



Investigating common assessment strategies in mathematics to develop a set of recommended assessment principles, based on Standards Based Grading (SBG)

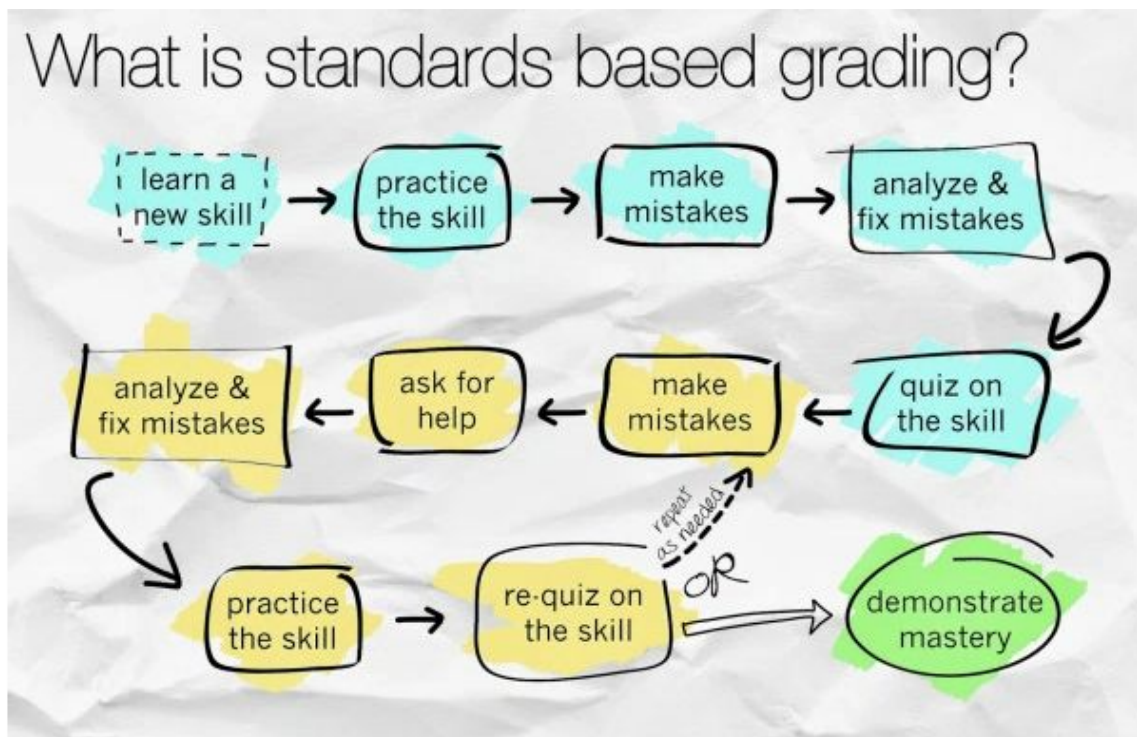
Literature review

Teachers' grading practices have received far more attention in the literature than have assessment practices (McMillan, Myran & Workman, 2002). In more recent research, Standards Based Grading (SBG) has begun to be a popular topic in question (Kohn, 2011). SBG is centered on the idea that there are specific elements of knowledge and skills that all students should know and be able to do and involves measuring students' proficiency on well-defined course objectives (Heflebower and Hoegh, 2014, Tomlinson and McTighe, 2006). Standards based education is common in the United States and its purpose is to raise student achievement by clearly communicating student progress towards learning outcomes in a timely, fair and accurate manner. There are a number of benefits and challenges that are faced with SBG which are discussed in this paper.

Benefits of SBG

Although traditional grades have important consequences and communicate some information about students' achievement to parents, students, and communities, traditional grades fail to communicate some important information to students, such as what standards to improve on and how to improve on them. This is where SBG, if used correctly, can be of great benefit to the students since it is a system of reporting student proficiency in a number of specific learning objectives (or standards). Rather than giving students one grade on a test that assesses multiple skills, this system gives students a number of scores that represent their proficiency in each of the skills assessed. The idea is that at the end of the class a student has mastered the essential content necessary for the next level. Figure 1 shows the process involved in the SBG system.

Figure 1. (Standards Based Grading and My Light Bulb Moment, 2015)



SBG gives students feedback on how well they understand the information and on what they need to improve, while helping teachers identify struggling students early and provide them with the targeted assistance they need in order to master the standards. Parents appreciate the detailed information as traditional letter grades do not tell parents which skills their children have mastered or the specific areas in which they need additional support (Guskey & Jung, 2006).

