STANDARDS-BASED GRADING IN MATH AND BEYOND

Christopher Hanusa
Queens College Mathematics

@mathzorro  #sbg  #MasteryGrading #edchat
Life Before Standards

- Material to cover
- Teach it well
Life Before Standards

- Material to cover
- Teach it well
- How do I assess their learning?
- Choose concepts to test
Life Before Standards

- Material to cover
- Teach it well
- How do I assess their learning?
- Choose concepts to test

“What should I study?”
Life Before Standards

- Material to cover
- Teach it well
- How do I assess their learning?
- Choose concepts to test

“What should I study?”

“STUDY IT ALL”
Life Before Standards

- Material to cover
- Teach it well
- How do I assess their learning?
- Choose concepts to test

“What should I study?”

“STUDY IT ALL”
Life Before Standards

- Material to cover
- Teach it well
- How do I assess their learning?
- Choose concepts to test
- Partial credit: Worth 5 points? 7?
- What corresponds to an A?

“What should I study?”

“STUDY IT ALL”
Life Before Standards

- Material to cover
- Teach it well
- How do I assess their learning?
- Choose concepts to test
- Partial credit: Worth 5 points? 7?
- What corresponds to an A?
- Final grade: Average exam grades.

“What should I study?”

“STUDY IT ALL”
My issues

- Exams are high stakes
My issues

- Exams are high stakes
- Focus on grades, NOT learning
My issues

- Exams are high stakes
- Focus on grades, NOT learning
- Grades don’t align with mastery
My issues

- Exams are high stakes
- Focus on grades, NOT learning
- Grades don’t align with mastery
- We assess only what is testable

Is a B:

- Fair understanding of most material?
- Excellent understanding of some material?
My issues

- Exams are high stakes
- Focus on grades, NOT learning
- Grades don’t align with mastery
- We assess only what is testable
- Exams gauge understanding at a fixed point in time

Is a B:

- Fair understanding of most material?
- Excellent understanding of some material?
My issues

- Exams are high stakes
- Focus on grades, NOT learning
- Grades don’t align with mastery
- We assess only what is testable
- Exams gauge understanding at a fixed point in time
- Opaqueness of the whole system

Is a B:

- Fair understanding of most material?
- Excellent understanding of some material?
My Standards-Based Grading

- Transparent list of standards
- Assessments of 3-4 standards every 2-3 weeks
My Standards-Based Grading

- Transparent list of standards
- Assessments of 3-4 standards every 2-3 weeks
- Each standard scored for mastery
  - 4: Completely correct
  - 3: Almost correct with most main ideas
  - 2: Some main ideas; not complete
  - 1: Very partial solution
  - 0: Weak Start
My Standards-Based Grading

-Transparent list of standards

-Assessments of 3-4 standards every 2-3 weeks

-Each standard scored for mastery
  - 4: Completely correct
  - 3: Almost correct with most main ideas
  - 2: Some main ideas; not complete
  - 1: Very partial solution
  - 0: Weak Start

-Reassessments to improve score (2 per week)
My Standards-Based Grading

- Transparent list of standards
- Assessments of 3-4 standards every 2-3 weeks
- Each standard scored for mastery
  - 4: Completely correct
  - 3: Almost correct with most main ideas
  - 2: Some main ideas; not complete
  - 1: Very partial solution
  - 0: Weak Start
- Reassessments to improve score (2 per week)
- Grade based on mastery of standards:
  - A: 90% 3.5+, others 3+
  - B: 80% 3+, others 2.5+
  - C: 80% 2+, others 1.5+
  - F: less than 80% 2+
Examples of Standards

- **Basic Integrals. (core)**
  Can you **evaluate** standard antiderivatives, definite integrals, and indefinite integrals involving polynomials? Involving trigonometric functions?

- **Area between curves.**
  Can you set up and evaluate an integral with respect to x? y? Can you **convert** between the two? This involves determining the correct bounds of integration.

- **Key Theorems.**
  Can you **state and apply** the Fundamental Theorem of Calculus, parts I and II? Mean Value Theorem for Integrals? Do you understand their interpretations?

- **Mathematical Experience.**
  Can you approach problems in multiple ways? Are you **willing to make mistakes**? Can you learn from your mistakes? Are you able to **discuss mathematical concepts** with your classmates?

