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Assessment Analysis and Critique

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The following report analyzes the results of a third grade summative assessment on simple machines. The mean score on the assessment (after adjustments) was an 83 with a range of 48 to 98. The intent of this analysis is to evaluate the learning of students beyond a test score, to help make instructional decisions based on student learning, and to improve the reliability and validity of the assessment for future use.

Class Analysis

In order to get an overview of class results on the assessment, I have recorded student performance into the Table of Specifications, which can be found on the following page. The table shows by question overall results of the class.

The charted results are similar to what I expected from the class. Higher percentages of correct answers are recorded with lower order thinking while as the cognitive level increases, the percentage of correct answers decreases. Looking at the aggregate, I infer that the majority of students mastered the intended learning outcome of types and functions of simple machines for lower cognitive levels as well as applying this knowledge to common examples of the simple machines. This is clearly demonstrated by the large percentage of students answering questions 1-5 and question 7 correctly. However, many students appear to struggle with higher order thinking, especially analysis. For example, though students demonstrated their knowledge of what a wedge and screw are separately, they were unable to recognize both simple machines as part of the inclined plane family (question 8).

Table 1.
Table of Specifications – Aggregate Results

Content	Cognitive Levels					
	Knowledge	**Comprehension**	**Application**	**Analysis**	**Synthesis**	**Evaluation**
Types of simple machines	Q: 1, 2*, 3*, 4, 5, *14* ♦			Q: **8,** *12*, *15* ♦		
Application and function of simple machines		Q: 7*, **16** ♦		Q: *9*, 10, 13* ♦		
Specific examples of simple machines in school and household items			Q: 6, 17* ♦	Q: **11**, *19* ♦		
Apparatus that contains a simple machine					Coop. Learning Project ♦	
The simple machines composed of a compound machine		Q: *18* ♦		Q: *19*, *20* ♦		

Key:
Bold: less than 50% of students answered correctly
Italics: between 50-75% of students answered correctly
Underline: at least 85% of students answered correctly
Underline*: at least 90% of students answered correctly
Red: determined unreliable

In addition to working on higher order thinking skills, an intended learning outcome that the class did not perform well on overall was pertaining to compound machines. From this table, it is evident that not a single question about compound machines was answered correctly by over 85% of the class. I can conclude from this that the concept of compound machines needs to be revisited and better explained in order to improve student learning.

Student Analysis

In order to further evaluate student learning, I have charted two students' results into the assessment's Table of Specifications. This allows me to take a closer look at the standards the students mastered and the arrears where re-teaching needs to be directed.

Student A

The first student, who has been referred for child study, scored a 48 on the test. The student was given the opportunity to verbally express answers for the written components of the assessment. The verbal answers were graded, although I also looked at the student's written answers to compare answers. I found few matches between the verbal and written answers.

Table 2 clearly shows the student is performing strictly at knowledge and comprehension levels since only one application question and one analysis question were answered correctly. The student needs further instruction in all intended learning outcomes, though mainly with compound machines and the higher order thinking skills. The student can clearly identify the type of simple machine when shown an example (questions 1-5) and can even give the job of the machine when asked straightforward (i.e. question 7: "The job of the simple machine shown in Figure 1 is to _____."); however, connections need to be drawn from the name and job of the simple machine to how it is used or applied in situations (questions 12, 13, 15).

Table 2.
Table of Specifications – Student A

Content	Cognitive Levels					
	Knowledge	Comprehension	Application	Analysis	Synthesis	Evaluation
Types of simple machines	Q: 1-5, **14** ♦			Q: **8, 12, 15** ♦		
Application and function of simple machines		Q: 7, 16 ♦		Q: **9, 10, 13** ♦		
Specific examples of simple machines in school and household items			Q: **6**, 17 ♦	Q: 11, *19* ♦		
Apparatus that contains a simple machine					Coop. Learning Project ♦	
The simple machines composed of a compound machine		Q: *18* ♦		Q: *19, 20* ♦		

Key:
Bold: answered incorrectly
Italics: partial credit awarded

Student B

The second student scored just below the average class score. This student's results closely mirror the results of the class; the table shows the student has a strong understanding of simple machines at the knowledge, comprehension and application cognitive levels, but learning breaks down when the thought process involves analysis.