One issue that can arise in a traditional grading system is that when students fail an assessment early in the unit, they tend to give up; however with SBG, the door remains open to achieving the standard, giving students multiple opportunities to improve and meet the standard. SBG helps teachers address individual students' needs by enabling them to develop a better work habit and giving feedback on their current level of understanding and how to improve. This then creates an opportunity for students to persevere in the face of challenges.

The confusion about how grades should be computed, what they mean, and how they should be used is very a big challenge when it comes to grading. It is important that students' grades are valid, fair and consistent and clearly reflect what students know and are able to do, but research shows that this is not always the case. Unfortunately, many current grading practices base grades on various additional factors beyond academic performance, such as a student's level of effort, attitude, responsibility, attendance and social behaviour (Heflebower, Hoegh and Warrick, 2014). The resulting grades are difficult to interpret and rarely provide a true picture of students' proficiency. Including these measures in students grades creates systems in which 'grades are so imprecise that they almost are meaningless' (Marzano, 2000, p.1).

In SBG systems this is not the case as students' grades are based solely on their levels of academic achievement and non-achievement factors are reported separately. Experts suggest that standards-based report cards contain one section for achievement and one section for non-achievement factors (Erickson, 2011; Scriffiny, 2008; Guskey & Jung, 2006; Allen, 2005).

Many grading systems rely only on the mean, which can lead to misleading grades due to the effect of outlier scores, making the mean less meaningful as a measure of central tendency. One zero in the gradebook will skew the average to a point that the student will find it hard to overcome the zero. O'Connor (2011 p.91) gives the example in Figure 2 below.

Figure 2. An artificial gradebook

Grades:									
91	91	91	91	91	91	91	91	91	70
Mean= 88.9, Final Grade B									

Given that a score of over 90 is an A, the student performed at this A level nine times out of 10. However the final grade in the course has been determined as a B. This example raises the question of "Should evidence be summarized by strict mathematical calculations?" (O'Connor, 2011 p.91). In SBG, proficiency scales and a variety of assessments based on standards can lead to assigning grades that are valid and consistent (Heflebower, Hoegh and Warrick, 2014) when computing the overall grade for the course, rather than computing an average score.

Heflebower, Hoegh and Warrick (2014 p.58) recommend the following four guidelines to teachers to help assign students grade accurately and fairly:

1. Examine the student's performance on assignments and assessments;
2. Give more weight to recent information;
3. If necessary, discuss the content with the student to shed light on learning progress; and
4. Limit the use of zero (Incomplete or missing work should not be assigned a zero)

Standards-based grading systems replace early scores with the most recent evidence of achievement and researchers maintain that emphasizing recent achievement is a more accurate method of assigning grades because learning is developmental and grows over time with teacher feedback and repeated opportunities to reach mastery (Marzano & Heflebower, 2011; O'Connor, 2011; McTighe & O'Connor, 2005).

It is not only educators that are empowered by SBG systems (Scriffiny, 2008); parents and students are also empowered by the wealth of information present in SBG reporting tools. SBG gives teachers the opportunity to reflect on instruction and evaluate if their lessons truly met the needs of their learners.

Challenges of SBG

New challenges do arise with SBG. For example, leaving the door open to achieve a standard later means that students may not complete work or may reduce their effort on the initial opportunity in favour of revisiting the outcome at a later date (Erickson, 2011). To address the problem of not completing work, which is related to effort and behaviour, the teacher can record and report this separately from the academic grade. This approach is based on the idea that not completing work is a behaviour issue, not an academic one. For the problem of students not taking the first attempt seriously once they realise they have a second chance, McTighe and O'Connor (2005) suggest that teachers require their students to provide some evidence of the corrective action they will take, such as revising their work, practicing the needed skill in a given way, or taking part in a study session before embarking on their second chance. Some researchers suggest that an "opportunity cost" be attached to retests such as having retests administered outside of class time, to help students recognize that it is better to put maximum effort into a test the first time it is administered (Erickson, 2011; O'Connor, 2011).

Another possible downside to SBG is that finding time for reteaching and reassessment opportunities create additional work for the classroom teacher, as does making and recording separate judgments for each student on each criterion (Lehman 1997). One concern that researchers addressed across the board is the difficulty the teacher has in determining how to evaluate, record, and communicate student progress in a SBG system (Colby, 1999). One way to try and overcome this is by offering teachers with high quality professional development opportunities where teachers are provided with opportunities to engage in collaboration with their peers in order to create and maintain consistency across the school and by sharing tips and strategies with teachers regarding time management and mastering new record keeping systems.

