure that data were collected in a manner that produced minimal disruption for individuals, programs, and organizations should be documented.

6.5.8. All safeguards used to protect the data from distortions and the biases of data collectors and analysts should be documented.

6.5.9. Technical reports should describe the procedures used to *operationalize* each variable. For example, reports should explain how missing data were treated and how differentiated item weighting was employed. Reports should also address the procedures for "reversing" items and note whether items were combined to create new variables or to produce index or scale scores.

6.5.10. Technical reports should describe the procedures used to quantify or code and enter the data.

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Continued

6.5. Standard for Preparing Documentation and Technical Reports

6.5.11. Technical reports should describe in detail all procedures used to store raw and processed data--including interview protocols, training procedures, coding manuals, archived dictionaries, and the like.

6.5.12. Documentation of analytic procedures should be sufficiently detailed to permit someone with access to the data to replicate the results.

6.5.13. When utilized, procedures for rounding figures should be made explicit in the report, as should decisions about the appropriate number of significant digits to be reported.

RELATED STANDARDS

    2.9.   Standard for Preparing a Written Design
    3.3.   Standard for Ethical Treatment of Data Providers
    6.2.   Standard for Reviewing the Report

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APPENDIX A

RELATED STANDARDS

Appendix A. Related Standards

The following standards were used as resource materials throughout the development of the Standards.

1.   American Educational Research Association, American Psychological Association, and National Council on Measurement in Education. 1985. *Standards for Educational and Psychological Testing*. Washington, D.C.

2.   U.S. Department of Energy. Office of Statistical Standards. Energy Information Administration. 1989. *Standards Manual*. Washington, D.C.

3.   Evaluation Research Society. 1982. *Standards for Evaluation Practice*.

4.   General Accounting Office. 1988. *Government Auditing Standards*. Washington, D.C.

5.   Joint Committee on Standards for Educational Evaluation. 1981. *Standards for Evaluations of Educational Programs, Projects, and Materials*. New York, N.Y.

6.   U.S. Department of Education. National Center for Education Statistics. 1987. *Standards and Policies*. Washington, D.C.

7.   U.S. Department of Health and Human Services. Public Health Service. Office of Health Research, Statistics, and Technology. National Center for Health Statistics. 1980. *Draft Guidelines for Statistics and Information on Effects of the Environment on Health*. Washington, D.C.

The following table indicates which of the above sets of standards may be referred to for additional information concerning the issues addressed by each of the standards in this document.

	AERA, APA, NCME, Standards for Educational and Psychological Testing (1985)	EIA, Standards Manual (1989)	ERS, Standards for Evaluation Practice (1982)	GAO, Government Auditing Standards (1988)	Joint Committee, Standards for Evaluation of Educational Programs, Projects, and Materials (1981)	NCES, Standards and Policies (1987)	NCHS, Draft Guidelines for Statistics and Information on Effects of the Environment on Health (1980)
1.1. Creating an Infrastructure to Manage Data Collection Activities					■		
1.2. Justifying Data Collection Activities			■	■	■	■	■
1.3. Fostering Commitment of All Participants			■		■	■	■
1.4. Creating an Appropriate Management Process			■		■	■	■
2.1. Formulating and Refining Study Questions							
2.2. Choosing the Data Collection Methods						■	■
2.3. Developing a Sampling Plan						■	
2.4. Assessing the Value of Obtainable Data							
2.5. Transforming Study Question Concepts into Measures			■		■		
2.6. Designing the Data Collection Instrument		■	■		■	■	■
2.7. Minimizing Total Study Error (Sampling and Nonsampling)						■	
2.8. Reviewing and Pretesting Data Collection Instruments, Forms, and Procedures	■					■	■
2.9. Preparing a Written Design					■	■	
3.1. Preparing for Data Collection	■	■	■			■	
3.2. Selecting and Training Data Collection Staff	■		■	■	■		
3.3. Ethical Treatment of Data Providers	■		■		■	■	
3.4. Minimizing Burden and Nonresponse	■	■	■		■	■	■
3.5. Implementing Data Collection Quality Control Procedures			■	■	■		■
3.6. Documenting Data Collections		■	■			•	
4.1. Planning Systems Requirements		■					

