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 Assessment Analysis and Critique
 CRIN 550: Assessment of Learning

During the student-teaching experience, I have given the major assessment for the heat and temperature unit. It was designed to match the standards set forth in the Virginia Standards of Learning (SOLs), with the intended learning outcomes being congruent with the standards. This paper will analyze and critique the assessment to show the strength of inferences about how the students acquired the intended learning outcomes and give strategies for future improvement.

Because of the diversity of the students within my various classes, I really provided students with three separate assessments. In the following tables of specifications, an assessment item in red means that greater than 40% of students answered incorrectly and an item in orange means that less than 4% of students answered incorrectly. For those students with individualized education plans (IEPs), I employed the original table of specifications to modify the assessment while maintaining a high degree of validity and reliability. The new table of specifications is (named IEP assessment):

| Content | K | C | App | An | S | E |
|---|----------|-------------------------------------|--|----------------------------------|----------|----------|
| The effect of the addition or subtraction of heat energy on the motion of molecules | | M explain MC: 1, 9, 15 TP: 12 | M illustrate MC: 2, 7, 13 TP: 12 | | | |
| Heat and temperature | | | | M distinguish SA: 24 TP: 5 | | |

| Content | K | C | App | An | S | E |
|---|----------|--|---------------------------------------|---------------------------------------|--------------------|----------|
| Fahrenheit, Celsius, and Kelvin temperature scales and absolute zero | | M describe MC: 3, 8, 20 TP: 12 | M convert MC: 16, 18, 22 TP: 12 | M compare/contrast SA: 25 TP: 3 | | |
| Time/temperature graph of phase change experiment | | | | M analyze TP: 0 | | |
| Temperature at which phase changes occur | | M determine MC: 4, 10, 12, 17 TP: 16 | | | | |
| Heat gained or lost | | | | M calculate TP: 0 | | |
| Conduction, convection, and radiation with common examples | | M explain MC: 6, 19, 21, 23 TP: 16 | | M compare/contrast TP: 0 | M provide TP: 0 | |
| Principle of heat transfer to heat engines, thermostats, and refrigerators and heat pumps | | M explain MC: 5, 11, 14 TP: 12 | | | | |
| Totals | | 68 | 24 | 8 | 0 | |

For the general population, I again employed the original table of specifications to modify the assessment while maintaining a high degree of validity and reliability. This new table of specifications is (named Modified assessment):

| Content | K | C | App | An | S | E |
|---|----------|--|--|---------------------------------------|------------------------------|----------|
| The effect of the addition or subtraction of heat energy on the motion of molecules | | M explain MC: 1, 14 TP: 8 | M illustrate MC: 2, 7, 12 TP: 12 | | | |
| Heat and temperature | | | | M distinguish SA: 22 TP: 5 | | |
| Fahrenheit, Celsius, and Kelvin temperature scales and absolute zero | | M describe MC: 3, 8, 17 TP: 12 | M convert MC: 15, 19 TP: 8 | M compare/contrast SA: 23 TP: 3 | | |
| Time/temperature graph of phase change experiment | | | | M analyze SA: 24 TP: 2 | | |
| Temperature at which phase changes occur | | M determine MC: 4, 9, 11, TP: 12 | | | | |
| Heat gained or lost | | | | M calculate TP: 0 | | |
| Conduction, convection, and radiation with common examples | | M explain MC: 6, 16, 18, 20 TP: 16 | | M compare/contrast SA: 21 TP: 7 | M provide SA: 21 TP: 3 | |
| Principle of heat transfer to heat engines, thermostats, and refrigerators and heat pumps | | M explain MC: 5, 10, 13 TP: 12 | | | | |
| Totals | | 60 | 20 | 17 | 3 | |

Finally, I kept the original assessment the same for students in the more advanced class, which began with a high degree of validity and reliability. This table of specifications is (named Original assessment):

| Content | K | C | App | An | S | E |
|---|----------|--|---------------------------------------|---------------------------------------|----------|----------|
| The effect of the addition or subtraction of heat energy on the motion of molecules | | M explain MC: 1, 9, 17 TP: 9 | M illustrate MC: 2, 7, 14 TP: 9 | | | |
| Heat and temperature | | | | M distinguish SA: 29 TP: 5 | | |
| Fahrenheit, Celsius, and Kelvin temperature scales and absolute zero | | M describe MC: 3, 8, 13, 22 TP: 12 | M convert MC: 18, 20, 24 TP: 9 | M compare/contrast SA: 31 TP: 3 | | |
| Time/temperature graph of phase change experiment | | | | M analyze SA: 26 TP: 3 | | |
| Temperature at which phase changes occur | | M determine MC: 4, 10, 12, 19 TP: 12 | | | | |
| Heat gained or lost | | | | M calculate SA: 27, 30 TP: 4 | | |