Though there are many questions that arise when looking at the literature on SBG a key point to remember is that SBG removes extraneous factors and focuses only on student academic achievement. SGB is a system that involves the students in the grading process and can provide valuable individualized feedback, which is perhaps what the main aim of grading should be.

The Action Research

The classes that took part in this action research study were Algebra 2 Honors, Pre-Calculus, Math Studies and IB Mathematics HL.

Questionnaire 1: Gauging students' views on assessment and feedback

In September, I asked four classes to complete a short questionnaire on assessment so that I could learn the students' view of assessment and get an idea regarding how students would like to be assessed. When asked "How do you prefer to be assessed in class?", students answered that they would like to be assessed with assignments/investigations & projects, through teacher conversations, open book tests, presentations and class quizzes/tests. When asked "How do you

prefer to receive feedback?”, the majority responded with written teacher comments, grade/score and verbal comment. Very few voted that they would like feedback from their peers. For the question “Once you have received feedback what do you do with it?”, the majority said use it for revision, review it, and work on my weaknesses. It was good to see that only five out of 53 students said they would do nothing with the feedback. All 59 students said that feedback was important to them and of the 59 students 53 said they liked to have targets set for them. Only six said they didn’t like being set targets.




The results from the questionnaire were used in my lesson planning for the rest of the semester and I made sure I used a variety of assessment methods (suggested by the students in the questionnaire).

Target Sheet

I also wanted to make sure students were getting good feedback and knew where their strengths and weaknesses lie, so I created a target sheet.

I made a target sheet for each class using the math Schemes of Work (SOW) and distributed it to the students. The target sheet showed the learning targets for each chapter that the students would cover this year (see Figure 3). These targets are based on knowing and understanding. I also indicated the textbook exercises that went with each target and attached video clips where applicable so that students could go over the topic in their own study time. Each time we completed a topic in class, students were asked to tick the happy, okay, or sad face to indicate how they felt about the target. It was simple and easy to use. I shared the target sheet with classes via Google drive so that the students could click on the video links. I also displayed the target sheets in my classrooms so that I could refer to specific targets in lessons.

Figure 3: Example of the probability section of the target sheet

Name:		Class:				
Learning Objectives	Exercise (Math Haese and Harris Textbook)	Tutorial Video clip number (Google drive - A2H folder)	Other resources (Myimaths, Khan Academy etc)			
Probability	25					
33. Understand and use relative frequency to estimate probability	Ex25B					
34. Identify the difference between experimental and theoretical probability	Ex25F	Clip 32				
35. Calculate expected outcomes of an event	Ex25D					
36. Identify probability from two-way tables	Ex25C	Clip 85				
37. Use a Venn diagram to calculate probabilities			http://goo.gl/D7WlaA			
38. Draw a sample space diagram for 2 events			http://goo.gl/CLBa1			
39. Draw a tree diagram for 2 or more events	Ex25H, Ex25I	Clip 153, 154				
40. Understand independent events, complementary events,		Clip 182				
			Review set 25A			
			review set 25B			

Grade book

I put all the targets into our grading system (note: the target number on the target sheet matches the target number in the grade book). Students, parents, and tutors could clearly see which targets the students were competent in and what areas they needed to improve (see Figure 4). I allowed for students to work on these targets as many time as they liked to improve their grades. I also made sure students understood that they grade could go down if they had forgotten how to do a particular target.

Figure 4: Example of the probability section in Grade Book

(S2) Final Grade	T	33. LO:Underst... 01/11/2016 LTR	34. LO:Differen... 01/11/2016 LTR	35. LO:Calculate... 01/11/2016 LTR	36. LO:Identify ... 01/11/2016 LTR	37. LO:Use Venn... 01/11/2016 LTR	39. LO:Draw a s... 11/2016	LO:Draw a tr... 11/2016	LO:Understa... 11/2016	LO: Draw a ... 11/2016	LO:Solve ex... 11/2016
B-	81%	n/a	-	A	B	B	B	B	B	B	B
B+	87%	n/a	1	B	B	B	B	B	B	B	B
C-	71%	n/a	-	C	C	C	C	C	C	C	C
C	73%	n/a	-	B	B	B	B	B	B	B	B
A	94%	n/a	-	A	B	B	B	B	B	B	B
C+	79%	n/a	-	A	B	B	B	B	B	B	B
C+	78%	n/a	-	B	C	C	C	B	B	C	
B	83%	n/a	-	B	B	B	B	B	B	B	B
C+	78%	n/a	-	B	B	B	B	B	B	B	B
B-	81%	n/a	-	C	B	B	B	B	B	B	B
F	64%	n/a	-	C	C	C	C	D	C		

Grade Criteria for targets

Targets corresponded to the following grade criteria.

