Houston...

we STILL have a problem.

Presented by Barbara Forrest

March 31, 2022

UNIVERSITY OF WATERLOO | FACULTY OF MATHEMATICS

University of Waterloo Territorial Acknowledgement

The University of Waterloo acknowledges that much of our work takes place on the traditional territory of the Neutral, Anishinaabeg and Haudenosaunee peoples. Our main campus is situated on the Haldimand Tract, the land granted to the Six Nations that includes six miles on each side of the Grand River. Our active work toward reconciliation takes place across our campuses through research, learning, teaching, and community building, and is centralized within the Office of Indigenous Relations.

Before COVID...

Prior to the pandemic, conversations about the poor math skills of secondary students were common among educators.

"There have been a number of wide-ranging studies out of OECD countries that have found that preparedness for math in postsecondary education is really bad and its getting worse."

– Big drop in math skills of entering students [University Affairs]

That was then, and here we are now – for two years secondary students have been learning mostly online and will be attending postsecondary institutions in person in the Fall.

Are they ready?

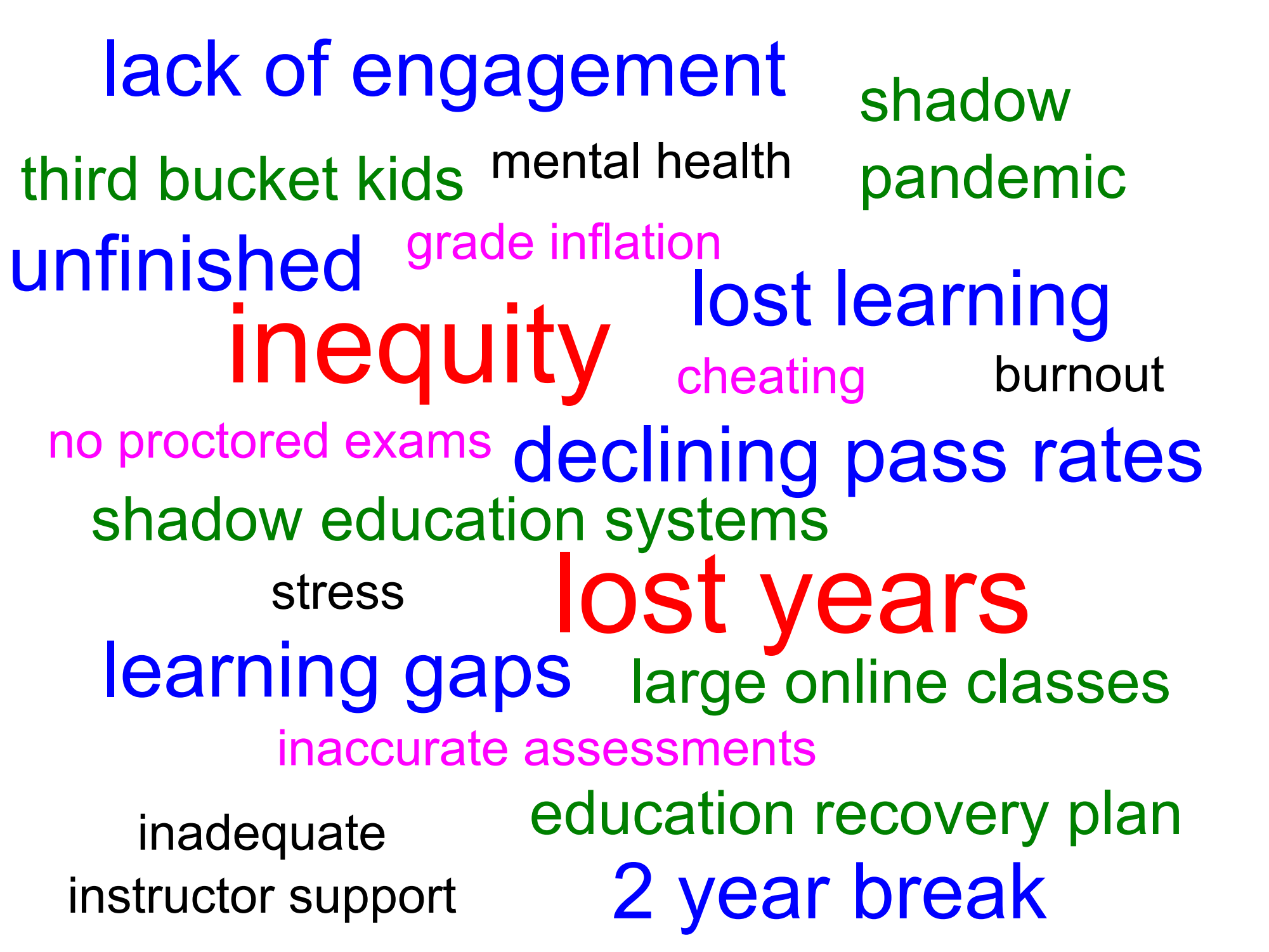
Are we ready?

