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Student assessment in the classroom is necessary to support student growth and increase students' content knowledge. Formative assessment, or assessment that helps guide instruction and learning, can take many forms. One widely-used form is student self-assessment, in which students assess their own learning and set goals to increase their understanding of a topic. While experts agree that the process of self-assessment is valuable, this value is dependent on the teaching methods, practice and support provided by teachers for students in the classroom throughout the school year. A number of research-based best practices were incorporated into a middle-school science self-assessment, which was used throughout the 2016-2017 school year. Teacher observations are discussed and next steps for further student growth are identified.

**KNOW THYSELF:
USING STUDENT SELF-ASSESSMENT TO INCREASE STUDENT LEARNING
OUTCOMES**

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Chapter 1

Introduction

Assessment is an important topic to anyone involved in education for many reasons. While used in a wide variety of ways, assessments in education are fundamentally a measure of how successful a student has been in mastering curriculum; student success (or lack thereof) in turn is considered representative of the success of a teacher, a school, a district, and even the parents and other adults in that student's life (Dunn Morgan, O'Reilly, & Parry, 2004; Hiang, Pandian, Ismail, & Nagaratnam, 2011). Formal assessments especially have come to hold great power; they can determine the short and long term paths a student is able to pursue in life, the financial strain or lack thereof placed upon a family, and can either directly or indirectly influence the career success of most persons who work in the education field (Horn, 2005; Koretz, 2000; Kunzel & Hezlett, 2007). Large-scale assessment results are used to determine the amount of funding and other monies given to schools and districts; they also correlate to the prestige and respect an institution or district is regarded (Banta, 1988).

For all these reasons, assessments, and more specifically student performance on assessments, are matters of grave importance. It is important to everyone involved in the educational system to ensure that students demonstrate their highest ability on assessments. Writing relevant and reliable exams has become an important and profitable business, and is often the focus in academic courses and professional development trainings (Hiang et al., 2011; Weiner, 2007). Pressure on teachers is immense. Teachers are expected to teach both depth and a breadth of subject matter, to use methods that ensure all students, regardless of demographics, can demonstrate understanding and mastery of the material, and to ensure students are prepared

to be successful on a variety of exams, in a variety of settings, within a wide range of times (Finkle, 2004; Plank & Condliffe, 2013).

As the pressure on teachers to adequately educate all students increases, so does the diversity of students that educators are faced with. Today's students are a remarkably heterogeneous group, encompassing multiple languages, religions, cultures, races, ages, socioeconomic ranges, learning styles, and special needs. Teachers are expected to successfully teach all students, which in many cases equates to ensuring that they are adequately prepared to pass the assessment-be it a unit, performance, or standardized assessment (Allison & Rehm, 2007; Morrison, 2002)

While less structured teaching approaches are joked about amongst educators, it is widely recognized that delivering lessons and hoping for the best when it is time for the final assessment is not an effective way of teaching students. It is essential that teachers continually assess how well students are understanding the material being taught, and adjust subsequent instruction to better meet students' needs. This type of assessment is a formative assessment, and should be the basis for most instructional adjustments made in the classroom once the basic structure of the lessons within a unit have been constructed (Gordon, McGill, Sands, Kalinich, Pellegrino, & Chatterji, 2014).

A wide variety of formative assessment methods are used to great effect, including a method that has students self-assess their work, understanding, and mastery of content. This method is widely used and thought to be highly effective, but is also a strategy that teachers are less familiar with and less confident in (Ross, 2006). There are a variety of ways to ensure student self-assessments (SSAs) are reliable and worthwhile. Researchers have identified both general practices and specific tasks that they believe will increase the overall value of the self-

reflection process for students, as well as approaches that are less effective in causing student gains. Using this research to design an in-class self-assessment for students should result in greater metacognition abilities and content mastery for students, as long as several vital practices identified by researchers are included. Here, the question “What practices give value to student self-assessment, and how can those practices be incorporated into a classroom setting?” is first explored through the literature, then applied in a self-assessment designed to be used in a typical middle school science classroom.

Chapter 2

Literature Review

The primary focus of the literature review pertained to the methodology of effective student self-assessment. Within the literature, there is a clear division between researchers who have determined student self-assessment and formative assessment in general are practices beneficial to students, and researchers who have found formative and self-assessment to be at best ineffective and at worst damaging to students. The review of literature addresses research concerns about the validity, reliability, and value of self-assessment by exploring criticisms and finding research-supported methods of preventing or compensating for those factors in the classroom. General and specific approaches for effective student self-assessment are explored, and the intended impact of each strategy is discussed.

Pros and Cons of Student Self-Assessment

Formative Assessment

Assessment in education comes in two forms: assessment *for* learning, or formative assessment, and assessment *of* learning, or summative assessment (Dixon & Worrell, 2016).

