

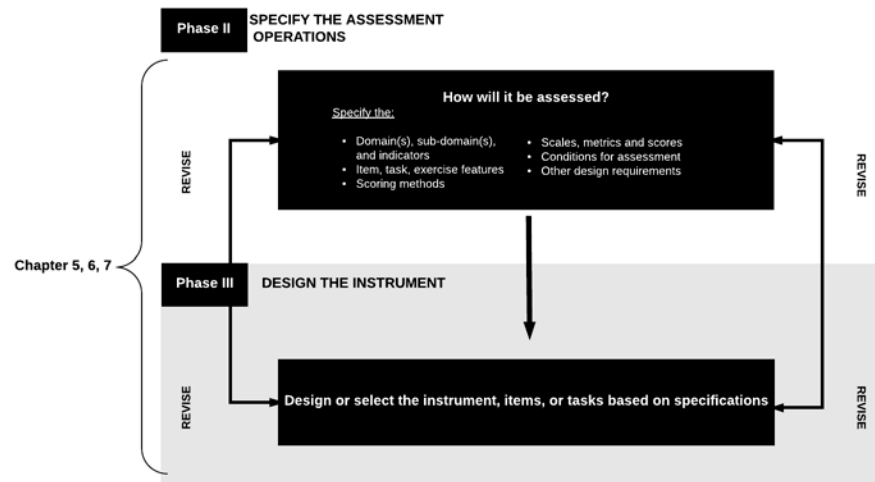
Designing assessments for multidisciplinary constructs and applications—A user-centered methodology

Chapter 6

DRAFT-January 2, 2019

Figures, Tables and Boxes

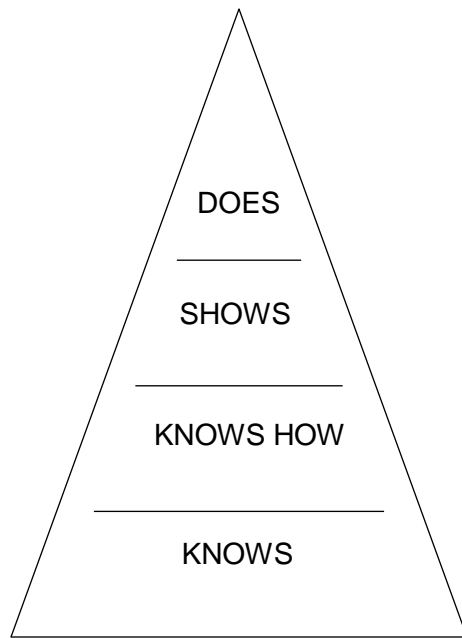
[in press, Guilford]



Note: See Figure 1.6 for the complete model

Figure 6.1

Connecting Chapter 6 to the Process Model and the rest of the book



The Miller Framework

Excerpted with minor adaptations from: Miller, G.D. (1990). The assessment of clinical skills/competence/performance. *Academic Medicine*, 65 (9) 63-67.

Figure 6.2

A Hierarchical Taxonomy: Four Levels of Expertise for Designing Competency-based Assessments

Box 6.1**A Competency-based Domain for Assessing Performance of Physicians****Design Specifications for “Formulating Patient Treatment Plans”****Assessment purposes:**

Inferences-competence and growth in skills on prescribing patient-specific treatment and care

Uses- evaluating performance of resident physicians

Users- supervising doctors, resident physicians, and medical school faculty and leaders

Population- resident physicians in years 1-4.