POLL:
Math Preparedness of Incoming Postsecondary Students

Which statement do you agree with most?

It is probably the case that the prerequisite math skills of incoming students are:

- worse than they were before the pandemic.
- about the same as they were before the pandemic, though still poor.
- about the same as they were before the pandemic, but they were satisfactory.


lack of engagement
shadow
third bucket kids
mental health
pandemic
unfinished
grade inflation
lost learning
inequity
cheating
burnout
no proctored exams
declining pass rates
shadow education systems
stress
lost years
learning gaps
large online classes
inaccurate assessments
education recovery plan
inadequate
instructor support
2 year break

School Closures During Covid

Two years ago this month, schools closed their doors in 185 countries.

According to UNESCO, roughly 9 out of 10 schoolchildren worldwide were out of school.

It would soon be the biggest, longest interruption in schooling since formal education became the norm in wealthier countries in the late 19th century.

`See References: KQED [Public Radio,Television, Digital Media and Educational Services]`

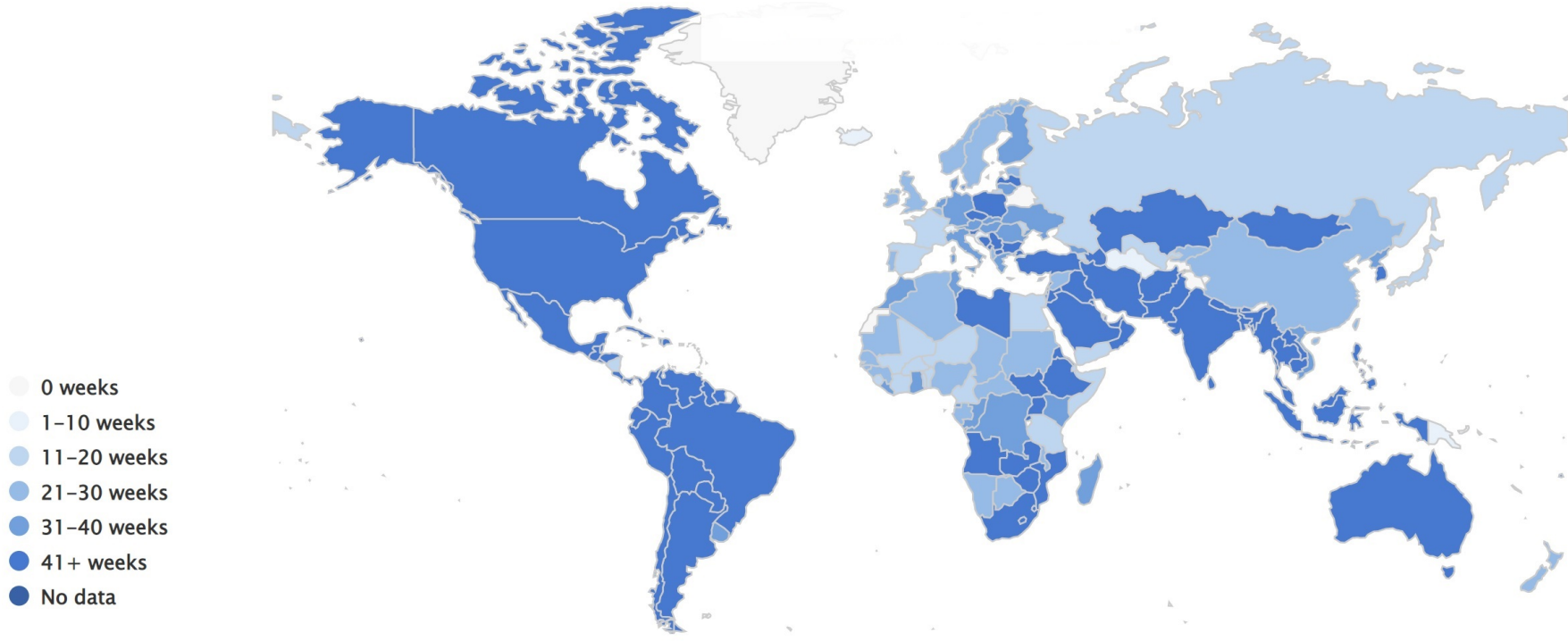
https://en.unesco.org/covid19/educationresponse#schoolclosures