Table 3.
Table of Specifications – Student B

Content	Cognitive Levels					
	Knowledge	Comprehension	Application	Analysis	Synthesis	Evaluation
Types of simple machines	Q: 1-5, 14 ♦			Q: **8,** 12, 15 ♦		
Application and function of simple machines		Q: 7, **16** ♦		Q: 9, **10,** 13 ♦		
Specific examples of simple machines in school and household items			Q: 6, 17 ♦	Q: **11,** *19* ♦		
Apparatus that contains a simple machine					Coop. Learning Project ♦	
The simple machines composed of a compound machine		Q: *18* ♦		Q: *19, 20* ♦		

Key:
Bold: less than 50% of students answered correctly
Italics: partial credit awarded

Looking at the individual intended learning outcomes, the student demonstrates mastery of the types of simple machines and the application and function of simple machines (once the reliability of question 16 is addressed). The final intended learning outcome needs the most support with more instruction. The student needs further instruction on compound machines as full credit was not awarded for any of the questions assessing this outcome. This instruction on compound machines would more than likely increase his analysis skills of examples of simple machines if done in a higher level

thinking activity where the student uses the foundational knowledge of simple machines to compare and contrast these machines to compound machines.

Instructional Decisions

Analyzing the results of the assessment and evaluating student learning helped me determine the areas I needed to re-teach since mastery of the content had not been demonstrated. The follow-up lessons on the unit focused on compound machines since mastery was not demonstrated at any cognitive level for this learning outcome (questions 18, 19, and 20).

When teaching this unit in the future, I will allow for more time to introduce the concept of compound machines. I erroneously believed that once students understood a simple machine, it would be relatively easy to understand that a compound machine was two or more simple machines working *together* to perform a job; however, it was the *together* concept that provided difficulty. In addition, rather than waiting until after instruction has been provided for the six different simple machines to introduce compound machines, the connections may be clearer for students if it is discussed when exploring simple machines. For example, many students correctly labeled scissors as a wedge during the lesson on wedges, but I let students overlook the fact that it also uses a lever. Therefore, when levers were introduced, the students were unable to see how the wedge and lever worked together in scissors to perform the task of cutting paper.

I further believe that I will attempt to better prepare for student questions in the future because although I felt prepared and confident in the material, I was uncertain in responses to a few students' questions which may have contributed to the unsuccessful instruction on compound machines.

In addition to focusing more on compound machines, I will try to extend third graders to higher order thinking during the lessons. I attempted to do this with experiments and hands-on learning as well as preparing specific higher level questions to ask students, but more practice in order to train students to think in this way. I was unsure of how students were perform on the analysis questions after these types of questions on a practice test and during test review. I was fearful that I had turned one analysis question into either a knowledge or comprehension question after reviewing the concept numerous times, but students still struggled with the concept of the inclined plane family including both a wedge and a screw (question 8).

Reliability and Validity of the Assessment

The table of specifications verifies the content validity of the assessment which in turns supports content validity. Further support for the validity of the assessment is drawn from a practice test given prior to the assessment; scores from both assessments demonstrated strong concurrent validity of the given assessment. The assessment is also reliable, as extensive efforts were taken to write questions and assemble the test in a manner that would minimize, if not eliminate, systematic error. However, there are several areas of the assessment I feel would benefit from change if I were to re-administer the test in the future. These alterations come from having to adjust scores based on three questions: questions 8, 11 and 16. Questions 8 and 11 are reliable questions, as measures were taken to reduce systematic error (i.e. parallel answer choices, etc.); however, I realize I would need to alter instruction in order to help students draw the analysis between the simple machines and their functions in order for the question to

be a fair question. This, in turn, is why I justified adjusting students' scores to reflect the lack of instruction for these questions.

Even though question 11 is reliable in the format with parallel answer choices and the "not" emphasized with capital letters and underlining, one way to increase the reliability for question 11 would be to change the question to a positive form. The reliability of this question may have been affected since students are unaccustomed to having to find the answer choice that does not belong; therefore, the question would not be a true indicator of student learning (Gareis & Grant, 2008).

In addition to changes made in question 11, I would change the wording of question 16 in order to increase the reliability of this question. When analyzing the results, students selected either answer choice "B" or "D." With over half of the students incorrectly selecting answer choice B, I realized that the answer was correct, but answer choice D was a *better* answer to describe the purpose of simple machines. Since answer choice B described the job of the paper cutter, however, it was not a reliable question with two possible answer choices. Also, I found that a handful of third graders were unsure what the word "purpose" meant, affecting the true evaluation of student learning as well.

Finally, while I liked the higher level thinking component of classifying simple and compound machines in questions 18 and 19, I would also insert lower order cognitive questions aligned with this intended learning outcome to accurately assess student learning. This would benefit students who struggle with higher level thinking even with a solid understanding of the concepts.

Overall, while my cooperating teacher and I would have liked to have seen higher scores on the test after feeling confident with student understanding of the material, I felt the test gave an accurate representation of the students who think on higher cognitive level than those who are still cognitively developing higher order thinking skills. Higher order thinking will take practice for students as well as for me to be able to effectively teach students at this level. I will continue to strive to teach at this level rather than giving unreliable and invalid assessments that are only measuring lower level knowledge and comprehension.