Construct: Medical competence on a continuum of expertise

Domain- General Outcome:

When serving diverse patient populations in hospitals or clinics, resident physicians will prescribe patient-specific treatment plans drawing on relevant kinds of medical knowledge and “best practice” guidelines in the profession

Taxonomic classifications: “Does” –Miller

Complex Procedural Skills

Embedded skills

Competent residents will be able to:

- (a) Examine patients thoroughly (“Shows how”; *Complex Procedural Skills*)
- (b) Record results of patient examinations systematically (“Shows how”; *Application*)
- (c) Synthesize information from relevant sources and patient history/examination (“Shows how”; *Synthesis; Higher Order Thinking*)
- (d) Evaluate the information to make diagnoses of patients’ health conditions (“Shows how”; *Evaluation; Higher Order Thinking*)
- (e) Prescribe a patient treatment or plan of care using knowledge of medicine, and best practice guidelines. (“Shows how/Does”; *Complex Procedural Skills*)

Situation and context specifications- Hospitals and clinics in designated regions

Facets – Examinees x Domain of all skills

Examinees x Sub-domains of each skill and embedded enabling skills

Assessment methods selected: *Portfolio-based assessment*

Portfolios will include-

Behavior-based Assessments tapping skills (b)-(d) in domain, 2 records per year on each resident.

Product-based Assessments tapping skills (a)-(e) in domain based on electronically kept patient records, documentation, and notes on treatment plans with 5 patient cases per resident rated randomly per year

Box 6.2.**A Case Study in Designing a Behavior-based Assessment**Development of the *Hypertonia Assessment Tool*

The researchers in this case are developing a practical tool to identify “hypertonia” subtypes in pediatric populations of children with cerebral palsy (CP). Hypertonia is a movement disorder, defined as “an abnormally increased resistance to externally imposed movement about a joint” (p. 82). To begin, the researchers developed 14 items reflecting three different disorder symptoms in body movements: spasticity, dystonia, and rigidity. The items in each subset formed “subscales” that were then tested and validated with normal and CP-affected children. Here are some excerpted items and results of their validation study.

Item ExamplesCheck (if observed)**Dystonia (2 of 9 items)**

- a. Involuntary twisting movements
- b. Variable abnormal postures

Spasticity (2 of 3 items)

- a. Presence of spastic catch
- b. Hyperreflexia

Rigidity (2 of 2 items)

- a. Equal resistance to passive stretch
in a bidirectional passive movement of a joint
- b. Maintenance of limb position after passive movement

Results for test-retest reliability, interrater reliability and content/convergent validity studies, presented as prevalence-adjusted, bias-adjusted *kappa* agreement levels, with estimates <0.55 in italics

Subscale	Kappa
Spasticity	
Test-retest reliability	1.00
Interrater reliability	0.65
Validity (Physician 1)	0.74
Validity (Physician 2)	0.57
Dystonia	
Test-retest reliability	0.43
Interrater reliability	0.30
Validity (Physician 1)	0.30
Validity (Physician 2)	0.65
Rigidity	
Test-retest	1.00
Interrater	0.91
Validity (Physician 1)	1.00
Validity (Physician 2)	0.91

Source:

Jetthwa, A., Mink, J., MacArthur, C., Knights, S., Fehlings, T., & Fehlings, D. (2010). Development of the Hypertonia Assessment Tool (HAT): a discriminative tool for hypertonia in children. *Developmental Medicine and Child Neurology*, 52, 82-87.

Box 6.3

Matching Performance Modalities with “Process” versus “Product” Outcomes

Assessing “Management Competency” in Business Leaders

Competent leaders are able to:

- (a) Write a clear and cogent vision statement mapping a trajectory for an organization’s growth, during their first year in a leadership role

Taxonomic level: “Does”-Miller’s taxonomy; *Higher Order Thinking*;

Product indicator

Best-matched Performance Mode

Product-based assessment-

A leader creates a vision statement- A formal letter sent to the organization’s shareholders, clients and employees

- (b) Communicate a vision formally through speeches and informally at meetings, in a manner that resonates with, and inspires, employees during the first year in a leadership role

Taxonomic levels: “Does”-Miller’s taxonomy; *Higher Order Thinking*;