- **Project Management.**
  Can you **work together** on your project as a group? Can you follow project instructions? Can you work within a given timeframe and **meet deadlines**?
What I Love About Standards

- Focus is on the learning
What I Love About Standards

- Focus is on the learning
- Growth mindset – “How do I improve?”
  - More one-on-one contact & just-in-time teaching
What I Love About Standards

- Focus is on the learning
- Growth mindset – “How do I improve?”
  - More one-on-one contact & just-in-time teaching
- Transparency in Grading
### Grade Sheet Example - Gradesly

<table>
<thead>
<tr>
<th>Assignment Name</th>
<th>Your Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>----------------------------------</td>
<td>------------</td>
</tr>
<tr>
<td><strong>Current Standard Scores</strong></td>
<td>999</td>
</tr>
<tr>
<td>Current Score for Standard 1</td>
<td>4</td>
</tr>
<tr>
<td>Current Score for Standard 2</td>
<td>2</td>
</tr>
<tr>
<td>Current Score for Standard 3</td>
<td>3</td>
</tr>
<tr>
<td>Current Score for Standard 4</td>
<td>1</td>
</tr>
<tr>
<td>Current Score for Standard 5</td>
<td>2</td>
</tr>
<tr>
<td>Current Score for Standard 6</td>
<td>4</td>
</tr>
<tr>
<td>---- For an A you need 90% of your scores &gt;= 3.5 and no scores under 3 ------</td>
<td>999</td>
</tr>
<tr>
<td>---- For a B you need 80% of your scores &gt;= 3 and no scores under 2 ------</td>
<td>999</td>
</tr>
<tr>
<td>---- For a C you need 80% of your scores &gt;= 2 and no scores under 1 ------</td>
<td>999</td>
</tr>
<tr>
<td>You have this many scores less than 3.5:</td>
<td>4</td>
</tr>
<tr>
<td>You have this many scores less than 3:</td>
<td>3</td>
</tr>
<tr>
<td>You have this many scores less than 2:</td>
<td>1</td>
</tr>
<tr>
<td>You have this many scores less than 1:</td>
<td>0</td>
</tr>
<tr>
<td><strong>Raw Score for Assessment 1</strong></td>
<td>999</td>
</tr>
<tr>
<td>A1S1: Assessment 1, Standard 1</td>
<td>0</td>
</tr>
<tr>
<td>A1S2: Assessment 1, Standard 2</td>
<td>2</td>
</tr>
<tr>
<td><strong>Raw Scores for Assessment 2</strong></td>
<td>999</td>
</tr>
<tr>
<td>A2S3: Assessment 2, Standard 3</td>
<td>1</td>
</tr>
<tr>
<td>A2S4: Assessment 2, Standard 4</td>
<td>1</td>
</tr>
<tr>
<td><strong>Raw Scores for Assessment 3</strong></td>
<td>999</td>
</tr>
<tr>
<td>A3S5: Assessment 3, Standard 5</td>
<td>2</td>
</tr>
<tr>
<td>A3S6: Assessment 3, Standard 6</td>
<td>4</td>
</tr>
<tr>
<td><strong>Scores for Any Reassessments Taken Below</strong></td>
<td>999</td>
</tr>
<tr>
<td>S1R1: Standard 1 Reassessment 1</td>
<td>4</td>
</tr>
<tr>
<td>S1R2: Standard 1 Reassessment 2</td>
<td>999</td>
</tr>
<tr>
<td>S2R1: Standard 2 Reassessment 1</td>
<td>999</td>
</tr>
<tr>
<td>S2R2: Standard 2 Reassessment 2</td>
<td>999</td>
</tr>
<tr>
<td>S3R1: Standard 3 Reassessment 1</td>
<td>3</td>
</tr>
<tr>
<td>S3R2: Standard 3 Reassessment 2</td>
<td>999</td>
</tr>
</tbody>
</table>
What I Love About Standards

- Focus is on the learning
- Growth mindset – “How do I improve?”
  - More one-on-one contact & just-in-time teaching
- Transparency in Grading
- Assessments not as stressful
What I Love About Standards

- Focus is on the learning
- Growth mindset – “How do I improve?”
  - More one-on-one contact & just-in-time teaching
- Transparency in Grading
- Assessments not as stressful
- Higher expectations for students
Challenges with SBG

- Extra start-up costs: Multiple questions per standard
Challenges with SBG

- Extra start-up costs: Multiple questions per standard
- Extra work from tabulation
- Extra work from reassessments
Challenges with SBG

- Extra start-up costs: Multiple questions per standard
- Extra work from tabulation
- Extra work from reassessments
- Doesn’t scale well – Automate?
Challenges with SBG

- Extra start-up costs: Multiple questions per standard
- Extra work from tabulation
- Extra work from reassessments
- Doesn’t scale well – Automate?
- Questions spanning multiple standards?
Challenges with SBG

- Extra start-up costs: Multiple questions per standard
- Extra work from tabulation
- Extra work from reassessments
- Doesn’t scale well – Automate?
- Questions spanning multiple standards?
- Higher expectations for students
Challenges with SBG

- Extra start-up costs: Multiple questions per standard
- Extra work from tabulation
- Extra work from reassessments
- Doesn’t scale well – Automate?
- Questions spanning multiple standards?
- Higher expectations for students
- Students are working – Scheduling constraints?
Student Feedback

- “I like knowing what I should learn from each topic”
- “SBG lets the student control their grade.”