Grade A

You demonstrate a consistent and thorough understanding of the required knowledge and skills, and the ability to apply them **almost faultlessly** in a wide variety of situations. There is consistent evidence of analysis, synthesis and evaluation shown where appropriate in your work. You **consistently** demonstrate originality and insight and have produced work of **high quality**.

Grade B

You demonstrate a consistent and thorough understanding of the required knowledge and skills, and the ability to apply them in a **wide variety** of situations. There is consistent evidence of analysis, synthesis and evaluation shown where appropriate in your work. You **generally** demonstrates originality and insight. To get an A you should practise to produce work that is almost faultless, and perhaps in some cases you will need to produce work of higher quality.

Grade C

A **good general understanding** of the required knowledge and skills, and the ability to apply them effectively in **normal** situations. There is **occasional** evidence of the skills of analysis, synthesis and evaluation. For a C you will be able to answer most of the usual, less challenging questions, so to achieve a higher grade you will need to practise a little more to demonstrate understanding of the harder questions, usually found at the end of an exercise

Grade D

You demonstrate limited achievement against most of the objectives, or show clear difficulties in some areas. Often you will demonstrate a **limited understanding** of the required knowledge and skills and is **only able to apply** them fully in normal situations **with support**. If you are

working hard but struggle to understand a concept then your teacher may award this grade, to achieve a C you will need to continue working until you are able to answer questions without prompts and teacher input.

Grade F

You show **minimal** achievement in terms of the objectives and you need to revisit this learning objective. To receive a passing grade you must show that you are willing to work with the teacher to demonstrate some understanding. You can receive a grade even if you are receiving support for the questions you are answering, but your teacher will only support you and not guide you on every step to receive a passing assessment grade.

This grade criteria was adapted from the [IB MYP Coordinators handbook](#)¹ and was explained to students at the start of the year. I also displayed in the classroom for the students to refer to.

Conclusion

Throughout the first semester I had to keep reinforcing and reminding students to fill in the target sheet. This semester, however, most of the students seem to be completing the target sheet with constant reminders.

Students have stopped asking me if they can redo a test, get extra credit, and so on because they know they can work on their targets to improve their grades at anytime. Students know what my expectations are when it comes to meeting targets, which helps the whole process.

From carrying out this research project, writing the literature review, and talking to our visiting scholar [Beth Skelton](#)², I would recommend the following when grading:

- Don't reduce marks on work submitted late; provide support for learners;
- Don't give points for extra credit or use bonus points; seek only evidence that more work has resulted in a higher level of achievement;
- Don't punish academic dishonesty with reduced grades; apply other consequences and reassess to determine actual level of achievement;
- Don't consider attendance in grade determination;
- Don't include group scores in grades; use only individual achievement evidence; and
- Don't include zeros in grade determinations when evidence is missing or as punishment; use alternatives, such as assessing to determine real achievement or use 'I' for incomplete or insufficient evidence.

(Adapted from O'Connor, 2011)

Students must be involved in the assessment process and grades should be as pure a measure of student achievement as possible. It is important that academic reports and behavior reports are separate. Extra credit shouldn't be given – instead students should work on the targets they need to improve in order to improve their grade.

¹ https://ibpublishing.ibo.org/live-exist/rest/app/pub.xql?doc=m_g_mypxx_coh_1308_1_e&part=7&chapter=1

² <http://bethskelton.com/>

A second questionnaire was distributed to students to see how they felt about the way they had been assessed and the target sheets. All 59 students said they liked the target sheets because they were able to track their strengths and weaknesses. Many also commented that the target sheets helped them to prioritise which areas of math to study when revising for tests. Being assessed through presentations, open book tests, book checks, and projects were the students' preferred methods of assessment.

In conclusion, it seems that target sheets are a good idea because teachers, students, and parents can track student progress on learning objectives. The target sheets enable us to clearly see where strengths and weakness lie. In turn, they help teachers plan revision lesson topics and use time for extra help productively by working with students on specific skills that they have struggled with.

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