Process indicator

Best-matched Performance Mode: Behavior-based assessment

A leader presents the vision via speeches or at meetings

Note: Indicators are excerpted from Communication Skills, a sub-domain of the construct, *Management Competency*

Table 6.1

Demonstrable Indicators of Content Knowledge of Teachers: A Sample of Classroom Actions and Behaviors

Indicators	What teachers of Mathematics would do:	What teachers of English Language Arts (ELA) would do:
1. Anticipates student challenges, misconceptions, partial misconceptions, alternate conceptions, strengths, interests, capabilities, and background knowledge	<ul style="list-style-type: none"> • Anticipate student challenges in reasoning about and doing mathematics due to the interplay of content demands and students' understanding • Anticipate likely misconceptions, partial conceptions, and alternate conceptions about particular mathematics content and practices 	<ul style="list-style-type: none"> • Anticipate the impact of limited English language proficiency on students' comprehension of text and speech and on their written and spoken expressions • Anticipate how students' background knowledge, life experiences, and cultural background can interact with new ELA concepts, texts, resources and processes
2. Evaluates student ideas evident in work, talk, actions, and interactions	<ul style="list-style-type: none"> • Evaluate student work, talk, and actions in order to identify conceptions in mathematics, including incorrect or partial conceptions • Evaluate non-standard responses for evidence of mathematical understanding and in terms of efficiency, validity, and generalizability 	<ul style="list-style-type: none"> • Evaluate student work, talk, and actions for evidence of strengths and weaknesses in reading, writing, speaking, and listening • Evaluate discussion among groups of students for evidence of understanding ELA concepts, texts and processes
3. Explains concepts, procedures, representations, models, examples, definitions, and hypotheses	<ul style="list-style-type: none"> • Explain mathematical concepts or why a mathematical idea is "true" • Interpret a particular representation in multiple ways to further understanding 	<ul style="list-style-type: none"> • Explain literary or language concepts, using definitions, concepts, and analogies when appropriate • Explain processes of reading, including why certain processes are appropriate for particular texts and/or tasks
4. Creates and adapts resources for instruction (examples, models, representations, explanations, definitions, hypotheses, procedures)	<ul style="list-style-type: none"> • Create and adapt examples that support particular mathematical strategies or to address particular student questions, misconceptions, or challenges with content • Adapt student-generated conjectures to support instructional purposes 	<ul style="list-style-type: none"> • Create and adapt examples or model texts to introduce a concept or to demonstrate a literary technique or a reading, writing or speaking strategy • Create and adapt analogies to support student understanding of ELA concepts, texts, and processes

Excerpted with minor adaptations from:

Gitomer, D.H. & Zisk, R.C. (2015). Knowing what teachers know. *Review of Research in Education*, 39, 1-53.

Table 6.2

A Facet Grid: Designing a Portfolio-Based Assessment for Measuring Performance of Resident Physicians

Facet	# Elements in Facet	Desired Scores	Sampling Decisions
1. Examinees/ Subjects	20 <i>Number of residents in a cohort</i>	a) Individual examinees’ “end-of-year scores and competency profiles” b) Individual examinees “gain scores” in years	<i>Total # of observations to be made on each resident?</i>
2. Tasks	5 <i>Patient problems per year</i>	N/A	<i># of tasks to be randomly selected from a potential range of 30+ patient health problems?</i>
3. Settings	2 <i>Hospitals and clinics</i>	N/A	<i># of direct observations to be made at each setting?</i>
4. Domain and Sub- domains	5 <i>Targeted skills</i>	a) Total domain score b) Sub-skill scores	<i>All or some indicators (a)-(e) in Box 6.1 to be rated for each assessment?</i>
5. Observers/ Examiners	14 <i>Attending physicians and senior residents</i>	N/A	<i># of attending physicians vs. senior residents from pool of 14 who will observe and rate residents?</i>

Box 6.4A.**Applying Phases I-II to Design a Behavior-based Assessment****Phase I. Specify the Construct, Assessment Purposes, and Population**

Construct. *What is to be measured?* Competencies in providing physical therapy care to cardiac patients.