- “It helped me to understand each topic more thoroughly.”
- “Grading scheme made me go back over where I was weak.”

- “I wouldn’t have bothered to study this concept.”
- “I’ve never been so excited to “get” a math concept.”

- “YES! I finally got it!”
Course Projects

- Projects = Active Learning
Course Projects

- Projects = Active Learning

- **Math Modeling:** Simulate real-world scenario using Python
  - Bikeshare  • Population Growth  • Infectious Diseases

- **Math Programming:** Learn Mathematica and program:
  - Tutorial  • Mathematical Art  • Interactive App

- **Combinatorics:** Find real world situations / objects to count

- **Integral Calculus:** The Goblet Project
Project Deliverables

- Papers (Summary / Reflection)
  - Revision Process
- Programming Notebooks
Project Deliverables

► Papers (Summary / Reflection)
  ► Revision Process

► Programming Notebooks

► Presentations

► Posters
Project Deliverables

- Papers (Summary / Reflection)
  - Revision Process
- Programming Notebooks
- Presentations
- Posters
- 3D Printed Artwork / Exhibit
Project Deliverables

- Papers (Summary / Reflection)
  - Revision Process
- Programming Notebooks
- Presentations
- Posters
- 3D Printed Artwork / Exhibit
- Podcasts
Project Deliverables

- Papers (Summary / Reflection)
  - Revision Process
- Programming Notebooks
- Presentations
- Posters
- 3D Printed Artwork / Exhibit
- Podcasts
Grading, Before and After

(5) Format Specifications
(10) Organization
(10) Grammar + Sent. Struct
(5) Abstract
(10) Background
(15) Model
(15) Results
(20) Discussion
(5) Appendices
(5) Bib. / References

Add up the points to get a *weighted average*. 
### Grading, Before and After

<table>
<thead>
<tr>
<th>Category</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Format Specifications</td>
<td>5</td>
</tr>
<tr>
<td>Organization</td>
<td>10</td>
</tr>
<tr>
<td>Grammar + Sent. Struct</td>
<td>10</td>
</tr>
<tr>
<td>Abstract</td>
<td>5</td>
</tr>
<tr>
<td>Background</td>
<td>10</td>
</tr>
<tr>
<td>Model</td>
<td>15</td>
</tr>
<tr>
<td>Results</td>
<td>15</td>
</tr>
<tr>
<td>Discussion</td>
<td>20</td>
</tr>
<tr>
<td>Appendices</td>
<td>5</td>
</tr>
<tr>
<td>Bib. / References</td>
<td>5</td>
</tr>
</tbody>
</table>

Add up the points to get a **weighted average**.

#### Standards List

1. **Timeliness**
2. **Writing Style**
3. **Abstract**
4. **Introduction**
5. **Methodology**
6. **Results**
7. **Analysis**
8. **Conclusions**

#### Score each standard:

- 4: Truly exceptional
- 3: Exceeds expectations
- 2: Meets expectations
- 1: Minimally Acceptable
- 0: Unacceptable

---

**Christopher Hanusa**

**Standards-Based Grading In Math and Beyond**
Grading, Before and After

Add up the points to get a weighted average.

<table>
<thead>
<tr>
<th>Standards List</th>
<th>Score each standard:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Timeliness</td>
<td>4: Truly exceptional</td>
</tr>
<tr>
<td>Writing Style</td>
<td>3: Exceeds expectations</td>
</tr>
<tr>
<td>Abstract</td>
<td>2: Meets expectations</td>
</tr>
<tr>
<td>Introduction</td>
<td>1: Minimally Acceptable</td>
</tr>
<tr>
<td>Methodology</td>
<td>0: Unacceptable</td>
</tr>
<tr>
<td>Results</td>
<td></td>
</tr>
<tr>
<td>Analysis</td>
<td></td>
</tr>
<tr>
<td>Conclusions</td>
<td></td>
</tr>
<tr>
<td>Python Notebook</td>
<td></td>
</tr>
</tbody>
</table>

Grade based on scores:

- **A+** 4 on 3 stds, others 3+
- **A** 3 on 6 stds, others 2+
- **B** 3 on 2 stds, 2 on 7 stds, no 0’s
- **C** 2 on 4 stds, at most 1 0
- **D** at most one 0
- **F** at least two 0’s

Christopher Hanusa

Standards-Based Grading In Math and Beyond
Thank you!

- Robert Talbert
- Kate Owens
- My students