	AERA, APA, NCME, Standards for Educational and Psychological Testing (1985)	EIA, Standards Manual (1989)	ERS, Standards for Evaluation Practice (1982)	GAO, Government Auditing Standards (1988)	Joint Committee, Standards for Evaluation of Educational Programs, Projects, and Materials (1981)	NCES, Standards and Policies (1987)	NCHS, Draft Guidelines for Statistics and Information on Effects of the Environment on Health (1980)
4.2. Designing Data Processing Systems		■				■	
4.3. Developing Data Processing Systems		■				■	
4.4. Testing Data Processing Systems		■				■	
4.5. Planning for Data Preparation			■		■		
4.6. Preparing Data for Processing and Analysis		■			■	■	
4.7. Maintaining Programs and Data Files		■	■				■
4.8. Documenting Data Processing Activities		■	■			■	
4.9. Evaluating Data Processing Systems		■			■		
5.1. Preparing an Analysis Plan							
5.2. Developing Analysis Variables	■				■		
5.3. Applying Appropriate Weights		■				■	■
5.4. Estimating Sampling and Nonsampling Errors		■				■	■
5.5. Determining Statistical Significance			■				■
6.1. Presenting Findings		■		■	■	■	■
6.2. Reviewing the Report						■	
6.3. Releasing Data							
6.4. Disseminating Data							
6.5. Preparing Documentation and Technical Reports							

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APPENDIX B

OTHER RELATED STANDARDS

Appendix B. Other Related Standards

The following sets of standards were referred to for specific topics covered by one or more phase.

1. General Accounting Office. 1986. *Developing and Using Questionnaires.* Washington, D.C.

2. Joint Committee on Testing Practices. 1988. *Code of Fair Testing Practices in Education.*

3. National Institutes of Health. *Manual for Statistical Presentations.* Bethesda, MD.

4. Office of Management and Budget. Office of Information and Regulatory Affairs. 1989. *Information Collection Review Handbook.*

5. U.S. Department of Commerce. *Federal Information Processing Standards (FIPS).* Washington, D.C.

6. U.S. Department of Commerce. Office of Federal Statistical Policy and Standards. 1978. *Statistical Policy Handbook.* Washington, D.C.

The following table indicates which sets of standards may be referred to for additional information on topics addressed by each of the standards listed.

	GAO, *Developing and Using Questionnaires* (1986)	Joint Committee, *Code of Fair Testing Practices in Education* (1988)	NIH, *Manual for Statistical Presentations*	OMB, *Information Collection Review Handbook* (1989)	U.S. Dept. of Commerce, *Federal Information Processing Standards* (FIPS)	U.S. Dept. of Commerce, *Statistical Policy Handbook* (1978)
1.1. Creating an Infrastructure to Manage Data Collection Activities						
1.2. Justifying Data Collection Activities						
1.3. Fostering Commitment of All Participants			■		■	
1.4. Creating an Appropriate Management Process			■		■	
2.1. Formulating and Refining Study Questions						
2.2. Choosing the Data Collection Methods						
2.3. Developing a Sampling Plan						
2.4. Assessing the Value of Obtainable Data	■					
2.5. Transforming Study Question Concepts into Measures	■					
2.6. Designing the Data Collection Instrument	■					
2.7. Minimizing Total Study Error (Sampling and Nonsampling)	■					
2.8. Reviewing and Pretesting Data Collection Instruments, Forms, and Procedures	■					
2.9. Preparing a Written Design						
3.1. Preparing for Data Collection						
3.2. Selecting and Training Data Collection Staff						
3.3. Ethical Treatment of Data Providers						
3.4. Minimizing Burden and Nonresponse						
3.5. Implementing Data Collection Quality Control Procedures						
3.6. Documenting Data Collections						
4.1. Planning Systems Requirements						
4.2. Designing Data Processing Systems	■					