Black and Wiliam (2009) define formative assessment as the process of “eliciting, interpreting, and using evidence about student achievement to make decisions about next steps in instruction that are likely to be better, or better founded, than the decisions they would have taken in the absence of the evidence that was elicited” (pg. 6). This differentiates formative assessment from broader methods by which teachers respond to and interact with students. Formative assessment focuses specifically on “creating and capitalizing on ‘moments of contingency’,” to regulate, and specifically to improve, the learning process (Black & Wiliam, 2009). These moments of contingency can be synchronous or asynchronous depending on the

immediacy of the teacher's response to students. Regardless of how the assessment is made and the lesson adjusted, however, it is essential that the external stimulus-the behavior or work that the teacher is assessing-be paired with deliberate internal processing and a reasoned response. In this way, it is not enough to simply grade a test or reply to a student's comment in class. To be effective, the response must be reasoned and specific to the goal the teacher wants the student to achieve (Black & Wiliam, 2009). Noonan and Duncan define formative assessment similarly in their 2005 publication, stating "Formative assessment refers to the feedback provided by teachers during the formation stage of learning to check on student learning outcomes" (p. 2). Formative assessments are typically defined as being teacher and classroom based, as opposed to summative assessments that are used for promotion, or largescale assessments that are outside the classroom. Again, by definition, two elements are vital to make a teacher-student interaction a formative assessment: an evaluation of the student's current understanding or ability and a planned, intentional response to elicit specific further learning or ability.

Formative assessments have been shown to be valuable teaching tools (Bennett, 2011; Black, 2003), but the quality of any formative assessment is dependent on the method used to gather evidence of student thinking (Furtak & Ruiz-Primo, 2008). In this way, the methods and preparedness of the teacher administering the formative assessment directly determines the amount of useable information that can be gained from students.

The idea that method and administration determine a formative assessment's value is further supported by a study by Dunn & Mulvenon (2009), who present a critical view of formative assessment, declaring that there is only limited evidence to support the use of formative research in classrooms. They go on to soften their position, though, stating that the

lack of universal verbage...and questionable methodologies led to their distrust of the value of formative assessment. Thus, criticism of formative assessment focuses on methods and administration rather than criticizing the value of formative assessment itself. In fact, Dunn and Mulvenon stated, “It is difficult to hypothesize, and somewhat irresponsible to conclude that the use of formative assessments does not provide information to help improve instructional practices or student outcomes in classrooms” (2009, p. 2).

The way formative assessments are conducted is key to their value. The complications of designing an effective formative assessment become apparent when one considers the variety of formative assessment types available, and the many different forms and administration methods of each. Observations, questioning protocols or interviews, worksheets, exit tickets, and quizzes are well-known and widely-used forms (Dixon & Worrell, 2016; Samah & Tajudan, 2017). Indeed, it constitutes best practice to utilize a variety of formative assessment types, depending on the students, material being assessed, and ultimate goal of understanding for the assessor (Offerdahl & Montplaisir, 2014). However, it is this same diversity from which challenges to proper, meaningful administration of formative assessments arise. To prevent poor formative assessment practice in classrooms, then, a teacher must learn to give a formative assessment well, which can be accomplished by knowing about the assessment, what makes it valuable, and how to properly conduct the assessment in ways that deliver that value to students. Deep understanding and proper application will allow for students to benefit from a formative assessment, indicating a need for knowledge and training on the part of teachers in the types of formative assessment they wish to employ in their classroom.

Student Self-Assessment

One form of formative assessment is self-assessment or self-reflection by students.

Self-reflection is “the evaluation or judgment of ‘the worth’ of one’s performance and the identification of one’s strengths and weaknesses with a view to improving one’s learning outcomes” (Klenowski 1995, p. 151), or more succinctly, reflecting on and monitoring one’s own work processes and/or products (Brown & Harris, 2013). Student self-assessment has long been encouraged as an educational and learning strategy in the classroom, and is both popular and positively regarded by the general education community (Andrade, 2010; Leahy, Lyon, Thompson, & Wiliam, 2005).

Despite the wide-spread acceptance of student self-assessment and subsequent inclusion in many curricula and professional development programs, many teachers have doubts about the accuracy and value of student self-assessment as an assessment strategy (Ross, 2006). Student self-assessment is used as a formative assessment tool by many teachers at least part of the time (Noonan & Duncan, 2005), and was emphasized as one of four components of effective formative assessment in a study done by Black, Harrison, Lee, Marshall, and Wiliam (2004). High usage rates and high satisfaction among teachers using the technique (Panadero, Brown, & Courtney, 2014) indicates that student self-assessment is perceived by educators as having value, and suggests that doubts about its overall effectiveness may occur mostly among teachers who do not use the technique or are not doing so appropriately. “What has not been studied in such depth is the degree of SSA implementation in classrooms across educational levels. Less well understood are the reasons teachers have for using or not using SSA, and whether issues of accuracy in SSA are a major factor affecting its implementation” (Panadero et al., 2014). “There is little consistency or clarity in what SSA actually means, what it looks like in classroom practice, nor how its effects should be determined... There are substantively different theories and SSA formats that have fundamentally different consequences for ...practical applications

(Panadero Brown, & Strijbos, 2016).