Assessment Purposes. *Why?* To evaluate trainee outcomes and the effectiveness of physical therapy training programs

Users: Faculty, program administrators/leaders, other hospital support personnel.

Specific Uses:

- (a) Summative decision-making to evaluate the effectiveness of the program, and examine trainee outcomes at end of program. The last two scores from 3-7 observations performed on each trainee should be used for summative evaluations of trainee outcomes.
- (b) Formative decision-making to diagnose needs and shape the growth of individual trainees. Analytic indicator profiles on domain of skills should be used for giving formative feedback and coaching during the course of the program.

Intended Score-based Inferences:

- (a) Program effectiveness- *How effective is the program based on aggregated scores as the unit of analysis?*
- (b) Students' mastery levels -*To what extent have individual trainees mastered the domain based on the total scores?*
- (c) Students' knowledge/skill gaps- *Where should we refocus our instructional resources so as to coach trainees in areas of weakness?*

Population. *On whom will the instrument be applied?* Students in physical therapy programs affiliated to the cardiac care units of university-affiliated hospitals

Phase II. Specify the Assessment Operations

Domain specifications. See Box 6.4

Assessment method(s) selected. Behavior-based assessment with an analytic rubric yielding a total domain score and sub-domain scores for individual trainees. Each indicator-based item is scored on a three-point rating scale (0-2).

Facets and Weights desired in Scores.

Score type 1: Domain x Examinees (Total Score based on 25 items).

Score type 2: Sub-domains x Examinees (Scores-Indicators 1.1, 1.2, 1.3 of 10, 10, 5 items each).

Table of Specifications shows weights by taxonomic level of indicators (Box 6.4 B).

Situation/conditions specifications. Skills must be demonstrated while students are examining cardiac patients in hospital-based care and rehabilitation programs, and under supervision of instructors. Tasks should be performed with at least 5 different patient cases.

Who Assesses? Clinical instructors. All instructors must receive a formal orientation to assessment

procedures via a rater training guide and video-taped observation records of trainees.

Administration Conditions: Individually-administered assessment, initiated after trainee completes induction at hospital or clinic.

Source: Adapted from the original designed by P. Belarmino, Jr.. Posted with permission under Process Model Applications

Box 6.4B. Applying Phases I-II to Design a Behavior-based Assessment (contd.)**Phase II. Specify the Assessment Operations (continued).****Construct Domain Specifications:****Targeted Performance Outcome-**

Upon completion of training, the trainees will be able to-

Perform a physical therapy evaluation competently for cardiac patients undergoing rehabilitation in hospital settings, and prepare a plan of care that complies with best practice standards in the field. (*Shows How-Miller; Complex Procedural Skills*)

Embedded Specific Indicators-

1.1. Investigate the medical condition of patients (*Complex Procedural Skills*)

1.2 Perform the tasks of a physical therapy evaluation safely and systematically following established guidelines. (*Complex Procedural Skills*)

1.3 Create a comprehensive plan of care for patients based on medical condition, physical therapy evaluations, and needs/ life circumstances of individual patients. (*Higher Order Thinking*)

Sources: *American College of Sports Medicine's exercise prescription guidelines; American Heart Association's exercise guidelines; American Physical Therapy Association's Standards of Practice Act and Code of Ethics; Guide to Physical Therapy Practice of American Physical Therapy Association/Cardio-pulmonary section (2nd edition, 2001); New York State's Physical Therapy Practice Act*

Table of Specifications- Cells Show # of Items by Indicator					
Content	Taxonomic Levels				Total Score
Indicators and Sub-indicators	Complex Procedural Skills	Application of Knowledge	Evaluation: Higher Order Thinking	Synthesis-Evaluation: Higher Order Thinking	Weighted Points
Indicator 1.1	2				2
1.1.1		4			4
1.1.2			4		4
Indicator 1.2	2				3
1.2.1		4			4
1.2.2	3				3
Indicator 1.3				2	3
1.3.1		2			2
1.3.2		2			2
Total	7	12	4	2	25