	GAO, *Developing and Using Questionnaires* (1986)	Joint Committee, *Code of Fair Testing Practices in Education* (1988)	NIH, *Manual for Statistical Presentations*	OMB, *Information Collection Review Handbook* (1989)	U.S. Dept. of Commerce, *Federal Information Processing Standards* (FIPS)	U.S. Dept. of Commerce, *Statistical Policy Handbook* (1978)
4.3. Developing Data Processing Systems	■					
4.4. Testing Data Processing Systems	■					
4.5. Planning for Data Preparation						
4.6. Preparing Data for Processing and Analysis						
4.7. Maintaining Programs and Data Files						
4.8. Documenting Data Processing Activities	■					
4.9. Evaluating Data Processing Systems						
5.1. Preparing an Analysis Plan	■					
5.2. Developing Analysis Variables		■				
5.3. Applying Appropriate Weights						
5.4. Estimating Sampling and Nonsampling Errors						
5.5. Determining Statistical Significance			■			
6.1. Presenting Findings		■				
6.2. Reviewing the Report		■				
6.3. Releasing Data						
6.4. Disseminating Data						
6.5. Preparing Documentation and Technical Reports						

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INDEX

STANDARDS BY TOPIC OF INTEREST

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Index. Standards by Topic of Interest

Throughout this document, standards are grouped within the six key phases of data collection and reporting activities. There are, however, a number of themes that run through all of the phases, such as developing sound management practices, minimizing burden on data providers, improving the quality and rate of responses, protecting the confidentiality of data providers, fully documenting data collection activities, and providing training for those involved in data collection activities.

This index groups standards in different phases by key subject areas to provide a convenient reference for looking at important topics across multiple phases.

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Index. Standards by Topic of Interest

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Data Requestor

Standard 1.1.	Creating an Infrastructure to Manage Data Collection Activities
Standard 1.2.	Justifying Data Collection Activities
Standard 1.3.	Fostering Commitment of All Participants
Standard 3.1.	Preparing for Data Collection
Standard 4.1.	Planning System Requirements
Standard 5.1.	Preparing an Analysis Plan

Data Users

Standard 1.1.	Creating an Infrastructure to Manage Data Collection Activities
Standard 1.2.	Justifying Data Collection Activities
Standard 1.3.	Fostering Commitment of All Participants
Standard 4.1.	Planning System Requirements
Standard 5.1.	Preparing an Analysis Plan

Documentation

Standard 2.9.	Preparing a Written Design
Standard 3.6.	Documenting Data Collections
Standard 4.8.	Documenting Data Processing Activities
Standard 5.1.	Preparing an Analysis Plan
Standard 6.5.	Preparing Documentation and Technical Reports

Evaluation

Standard 1.1.	Creating an Infrastructure to Manage Data Collection
Standard 2.5.	Transforming Study Question Concepts Into Measures
Standard 2.7.	Minimizing Total Study Error
Standard 2.9.	Preparing a Written Design
Standard 4.9.	Evaluation Data Processing Systems

Information Needs

Standard 1.1.	Creating an Infrastructure to Manage Data Collection Activities
Standard 1.2.	Justifying Data Collection Activities
Standard 1.3.	Fostering Commitment of All Participants
Standard 2.1.	Formulating and Refining Study Questions
Standard 2.2.	Choosing the Data Collection Methods
Standard 2.6.	Designing the Data Collection Instrument
Standard 4.1.	Planning System Requirements

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Review and Approval

Standard 1.1.	Creating an Infrastructure to Manage Data Collection and Reporting
Standard 2.6.	Designing the Data Collection Instrument
Standard 2.7.	Minimizing Total Study Error
Standard 2.8.	Reviewing and Pretesting Data Collection Instruments, Forms, and Procedures
Standard 2.9.	Preparing a Written Design
Standard 3.1.	Preparing for Data Collection
Standard 6.2.	Reviewing the Report

Sampling

Standard 2.2.	Choosing the Data Collection Methods
Standard 2.3.	Developing a Sampling Plan
Standard 2.7.	Minimizing Total Study Error
Standard 2.8.	Reviewing and Pretesting Data Collection Instruments, Forms, and Procedures
Standard 2.9.	Preparing a Written Design
Standard 3.1.	Preparing for Data Collection
Standard 4.5.	Preparing for Data Preparation
Standard 5.2.	Developing Analysis Variables
Standard 5.3.	Applying Appropriate Weights
Standard 5.4.	Estimating Sampling and Nonsampling Errors
Standard 6.2.	Reviewing the Report