Volante undertook a study to better understand the use of self-assessment, or using assessment *as learning*, in elementary and secondary schools in Ontario, Canada (2012). Volante discovered that teachers were lacking strong guidance or leadership in utilizing student self-assessment, which decreased both the use and effectiveness of self-assessment in many classrooms. An additional challenge he noted was the strong perception by students and parents of an assessment only being valuable if a grade or point value was attached, decreasing its effectiveness since students (and parents) did not see the point of investing genuine time and effort into assessments that were not summative in nature (Volante, 2012). The general perception by various factions in education of the value of different assessment forms is a barrier in effectively using student self-assessment to help students become better overall learners, as well as more educated in any particular content area. Student self-assessment is simply not perceived by stakeholders as being of value. This finding is supported by other research studies which conclude that students recognize that the teacher is the most expert person in the classroom, and which leads to student doubts about the value of relying on anyone's judgment other than the teacher's (Gao 2009; Panadero et al. 2014; Peterson & Irving 2008).

Part of the perception of student self-assessment as lacking value may lie in poor execution of the strategy. Responsibility for training and adequately preparing students to effectively self-reflect lies with the classroom teacher. This indicates a need for professional development or other training to help teachers better understand how to implement effective student self-reflection practices in their classrooms (Boston, 2002; Rolheiser & Ross, 2000).

Another potential shortcoming of student self-assessment is the Dunning-Kruger effect, which states that people with deficits in their knowledge should not be able to recognize those

deficits (Kruger & Dunning, 1999). A study by Guillory & Blankson (2017) expanded on Dunning and Kruger's work, and determined that increasing students' knowledge of a concept resulted in more accurate self-assessments of student understanding. This contradicts a study by Karpicke, Butler, and Roediger (2009) that showed increased familiarity can feel like mastery of the content for lower performing students, which then leads to less accurate self-assessments. Guillory and Blankson (2017) address this concern by citing Brown, Roediger, and McDaniel's 2014 study; this study suggests that an effective way to show students that familiarity is not the same as knowledge is providing them with objective gauges or reliable reference points outside of themselves to assess their knowledge. Guillory and Blankson then suggest that teaching metacognitive skills to students, and using a formative assessment or pre-test at the beginning of a unit to help students identify ideas or concepts they do not understand, are ways to help students more accurately self-assess.

In fact, in some studies student self-assessment has been shown to give results consistent with teacher scores for both performance tasks and cognitive skills. This seems to be true across subjects; Ross, Rolheiser and Hogaboam-Gray (2002) evaluated upper elementary students' ability to rate their own performance in both five dimensions of mathematical problem solving and in English, specifically students' writing abilities, (Ross, et al., 1999), with internal consistencies of .91 and .84, respectively. A study exploring the correlation between students' self-perception of ability and their scores on a standardized proficiency test showed similar validity. Interestingly, student scores showed a higher correlation with their test score than teacher/student score comparisons, indicating that students may be better able to judge their own abilities than teachers or other outside persons (Dam & Legenhausen, 1999). Another study focused on undergraduate college students found that, while there was a correlation between

tutor and self-estimated grades for assignments, there was a higher tendency for students to underestimate (56%) than to overestimate (40%) their assignment marks. (Cassidy, 2007). This suggests that many students are able to better identify areas for improvement and hold themselves to a higher standard of learning and performance than outside judges might, which in turn provides opportunity for greater growth and achievement than might otherwise occur.

Kostens (2009, 2010, 2012) has conducted several studies to better understand the wide variance in perceived accuracy of student self-assessments. He has discovered two conditions that seem to contribute to students' accuracy in self-evaluating, as compared to outside evaluations (such as a teacher's evaluation of student knowledge or performance). First, novice learners experience a greater cognitive load when processing novel information or concepts, leading to less working memory capacity to devote to activities like self-assessment that are extraneous to learning. Second, novice learners lack or have less procedural ability to complete the task at hand, which also increases cognitive load and decreases self-assessment ability (Kostons, van Gog, & Paas, 2009; Kostons, van Gog, & Paas, 2012; Kostons, 2010). Students learning a new concept or process also have less understanding of what quality work is and struggle to approach the task in new or more efficient ways. This lack of experience creates a barrier to accurate evaluation of their own performance as compared to what is possible, or what a more advanced individual might have done and in what manner. As in other studies, though, Kosten (year) found that training, either through worked examples or instruction with practice, increased self-assessment and task-selection accuracy, and led to higher learning outcomes with self-regulated learning (2010).