Source: Adapted from the original designed by P. Belarmino, Jr. Posted with permission under Process Model Applications

Table 6.3**Observational Assessment of Physical Therapy Skills**

Name of the trainee: _____

Name of the hospital/school/program: _____

Affiliation period: _____

Name of the clinical instructor: _____

Date of assessment: _____

Directions to the Clinical Instructors

- Please use this summary form to rate the last 3 observations on each trainee at end of program. Before checking the rating scale category, please see definitions of terms.**
- Individual sessions may be rated “live”, or videotaped and rated afterwards.
- Skills must be demonstrated while students are examining cardiac patients in hospital-based care and rehabilitation programs, using appropriate equipment and materials, as needed. Items should be checked separately at each session and compiled using this form. Keep checklists of prior observations on each student on file with instructor notes on training gaps/needs. Each behavioral item below is linked to an indicator in the curricular domain shown on the left (1.1-1.3).
- To interpret scores, please sum the ratings across items by sub-domain and domain to compute a total and % score out of the maximum possible score.

Link to Domain	Behaviors Observed	<i>Performed Competently and Consistently</i> (Points=2)	<i>Performed Competently but Inconsistently</i> (Points=1)	<i>Not Observed OR Performed Incompetently and Inconsistently</i> (Points=0)
1.1	1. Reads medical chart of cardiac patients before performing the actual physical therapy evaluation.			
	2. Discusses with medical staff any medical issues concerning the cardiac patients during the review of medical history.			
1.1.1	3. Reads the pre-admission notes of each patient during the review process			
	4. Records the past medical history of patients during history taking.			
	5. Reads any available laboratory reports of the patient, like blood tests, diagnostic, and/or routine tests during the review of medical history.			

	6. Reads current progress notes written in the medical chart of patients while reviewing the medical history.			
1.1.2	7. Consults the medical literature for the specific signs and symptoms of the disease before performing the evaluation procedure.			
	8. Correlates the current medical problem(s) from the past medical history while investigating the medical situation of patients.			
	9. Confirms with the medical staff the etiology of the disease and rules out possible alternate causes.			
	10. Explains the medical disease process to the clinical instructor concisely and correctly after reviewing the medical condition of patients.			
	Sub-domain 1.1 Score= (Max. Score Possible: 20)			
	<i>End-of Program Total Score</i>			

Source: Adapted from the original designed by P. Belarmino. Posted with permission under Process Model Applications

Table 6.4.**Designing a product-based assessment in workplace training contexts**

<p>Construct: Competency in Public Health Information Technology</p> <p>Domain Specifications</p> <p>Exiting performance outcome:</p> <p>1.0 During training sessions with Electronic Health Records (EHRs), convince healthcare professionals to comply with, and apply, health data definitions and standards while upholding patient privacy and confidentiality rights so as to improve patient care and reduce medical errors (<i>Higher Order Thinking</i>).</p> <p>Following instruction, students should be able to:</p> <p>1.1 Describe the role and importance of the following aspects of EHRs, data definitions and standards in accurate terms (<i>Concept Recall and Understanding</i>)</p> <ul style="list-style-type: none"> • patient rights under the Notice of Privacy Practices • identify and summarize each Health Information Privacy Protection Act (HIPPA) security requirements for administrative, physical, and technical areas • different types of standards required (e.g., information clinical data representation, technical, medication, terminology, and privacy and security) • grammar data standards for communicating in public health informatics • organization and context factors to consider for applying data standards. <p>1.2 Apply health data definitions and standards, as well as privacy and confidentiality issues, to improve patient care and reduce medical errors in public health scenarios (<i>Application</i>)</p> <p>1.3 Prepare compelling communications to convince professionals apply health data definitions and standards (<i>Higher Order Thinking</i>).</p>	
<p>Product-based Assessment</p> <p>Task:</p> <p><i>Directions to students/examinees.</i> You have been given the task of training and convincing a group of medical professionals to prepare for implementation of a new electronic health record system at your healthcare facility. With specific examples, argue why each of the following SIX aspects of public health information standards in using patient electronic health records (EHRs) will help patients and reduce error levels in providing patient care. Prepare a statement for a training scenario. The statement must not more than 3 typed, double-spaced pages in length.</p> <ul style="list-style-type: none"> • Clinical Data Representation • Medication Terminology • Organizational Context • Grammar data standards • Notice of Privacy Practices • HIPAA Security Requirements 	