Terminology/Data Definitions

Standard 1.1.	Creating an Infrastructure to Manage Data Collection Activities
Standard 1.2.	Justifying Data Collection Activities
Standard 2.1.	Formulating and Refining Study Questions
Standard 2.2.	Choosing the Data Collection Methods
Standard 2.6.	Designing the Data Collection Instrument
Standard 2.7.	Minimizing Total Study Error
Standard 3.2.	Selecting and Training Data Collectors

Training

Standard 1.4.	Creating an Appropriate Management Process
Standard 3.2.	Selecting and Training Data Collection Staff
Standard 4.5.	Planning for Data Preparation

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REFERENCES

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References

The following is a listing of publications suggested by the authors of these Standards. It is in no way meant to be an inclusive reference list. Indeed, there is a large body of literature available to a reader who wishes to research the subjects of data collection, processing, analysis, and reporting.

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GLOSSARY

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Glossary

abstracting - the process of converting information from existing records into a format required for analysis.

alternative hypothesis - see *hypothesis*.

analytic techniques - techniques which address questions about how or why units in the population are related (see *descriptive techniques*).

archiving - a managed system of storing data files off line in a secure area for an extended period of time.

audiences - persons and organizations who will be guided in making decisions by the results of the data collection activity and all others (data users) who are interested in the results of the data collection.

base weight - the product of all component weights; accounts for all stages of sampling units.

bias (due to nonresponse) - difference that occurs when respondents differ as a group from nonrespondents on a characteristic being studied.

bias (of an estimate) - the difference between the expected value of a sample estimate and the corresponding true or target value for the population.

burden - the aggregate hours realistically required for data providers to participate in a data collection activity.

CAPI - Computer Assisted Personal Interviewing enables data collection staff to use portable microcomputers to administer a data collection form while viewing the form on the computer screen. As responses are entered directly into the computer, they are used to guide the interview and are automatically checked for specified range, format, and consistency edits.

CATI - Computer Assisted Telephone Interviewing uses a computer system that allows a telephone interviewer to administer a data collection form over the phone while viewing the form on a computer screen. As the interviewer enters responses directly into the computer, the responses are used to guide the interview and are automatically checked for specified range, format, and consistency edits.

CD ROM - Compact Disc Read Only Memory is a computer storage disk in the same physical form as an audio CD. A CD ROM disk can store approximately 550 megabytes of digital data (e.g., about 1.5 thousand pages).

census - a count of all the elements of a population and a determination of the distributions of the characteristics.

closed-ended question - a type of question in which the data provider's responses are limited to given alternatives (see **open-ended question**).

codebook - a record of each variable being measured, including variable name, columns occupied by each variable in the data file, and values used to define each variable.

coding - the act of categorizing raw data into groups or giving the data numerical values.

component weight - for each stage of sampling, the component weight is equal to the reciprocal of the probability of selecting the unit at that stage.

Computer Assisted Personal Interviewing - see CAPI.

Computer Assisted Telephone Interviewing - see CATI.

confidence interval - a sample-based estimate expressed as an interval or range of values within which the true or target population value is expected to be located (with a specified level of confidence given as a percentage).

consistency edits - see *logic edits*.

construct - a concept that describes a characteristic, attribute, or variable relationship. The concepts are often unobservable ideas or abstractions such as community context or student educational performance.

correlation - the tendency for certain values or levels of one variable to occur with particular values or levels of another variable.

correlation coefficient - a measure of association between two variables that can range from -1.00 (perfect negative relationship) to 0 (no relationship) to +1.00 (perfect positive relationship).

data collection activities - all phases of data collection and reporting.

data dictionary - a database that holds the name, type, range of values, sources, and authorization for access for each data element in an organization's files and database. It may also indicate which application programs use that data so that when a change in data structure is contemplated, a list of the affected programs can be generated.

data element - the most basic unit of information. In data processing, it is the fundamental data structure. It is defined by its size (in characters) and data type (e.g., alphanumeric, numeric only, true/false, date) and may include a specific set of values or range of values.

data file backup - copies of the latest data files that can be used to restore lost data.

data flow diagram - depicts the movement of data within a system by describing the data and the manual and machine processing performed on the data.

data producer - agency or organization that carries out the actual study design, data collection, processing, analysis, and reporting. The term encompasses all members of the project staff including *managers, data collectors, data processors, data analysts,* and *data reporters.*

data provider - agency, organization, or individual who supplies data.