Effective Implementation of Self-Assessment in the Classroom

General Guidelines and Considerations

Some studies have attempted to quantify what aspects of self-reflection make the exercise most valuable to students in terms of increasing their understanding of their own learning. Panadero, Brown, and Strijbos (2016) classified self-assessment into different typologies, which “reflect different understandings of self-assessment based on [a wide variety of factors” (Panadero et al., 2016). The study identified several areas needing further study; one such suggested area is research into conditions that maximize the benefit of any SSA method and its underlying typology. Additionally, research needs to specify the SSA format and the academic ability of the studied learners so as to provide adequate guidance to teachers (Panadero et al., 2016).

Bingham, Holbrook, and Laura (2010) suggests that, to be meaningful, self-assessment must provide insight into students’ understanding and abilities. Additionally, self-assessment must be seen as contributing to one’s education, not merely judging it. “Developing the metacognitive awareness of students through self-assessment is at the heart of powerful, effective, and transformational teaching.” Thus, they say, self-assessment must be focused at least in part on moving children through the levels of thought on the “ladder of metacognition,” as presented in Swartz and Perkins’ 1989 study:

- “Tacit use: The child makes decisions without much prior thought.
- Aware use: The child's decision-making process is conscious.
- Strategic use: The child organizes his or her thoughts and

actively employs a series of strategies to reach a decision.

- Reflective use: The child monitors his or her thinking throughout the decision-making process and can contemplate ways to improve his or her work” (Perkins, 1989, p 12).

Bingham et al go on to suggest using forms of assessment that encourage students to more deeply evaluate both their learning and their process of learning. Aside from general examples such as the use of rubrics (as opposed to checklists) and student portfolios, few specific ways of accomplishing this self-reflection and metacognition are discussed in this paper.

Another study presents similar findings: four dimensions that must be addressed and implemented with fidelity to make self-assessment as meaningful as possible to students (Ross 2006). First, the rubric students use to assess their work must use language intelligible to students, address competencies that are familiar to students, and include performance features they perceive to be important. Second, the rubric criteria needs to be understood by students--by teacher modeling of the criteria, and application of the criteria both to exemplars and to students' own work. Third, says Ross, “giving students feedback on their self-assessments is a process of triangulating student self-assessments with teacher appraisals and peer assessments of the same work using the same criteria.” Fourth, students need to be taught how to, and assisted in using, self-assessment data to improve their performance (Ross, 2006).

Brown, Andrade and Chen (2015) discuss a number of other factors that impact students' willingness to self-assess and share that assessment with others, as well as the accuracy of the self-assessment. Factors of negative influence included showing the teacher's grade to students before they had self-assessed, not providing enough time to complete the activity without “emotional arousal,” limiting response styles, and a lack of perceived trust and respect in

the classroom. Keeping shared student responses anonymous, generalizing responses, or not discussing student responses with the class at all appear to be effective ways of encouraging honest self-evaluation. The authors caution that cultural differences amongst schools and classrooms have a strong but poorly-understood impact on the accuracy of student self-assessment, and caution should be taken in applying this information to other, non-American learning settings (Brown Andrade, & Chen, 2015). Schwartz and Perkins (1989) found similar influences on the accuracy of self-reporting, and suggested the following conditions were necessary for reliable and valid self-assessment:

1. Respondents' information is requested
2. Questions are phrased clearly and unambiguously
3. Questions refer to recent activities
4. Respondents think the questions merit a serious and thoughtful response
5. Answering the questions does not threaten, embarrass, or violate the privacy of the respondent or encourage the respondent to answer in socially desirable, rather than truthful ways (Schwartz & Perkins, 1989, p.64).

While these general guidelines are helpful in implementing self-assessments, little research has been done on the practical application of these bigger ideas (Panadero, et al., 2016), nor is there much research exploring the most beneficial form or design for student self-assessment, especially in math and science content areas. It is important to ensure both low- and high-achieving students are realistic in their self-assessment, but the potential negative impact on low-achievers when they become conscious of their poor performance is not well understood, and thus an area of concern requiring awareness and monitoring by the classroom teacher.

Specific Strategies for Using Student Self-Assessment in the Classroom

Panadero, Brown, and Strijbos (2016) suggest some specific ways of tailoring student self-assessments to specific groups of students. For example, low performing students may respond to performance scores that emphasize small learning gains, and motivation may be increased by comparing current and past individual performance rather than comparing students to their peers.