Rating	Description of Performance
4	<p>A. Reasonably argues for ALL six aspects and highlights the importance of each when implementing an EHR. Examples are compelling. Concepts, definitions and terms are accurately discussed and presented in a coherent and well-written statement.</p> <ul style="list-style-type: none"> • Different types of standards required (clinical data representation and medical

	<p>terminology)</p> <ul style="list-style-type: none"> • Importance of context regarding data standards • Importance of grammar data standards for communicating in public health informatics • Importance of patient rights under the Notice of Privacy Practice • Summarizes each HIPAA security requirement (administrative, physical, technical), and explains its importance
3	B. Reasonably argues for ALL six aspects above (see bullets under A above). Accurately describes 4-6 aspects and highlights their importance when implementing an EHR, but there are minor errors or omissions. Specific examples are good. Statement is coherent and well-written overall.
2	C. Argues for at least 4 aspects above (see bullets under A above) and highlights their importance when implementing an EHR. Some examples are specific and applicable, but there are several errors or omissions that make the statement less compelling. Statement is descriptive rather than persuasive and well-written in parts.
1	D. Fails to argue for at least 4 aspects above (see bullets under A above) or explain their importance when implementing an EHR. Examples are missing or limited, and there are major inaccuracies, errors or omissions that make the statement weak. Statement is not well-written overall.

Source: Adapted from the original designed by assessment design teams reported in Authors et al (2018).

Table 6.5

A Holistic Rubric: Designing a Product-based Assessment for Workplace Training Contexts

<i>Scoring Guidelines for Workplace Training Instructors or Examiners</i>	
Rating	Construct: Competency in <i>Public Health Information Technology</i>
Category	Description of Four Performance Levels
4	<p>Reasonably argues for ALL six aspects and highlights the importance of each when implementing an EHR. Examples are compelling. Concepts, definitions and terms are accurately discussed and presented in a coherent, clear and well-written 3 page statement.</p> <ul style="list-style-type: none"> • Clinical Data Representation • Medication Terminology • Organizational Context • Grammar data standards • Notice of Privacy Practices • HIPAA Security Requirements
3	Reasonably argues for <i>all or most</i> (4-6) aspects above (see bullets under item). Accurately describes <i>most</i> aspects and highlights their importance when implementing an EHR. But, there are <i>minor errors or omissions</i> . Specific examples are appropriate. Statement is coherent and well-written overall, and complies with page limits.
2	Argues for at least 4 aspects above (see bullets above) and highlights their importance when implementing an EHR. Some examples are specific and applicable, but there are <i>several errors or omissions</i> that make the statement <i>less compelling</i> . Statement is <i>descriptive rather than persuasive</i> and well-written in parts. May not comply with page limits.
1	Argues for less than 4 aspects (see bullets) or fails to explain their importance when implementing an EHR. <i>Examples are missing or limited, and there are major inaccuracies, errors or omissions that make the statement weak</i> . Statement is not well-written overall, and/or may not comply with page limits.