data requestor - agency or organization that requests or sponsors a data collection and reporting activity.

data users - agencies, organizations, or individuals who use the data developed by the data producer. Although the term data user may refer to the data requestor, it may also refer to other entities or individuals, including other agencies, individual researchers, the media, and members of the public, who utilize the results of a data collection activity in some way.

design effect - the variance of an estimate divided by the variance of the estimate that would have occurred if a sample of the same size had been selected using simple random sampling.

field test - the study of a data collection activity in the setting where it is to be conducted.

file - a set of related records.

file corruption - a file that has been physically damaged or that contains errors on the magnetic surface that prevent the file from being accessed by a computer.

file design - the method used in a file to store and retrieve data.

file recovery - copying the file from a current backup version.

file regeneration - the process of running necessary software to rebuild a file.

final adjusted weight - the product of all base-weight components, nonresponse adjustments, and the poststratification factor, if any.

"hot deck" imputation - a process that replaces missing data items with values observed from other sampled cases.

hypothesis - an assumption about a property or characteristic of a population. In statistical theory, there are usually two hypotheses under consideration, and the goal is to decide which of the two hypotheses is likely to be true. The *null hypothesis* usually corresponds to the hypothesis to be tested by accepted statistical techniques. That is, the null hypothesis is considered to be true unless there is compelling evidence from the sample data that it is false. The *alternative hypothesis* is the complement of the null hypothesis.

imputation for item or survey nonresponse - substituting plausible values for missing values in the survey data set.

input - any data entered into a computer or the act of entering data by keyboard, light pen, mouse, graphics tablet, magnetic disk or tape, communications channel, or key-punch card.

item nonresponse - items on a data collection form that are missing when a response was expected.

linearity - a relationship in which, when any two variables are plotted, a straight line results.

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logic edits - checks made of the data to ensure common sense consistency among the responses from a data provider.

master file - a collection of records holding the current data in an information system. It contains descriptive data as well as summary information.

modelling - a general class of statistical techniques in which the mathematical relationships between several variables are developed and analyzed.

multiple comparison procedures - statistical procedures that take into account the fact that several statistical tests are being performed simultaneously. In particular, multiple comparison procedures give the proper type I errors, considering the number of comparisons being made.

nonresponse - cases in a data collection activity in which potential data providers are contacted but refuse to reply or are unable to do so for reasons such as deafness or illness.

nonresponse bias - occurs when respondents as a group differ from nonrespondents in their answers to items on a data collection form.

nonsampling error - an error in sample estimates that cannot be attributed to sampling fluctuations. Such errors may arise from many sources including imperfect selection, bias in response or estimation, and errors of observation and recording.

null hypothesis - see *hypothesis*.

open-ended question - a type of interview item that does not limit the potential responses to predetermined alternatives (see **closed-ended question**).

operational definition - the sequence of steps or procedures a researcher follows to obtain a measurement; specifies how to measure a variable.

operationalize - to describe constructs or variables in concrete terms so that measurements can be made.

optical disk - a disk that is read optically (i.e., by laser technology), rather than magnetically.

out-of-range response - a response that is outside of the predetermined range of values considered acceptable for a particular item.

outliers - an observation so far separated in value from other observations that it raises the question of whether it comes from a different population or whether the sampling technique is at fault.

output - any computer-generated information appearing on hard copy, video display, or machine readable form (e.g., disk or tape).

pilot test - a brief and simplified preliminary study designed to test methods and to learn whether a proposed data collection activity appears likely to yield valid, reliable, and useful results.

population - all individuals in the group to which conclusions from a data collection activity are to be applied.

population variance - a measure of dispersion defined as the average of the squared deviations between the observed values of the elements of a population or sample and the corresponding mean of those values.

poststratification adjustment - a weight adjustment that forces study estimates to match independent population totals within selected poststrata (adjustment cells).

precision - the difference between a sample-based estimate and its expected value. Precision is measured by the sampling error (or standard error) of an estimate.

pretest - a test to determine performance prior to the administration of a data collection activity.

probability sample - a sample selected by a method such that each unit has a fixed and determined probability of selection.

processing - the manipulation of data.

range check - a determination of whether responses fall within a predetermined set of acceptable values.

record format - the layout of the information contained in a data record (includes the name, type, and size of each field in the record).