McMillan and Hearn (2009) offer the following outline of methods for effectively using student self-assessment in the classroom. Begin by establishing clear learning targets and evaluation criteria, and include students in the development process. This helps students develop higher levels of self-efficacy and increases their personal satisfaction with their performance. Rubrics are an excellent way to provide evaluation criteria, as are models and anonymous exemplars, because they are concrete examples that allow students to understand, visualize, and internalize the evaluation criteria. Awareness of the learning process is an important step in training students to use self-assessment informationally rather than judgmentally. This understanding of the evaluation criteria can then be clarified and solidified through a series of gradual release activities in which students use the criteria model to assess exemplars and work samples. This process will increase students' persistence as they work toward the goal of creating their own work aligned with the benchmarks. Then, students should be encouraged to use a variety of strategies to correct or improve their own work before the final submission, with an emphasis on identifying areas of personal strength and weakness. Finally, students need to be encouraged to reflect upon their work, and use that reflection to set new goals for learning. The goals should include a plan of approach, or "how to get there" (McMillan & Hearn, 2009).

Self-assessment is a guided, taught process involving four steps: collaboratively

determining criteria, showing students how to apply the criteria and providing practice time to apply the criteria to exemplars themselves, providing students with feedback about students' understanding of the criteria (as demonstrated by their application), and finally, identifying subsequent learning goals and strategies to attain each goal. Rolheiser's "growth scheme" is a recommended way of checking teachers' use of this self-evaluation process in their classrooms (McMillan & Hearn, 2009).

Watterson (2007), a practicing classroom teacher, presents some additional self-assessment guidelines in a 2007 *Science Scope* article, emphasizing spontaneity, simplicity, and a rubric-based format. She provides the following rubric as an example:

How well do I think I understand the topic...?:

0: I read it, but I am totally confused!

1: I am not sure I understand or followed what the author was explaining, but I got a few parts of it.

2: I followed what the author wrote and what the illustrations are about, but I have a hard time retelling the information in my own words. I am not sure what connection this has to my own life.

3: I am pretty sure I get all the ideas. I can remember it well enough to retell it in my own words. I have some ideas about connections to other parts of my life, but I'm not sure about them. I wouldn't want to teach this yet.

4: I could teach it. I can apply the information to my own life, and probably to new situations, and I can give examples not provided in the reading. (p. 61)

Additionally, she suggests that teachers assess often, focus on a learning target when assessing rather than grades or other markers not directly tied to understanding of the content, and explicitly show students their growth in the areas being assessed, all of which will increase the meaningfulness and value of students' self-assessment. She emphasizes that the focus should not be on grades and competitive factors in class, but on increasing student understanding of concepts. Making learning explicit removes the stigma attached to not knowing, and helps empower students to recognize and take ownership of their own learning; using the above rubric or one similar helps students begin to recognize and verbalize what they know and where they may be struggling with concepts or methods (Watterson, 2007).

In a study focused on language classrooms, Dam and Legenhausen (2007) make additional suggestions for incorporating self-assessment. Using a short, relatively simple form such as smiley faces or a 1-10 rating scale allows for daily reflection by learners without requiring an unmanageable amount of class time. Using questions that are opinion-based encourages responses that are not threatening to a student's self-esteem, and allow the student to answer with little constraint while still requiring reflection before answering. Scoring or other simplified methods can be augmented and taken to a deeper level of reflection by requiring that students justify or explain their self-rating.

Rubrics in Student Self-Assessment

Many of the suggestions from various research are compatible and complimentary, but the strongest trend in the research seems to support the use of rubrics. The topic of student self-assessment would be incomplete without a brief review of rubrics and how they can effectively be applied to student self-assessment tasks. While the more common use of rubrics is by teachers

to grade student work, many authors support the use of rubrics in student self-assessment with an oft-repeated argument that rubrics can teach as effectively as they evaluate (Arter & McTighe, 2001; McMillan & Hearn, 2009; Ross, 2006; Stiggins, 2001). In fact, well-constructed rubrics can do both simultaneously (Reeves & Stanford, 2009).

A rubric is defined as a set of criteria at varying degrees and levels used for evaluating student work. Rubrics answer the question, ‘By what criteria will student performance be judged?’ (Andrade, 2005; Goodrich, 1997; Montgomery, 2000). Rubrics are under-utilized for reasons akin to student self-assessment: teachers believe [rubrics] are time-consuming, lack reliability and validity, and are too confusing (Kamil, 2003). However, when certain methods of development are utilized, most of these concerns are eliminated. Developing an effective rubric follows a pattern similar to effective self-assessment, with student input and involvement being critical to the overall meaningfulness of the end product. To begin, the teacher must visualize what is expected from the written project, product or process (Reeves & Stanford, 2009). To include students in this process, teachers can provide past examples of students’ writing or teacher-made models, then guide students to identify important aspects of the desired product (Ward & Murray-Ward, 1999). As the list of criteria is developed, teachers must ensure they incorporate the criteria that students feel are important indicators of the success of the project. By following this collaborative process, teachers are able to create a rubric that is valid and meaningful for all stakeholders (Reeves & Stanford, 2009; Wilhelm, 2008).