Table 6.6.
Mapping Progress using a Portfolio-Based Assessment

Project CHILD Language Arts Portfolio
Handwriting Development Summary

Name: _____ Grade: _____

Checklist Codes:

Y=Observed

N = Not Observed

U = Unable to Determine or Not Applicable

Sample Description (Alphabet Writing, Creative Writing, Other Writing Sample)	Date Reviewed	Teacher Comments		
1. _____	_____	_____		
2. _____	_____	_____		

Dates when produced:	Semester 1	Semester 2	Year-end
1. Holds pencil properly			
2. Shows left to right directionality			
3. Has correct posture when writing			
4. Has correct paper position when writing			
5. Identifies uppercase letters correctly (How many?)			
6. Prints uppercase letters correctly (How many?)			
7. Identifies lowercase letters correctly (How many?)			
8. Prints lowercase letter correctly (How many?)			
9. Spaces correctly between words in sentences			
10. Demonstrates mastery of uppercase alphabets when writing			
11. Demonstrates mastery of lowercase alphabets when writing			
12. Prints words legibly			
13. Writes words and short sentences legibly in cursive			
14. Uses capital letters and basic punctuation marks correctly in sentences			
Other indicators (comments):			

Please fill in this section based on discussion with student and parents.
 What can we work on next?

Note to the Teacher:

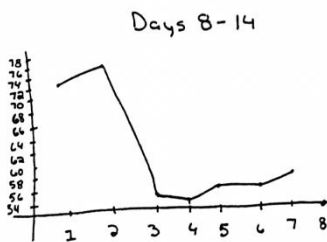
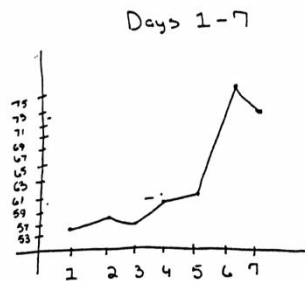
This instrument must be completed by the teacher based on observations made of the child in class, as well as, examination of informal or formal handwriting samples produced. Please share with parents at appropriate times.

Starting on Sunday, the average daily temperatures in degrees Fahrenheit that you recorded for 14 consecutive days were as follows:

Days:	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>	<u>8</u>	<u>9</u>
Temperature in degrees Fahrenheit:	56	58	57	60	61	75	72	71	77
Days continued:	<u>10</u>	<u>11</u>	<u>12</u>	<u>13</u>	<u>14</u>				
Temperature in degrees Fahrenheit	55	56	54	56	58				

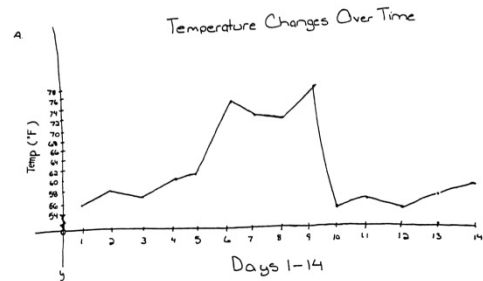
contd.:

- Make a graph to show how the temperature changed from Day 1 to Day 14.
- Describe in your own words how the temperature changed by comparing trends.
- What type of graph did you use (bar, line graph or other) and why?



In days 1-7 the temperature remains within a 6° difference for the majority of the days until a drastic 14° change on the sixth day. The temperature remains in the high 70's until about day 9. By day 10, the temperature has once again lowered to the 50's and stays relatively constant. The most relevant change occurred between days 6 and 9 for the most part.

Response from Student A



- The temperature from days one to seven generally increases, with the steepest incline occurring between days five and six. Days seven and eight seem to be a stabilizing period. Days eight to fourteen generally show a decline in temperature, where the steepest decline occurs on day ten and is followed by smaller drops.
- I used a line graph to illustrate the rises and falls in temperature over a period of time. A line graph clearly shows the relationship between each day's temperature and the day preceding it.

Response from Student B

Figure 6.3 Improving Rubrics using Common Errors: Responses from Two Middle School Students