records - a logical grouping of data elements within a file upon which a computer program acts.

regression - a statistical technique in which the functional relationship between a dependent variable and one or more independent variables can be estimated.

reliability - the consistency in results of an achievement test or measurement, including the tendency of the test or measurement to produce the same results when applied two times or more to some entity or attribute believed not to have changed in the interval between measurements.

replication techniques - methods of estimating sampling errors that involve repeated estimation of the same statistic using various subsets of data providers. The two primary methods are balanced repeated replication (BRR) and the jackknife technique.

respondent - the individual or agency who completes a survey (e.g., the person who marks the answers on a survey instrument or who provides answers verbally to a data collector).

sample - a subgroup selected from the entire population.

sampling error - that part of the difference between a value for an entire population and an estimate of that value derived from a probability sample that results from observing only a sample of values.

sampling strata - mutually exclusive and exhaustive subsets of the population within which elements of the population have similar characteristics, to the extent feasible.

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sampling variance of estimates - the distribution of values of a statistic that would occur if the survey were repeated a large number of times using the same sample design, instrument, and data collection methodology. The square root of the sampling variance is the standard error (see **standard error of an estimate**).

simple hypothesis - a statistical hypothesis that completely specifies the distribution function of the variates concerned in the hypothesis.

special population - a subset of the total population distinguishable by unique needs, characteristics, or interests (e.g., disadvantaged students, gifted students, physically or mentally handicapped students, vocational education students).

standard deviation - the most widely used measure of dispersion of a frequency distribution. It is equal to the positive square root of the population variance.

standard error of an estimate - the positive square root of the sampling variance. It is a measure of the sampling distribution of a statistic. Standard errors are used to establish confidence levels for the statistics being analyzed.

statistically significant - there is a low probability that the result is attributable to chance alone.

symmetry - refers to a property of a relationship in which no distinction is made between independent and dependent variables; "asymmetry" refers to a property of a relationship in which such a distinction is made. For example, the Pearson product-moment correlation coefficient is a *symmetric* measure of linear association between two intervally scaled variables while the linear regression coefficient is an *asymmetric* measure for such variables.

system flowchart - shows the flow through components of the data system or the relationship of macro-components of the data system.

system operator - a person who is responsible for the physical operation of the equipment (e.g., CPUs, disk drives, tape drives, printers).

systems design stage - the second of four stages in the development of an information processing system, it expands upon the systems requirements specified in the Systems Requirements Stage.

systems development stage - the third of four stages in the development of a data processing system; entails writing computer programs that follow the systems design specifications.

systems requirements stage - the first of four stages in the development of an information processing system, it defines the scope of the project.

systems testing stage - the fourth of four stages in the development of an data processing system, it provides for the testing of all computer programs according to a test plan before the system is considered operational.

t-test - any statistical test in which the underlying distribution of the test statistic has a student's

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t-distribution. Most commonly, t-tests are used to compare the means of two subsets of a population under study.

transaction file - a collection of records that record any change in a master file. The data in transaction files are used to update the data in master files. Transaction files also serve as audit trails and, after a period of time, are transferred from on-line disk to off-line tape for future statistical and historical processing.

type I error - in a formal statistical test of a hypothesis, the probability of rejecting the null hypothesis when it is true.

type II error - in a formal statistical test of a hypothesis, the probability of accepting the null hypothesis when it is false.

unit nonresponse - failure of a survey respondent to provide a response to any of the study questions.

validation sample - a sample drawn from a study so that the survey responses can be compared with values from another source that is assumed to contain the true or target values.

validity - the capacity of a measuring instrument to predict what it was designed to predict; stated most often in terms of the correlation between values on the instrument and measures of performance on some criterion.

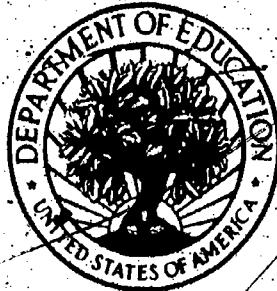**verification** - checking the accuracy of data collected.

weighted estimates - estimates from a sample survey in which the sample data are weighted (multiplied) by factors reflecting the sample design. The weights (referred to as sampling weights) are typically equal to the reciprocals of the overall selection probabilities, multiplied by a nonresponse or poststratification adjustment.

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