Criticism of rubrics and their impact on learning is similar to that of self-assessment: some studies have shown little difference between the work quality for students who did and did not use a rubric as part of the task (Reitmeier & Vrchota, 2009). The answer to this criticism is also the same: when the process of developing and using a rubric is explicitly taught, students are

given multiple opportunities to practice and apply their understanding of the process, teacher feedback is direct and timely, and the suggestions for implementing the rubric process above are followed with fidelity, the benefit of rubrics is apparent (Panadero & Jonsson, 2013; Reeves & Stanford, 2009). A number of benefits to the use of rubrics have been identified, including: increased grading transparency, by clarifying assignment expectations; reduced student performance anxiety, both through clarified expectations and an increased understanding of an assignment's relation to a student's overall grade.; support in the feedback process, by allowing students to better understand teacher feedback; and improved student self-efficacy, through rubric-based performance comparisons by teachers and individual students (Panadero & Jonsson, 2013).

Main Points

While the research is divided on the overall value of formative assessments, specifically the value of student self-assessment, much of the value is derived not from the activity but from the methods in which the activity is carried out. Students are rarely skilled at completing self-assessment tasks in ways that are meaningful, and so the self-assessment task has to be explicitly taught. This is accomplished through modeling, guided practice, and repeated exposure to the tasks, with immediate feedback from both peers and the teacher. This allows students to begin to recognize their own patterns of thought, and helps to prevent the largest pitfall in self-assessment: over-estimating one's own knowledge or performance due to the Dunning-Kruger effect. Use of rubrics also aids students in better evaluating their own performance, although this is also a skill that must be taught to students in deliberate ways to ensure the rubric has meaning and value to the students. By preplanning lessons that allow students to understand how to use and apply self-assessment tasks, self-assessment becomes valuable and meaningful, and

enhances a student's overall understanding and mastery of the content being taught.

Chapter 3

Reflection

Introduction

The National Board for Professional Teaching Standards (NBPTS) is a nonprofit organization established in 1987 to advance accomplished teaching. The mission of the NBPTS is focused on “maintaining high and rigorous standards for what accomplished teachers should know and be able to do.” Cite your source here, including the page number When completing the process to become board certified, teachers are expected to demonstrate a number of requirements arranged within four components. Each of these requirements is designed to determine if and how a teacher is demonstrating “accomplished teaching.” Successful demonstration of each of the standards through completion of the four components indicates that a teacher is a master in that content and age area, and is considered a prestigious accomplishment

A requirement of Component 4 is for candidates to “use your cumulative knowledge of students to analyze and reflect on the effectiveness of your assessment practices and how best to positively impact student learning.” Again, cite your source for this quote More specifically, the component requires the teacher candidate to provide and discuss data that reflects a process by which students monitor and evaluate their own learning, then use the student reflections to identify ways to improve performance and understanding. This requirement allows teacher candidates to be assessed on NBPTS Standard X: “Accomplished science teachers employ a variety of assessment methods...to assist students in reflecting on their own learning” (General Portfolio Instructions, 2016, p. 5).

One of the challenges I have seen my students struggle with over the last several years is a general, pervasive lack of metacognition and self-awareness of themselves as learners. The academic and personal benefits of metacognition, or thinking about one's own thinking, have been shown in numerous studies over the last half-century (e.g. Flavell, 1979; Lambert, 2000; Lifford, Byron, & Ziemian, 2000; Peverly, Brobst, & Morris, 2002). Student metacognition and the associated benefits are not new ideas but creating students that are skilled at the practice has been one of the greatest challenges of my teaching career thus far. Research shows that self-assessment is directly tied to metacognition, and gaining skill in one seems to directly correlate to an increase in skill in the other (Vacca, 2002). This correlation motivated me to teach my students to self-assess not only to fulfill my board component, but more importantly, to help them develop the metacognitive skills essential to successful lifelong learning (Williams et al., 2002).

Method and Design

Designing a student self-assessment for my classroom began with the research discussed in Chapter 2. Based on my research, I identified several important aspects of self-assessments. First, they need to be based on clear, preplanned learning objectives for the unit of study. To do this, I began with the Wyoming State Standards, and restated each standard in middle-student-level language. I then planned my formative and summative assessments for the unit. These assessments were also based directly on the learning targets and state standards. Summative assessments were co-written with my department and identical across all seventh grade classes. Formative assessments were designed to assess smaller portions of the learning target in multiple ways. At this point, I felt ready to begin designing a student self-assessment component.