| Content | K | C | App | An | S | E |
|---|----------|--|------------|---------------------------------------|------------------------------|----------|
| Conduction, convection, and radiation with common examples | | M explain MC: 6, 15, 21, 23, 25 TP: 15 | | M compare/contrast SA: 28 TP: 7 | M provide SA: 28 TP: 3 | |
| Principle of heat transfer to heat engines, thermostats, and refrigerators and heat pumps | | M explain MC: 5, 11, 16 TP: 9 | | | | |
| Totals | | 57 | 18 | 22 | 3 | |

After compiling the scores in the aggregate, I found that students on the IEP assessment scored on average 75%, the Modified assessment 71%, and the Original assessment 88%. These numbers suggest that students acquired most of the learning objectives, but it varied with each student which objectives were attained and which were not. An easy inference to draw would be to say that the students who took the Original assessment acquired the most learning objectives, whereas those who took the Modified assessment acquired the least amount of learning objectives. Two students on the extremes in the IEP assessment scored 96% and 46% respectively, which again is an easy inference. The student who scored a 96% on the assessment acquired almost all or all the learning objectives, and the student who scored 46% acquired approximately half of the learning objectives. Two students on the extremes in the Modified assessment scored 96% and 32% respectively, and the same inference may be drawn as was in the IEP assessment. Finally, two students in the extremes on the Original assessment scored 100% and 68%, which suggests that the student who scored 100% acquired all the learning objectives and the student who score 68% acquired most of the learning objectives.

Because assessments are not only useful for students to understand their progress in the class, they are also useful for teachers to make instructional decisions. Based on the results of this test, I am lead to several instructional decisions. For the near-term, I would focus on phase changes as a way to reinforce the concept of energy transformation during SOL review. Energy transformations are a large part of the end-of-course SOL exam, and by incorporating phase changes I would (hopefully) re-teach students about what happens when an object changes phase. I would also emphasize differences in temperature scales when discussing the phase changes, because many students that had taken either the IEP assessment or the Modified assessment had a difficult time comparing and contrasting the different scales. For long-term planning, I would provide more focus on phase change diagrams and the temperature at which these happen. The students also have this content when discussing an earlier unit, so I did not spend as much time on it as I could have. Therefore, I would push further with this to reinforce what they had learned in the earlier unit. I would also have students practice more with the calculations of heat gained and lost, and be very explicit about how I want the problems set up and solved. Many students lost points because they did not write the equation or include units, and this contributed to the difficulties of many students.

When making inferences from an assessment, validity and reliability are very important. For the IEP and Modified assessments, this assessment was valid and reliable, though not to the point that I had hoped. On the IEP assessment, 1 of the 2 short answer questions (worth 3 points total) was answered incorrectly by greater than 40% of students. This is either a sign that I did not provide enough instruction on the objective the question was measuring or that the question itself was faulty. In this case I believe it was the question, because I needed to specifically state that the students needed to remember reasons for why the temperature scales

were different instead of simply regurgitating the absolute zero, melting, and boiling points of water. For the Modified assessment, the same question was answered incorrectly by greater than 40% of students, and I think the analysis is the same. If I was giving the test in the future, I would change the wording of the item and explain it more thoroughly when providing the initial instruction. For the Original test, there were issues in the opposite direction. Many of the questions were answered incorrectly by less than 4%, which either means that the instruction to these students was much better than the other classes or that the test items were not valid and/or reliable. One aspect that might have skewed the reliability is a test review that I gave on the previous day, and many of those questions were similar to the questions on the assessments. With the advanced class, students were engaged on that day to understand the material and asked many more questions than the other classes. I believe this allowed them to acquire the learning objectives much more thoroughly than the other classes, and the 88% overall average seems to point to the same conclusion. I would also change the wording of questions that pertained to the motion of molecules, because 5 out of the 6 questions had students incorrectly answer less than 4%.

Overall, I believe that the assessments were valid and reliable, and that I may draw inferences about student learning from them. Students acquired most of the learning objectives that I set forth during my instruction, and demonstrated this acquisition through their performance on the assessment.