Research indicates that on-going practice with self-assessing helps students become proficient at the task, and makes both the learning task and the process of self-assessment more meaningful. This meant my students needed repeated opportunities for self-assessment throughout the school year, rather than a single isolated activity. Additionally, I knew that providing enough time to complete each aspect of self-assessment was an essential part of making the assessment accurate and meaningful (Brown et al., 2015; Kuh, 2005). To be able to provide repeated practice within the time constraints of the daily schedule, individual self-assessment tasks needed to be both short and generalized. Additionally, studies emphasize that effective self-assessment tasks should be taught and practiced in advance to ensure students understand how to appropriately use the assessment to create meaning from the content and to build metacognitive skills (e.g. McMillan and Hearn, 2009; Ross, 2006). By applying the same self-assessment exercise to multiple different learning tasks, I could maximize the value of my initial instruction and modeling of the assessment process, while also providing the greatest possible amount of student worktime for each individual self-assessment task.

To meet all of these requirements, I chose to create a basic self-assessment form that students could use for virtually any learning task in the classroom (see Appendix A). I limited the self-assessment to three questions requiring student thought, and provided a rubric-based rating scale. Students began the self-assessment for each task in the unit by identifying the main idea of that task. Then, students used the provided rubric to self-determine their understanding of the main idea or concept before and after completing the learning task. Finally, students identified the biggest challenge they faced during the task or a part of the task they were still struggling to understand.

The provided rubric levels and descriptors were designed for students to use to help them determine their own level of understanding while self-scoring and reflecting on each individual learning task in a unit. Beginning with the example rubric provided in Watterson's article on self-assessment (2007), I revised her criteria to include student-friendly language that is consistent with phrasing and ideas I regularly use in my classroom (Ross, 2006). These rubric levels were the guidelines by which students determined their self-perceived level of mastery for each learning task, and were written to be general enough that they could apply to any task on which I asked students to self-assess themselves. I aligned the levels to a 1-4 scale for simplicity and efficient use of space. The full rubric was provided on every self-assessment form throughout the year to ensure students were accurately interpreting the criteria each time they repeated the self-assessment task (Bingham et al., 2010; Ross, 2006; Watterson, 2007).

To simplify the assessment process and provide repetition of practice for students, and to allow for more effective review and feedback from myself as the teacher, I created a learning log model that allowed for multiple student self-assessments within a single science unit. This learning log template can be used for all content units throughout the school year with only minor form revisions (updating the unit learning objectives and list of learning tasks/assessments). Students follow the same general self-assessment process for each task or assessment within a unit. This entire collection of self-assessments within any unit is referred to as the "learning log" for that unit. Collecting self-assessments as a unit group for each student was a deliberate, strategic decision.

A primary criticism of student self-assessment is of discrepancies between students' self-assessed abilities and their abilities as judged by the teacher or evaluator (e.g. Kostons et al. 2009, 2012; Kostons 2010). To help prevent such over- or under-evaluation, I began each

unit learning log with the pretest for that unit. Students usually take the pretest about a week before the teaching unit on that topic begins. After collecting students' raw scores for the pretest, I convert each student's score to a 1-4 scale score. On the first day of the teaching unit, students are provided with the new unit learning log and their modified pretest score. Students review the unit objective as a class, break it down to determine topic objectives, and make predictions about topics based on the learning tasks listed in their logs. At this point, students complete the first self-assessment task on the learning log, based both on the questions they got wrong on the pretest & their overall scale score.

Explicit teaching of the self-assessment technique is essential to maximize student learning of content and growth in metacognition abilities. I introduced the learning log method of self-assessment to my students by modeling the steps necessary to fill out the learning log, and speaking all of my thinking out loud to help students understand how I arrived at each answer I filled in. Then, students filled in their own self-assessments, and discussed their answers with their peers. Student answers on the first unit learning log were short and showed little to no deeper thinking, indicating that students needed more modeling and practice with work samples and more gradual guided release. Constant application of the rubric both on the learning log and in class also helped students clarify the application of each level and align student perceptions with student performance. I found that revisiting the process for filling out the learning logs before each unit and asking students to discuss their responses with their peers throughout the entire year generated responses with more personal reflection and clearer awareness of the struggles or challenges students were facing in a particular task or concept.

Providing feedback to students is necessary to help students identify areas of lesser understanding or misconceptions, which improves student confidence and the meaningfulness of

the self-assessment task (Ross, 2006). Learning logs were shared with me in real time through GoogleClassroom and GoogleDrive, and I was able to see student updates as they were being typed. This allowed me to regularly monitor each student's progress and self-reflection throughout the unit. This continual and immediate access to student self-assessment data allowed me to monitor growth, identify and address concerns about student understandings, and intercept struggling students before they became defeated.

Revisions and Additions

While pleased with the growth I saw in my students over the course of the 2016-2017 school year, there are two major areas in which my student self-assessment needs significant improvement. The first is the student rubric. Last year, I provided students with a pre-written rubric. The rubric did satisfy a number of researcher recommendations, including being written in student-friendly language, provide concrete examples of achievement, and allow student responses to be generalized (Brown et al., 2015; McMillan & Hearn, 2009; Ross, 2006). It was not, however, created collaboratively with students, using their input and feedback. Collaborative rubric creation is one of the key ways to develop metacognition skills in students (McMillan & Hearn, 2009; Ward & Murray-Ward, 1999). Allowing students to create the rubric helps students to feel invested in the evaluation process, which in turn increases self-motivation and adds personal meaning to the self-assessment task (Reeves & Stanford, 2009; Wilhelm, 2008). Now that the self-assessment is built and exemplars are available, a collaborative rubric-writing activity can be added as the self-assessment task is initially introduced to students, which should increase the overall meaningfulness of the self-assessment process for students.

The second area of needed improvement again deals with the metacognitive growth I hope to achieve by having my students self-assess. Swartz and Perkins' 1989 study introduces a

“ladder of metacognition,” on which students progress from low to high levels of metacognition. My goal is for all of my students to think about their own thinking in as sophisticated and meaningful a way as possible. My self-assessment helps students to become aware of their thought processes and to use organized, strategic thinking to accomplish a task. It falls short on the highest of the four levels of metacognition; however my self-assessment task does not ask students to think of ways to improve their performance or develop methods to help them reach as-yet unmet goals. This is a vast oversight, yet easily remedied by simply taking the prompt which asks about problems and challenges a student faced with the learning task, and adding a final step: developing a way to overcome the challenge or acquire the needed information or understanding.

Final Thoughts

Research shows that student self-assessment can be a valuable tool in increasing student metacognition (e.g. Flavell, 1979; Lambert, 2000; Lifford, Byron, & Ziemian, 2000; Peverly et al., 2002), and gaining assessment skills seems to directly correlate to an increase in metacognition skills (Vacca, 2002). I saw a clear relationship between the self-assessment tasks my students completed in class and an increased ability to recognize their own thinking, identify errors, and recognize areas they were personally struggling in or challenges they were experiencing in mastering the content. In this way, my classroom observations directly aligned with the positive results shown in research on well-designed, well-executed student self-assessment tasks. In the same way, my experience showed that students need to have a rubric to help guide their thinking, (Ross, 2006), and that repeated practice with both the application of rubric criteria and the overall process of self-assessment was essential for student success (Panadero et al., 2016; Watterson, 2007). Student responses over the course of the year became

longer, more thoughtful, and more personal, all of which indicated the general student increase in metacognition indicated by research, and which I had hoped to establish with students in my classroom (Vacca, 2002).

Students in my classroom struggled with the task of self-assessment initially, and their self-perceived ability did not align with their scores on unit assessments. This was also a common issue in much of the research related to student self-assessment, and the basis for one of the biggest criticisms of student-self assessment as a learning tool (e.g. Brown et al., 2014; Guillory & Blankson, 2017; Kruger & Dunning, 1999; Panadero et al. 2014; Peterson & Irving 2008). However, with training, both through instruction-guided student practice with real-life examples, students increased their self-assessment accuracy (Kostons et al. 2009, 2012; Kostons 2010).

My experience with self-assessment in the classroom reflected the same problems and successes found in other research. With modification to add a goal-setting component, continuing to implement self-assessment exercises each year should help my students develop the metacognitive skills essential to successful lifelong learning (Williams et al., 2002).

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Appendix A: Teacher-Created Sample Student Self-Assessment Task

Life Science Learning Log-Scientific Method

Learning Goal: Scientific Method: I can follow a scientific process to learn about science topics and answer science questions. I can design and carry out my own experiments to help me understand ideas related to science, I can share my learning with my peers in appropriate ways, and I can read and understand their experiments and learning.

Date	Score Start/Finish	Activity/ Assessment Name	Type of Assessment	Main Idea of the Activity	Biggest Challenge or Part You are Struggling to Understand	Scoring:
October 3		Pretest	Formative			1=I am completely lost
October 6		Writing A Scientific Question	Formative			2=I think I get it, but I'm having trouble doing this on my own
October 13		Writing a Scientific Hypothesis	Formative			3=It might be hard, but I can do this with almost no mistakes
October 21		Identifying Variables	Formative			4=I understand it so well I can help other people who don't get it
October 25		Mini-lab: Ape Apps	Formative			n/a=I didn't practice this skill during this activity
October 26		Creating Data Tables	Formative			
November 1		Making Graphs	Formative			
November 4		Ruler Grab Mini-lab	Formative			
November 10		Rockets Lab	Summative			