UNESCO

COVID-19 | Global Education Coalition | What we do | Stories & Ideas | Resources

Total duration of school closures

Data



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UNESCO

COVID-19 | Global Education Coalition | What we do | Stories & Ideas | Resources

Total duration of school closures

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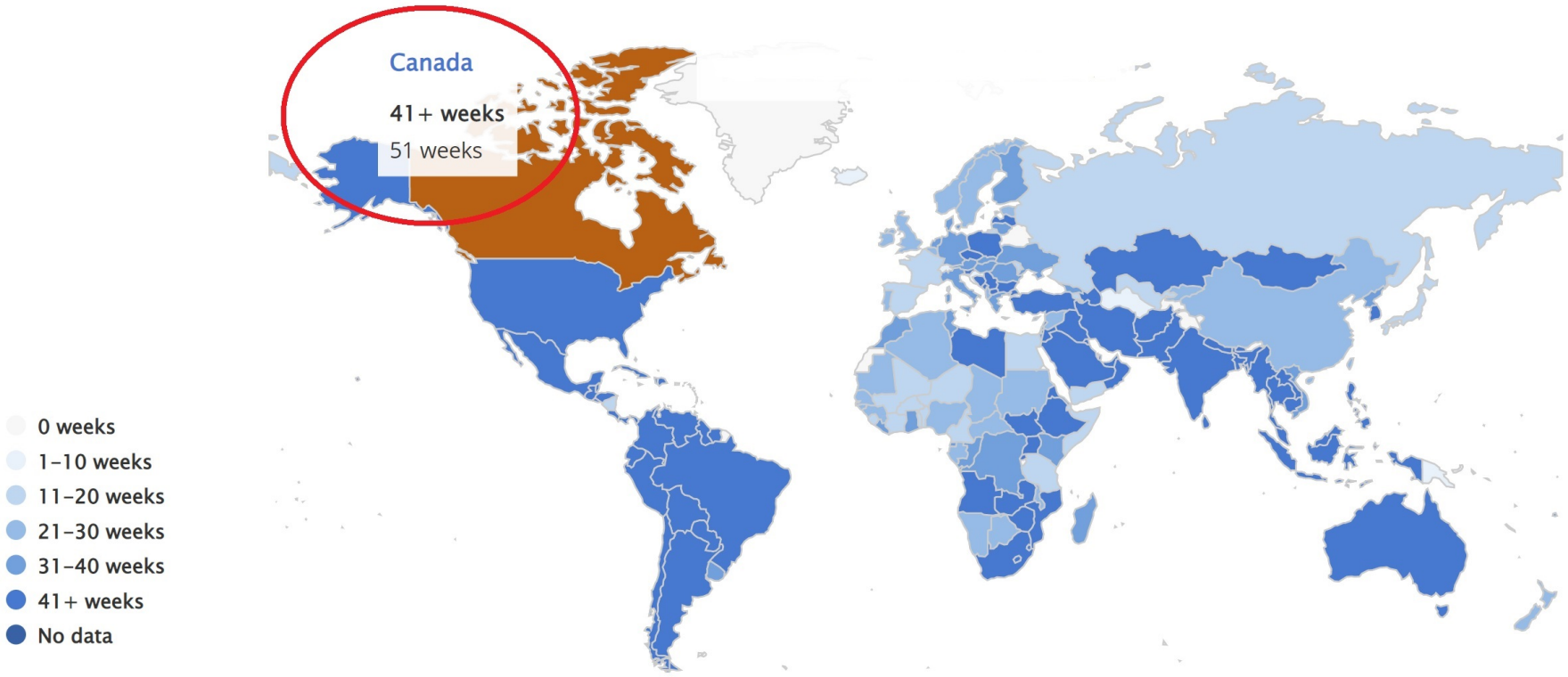

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Impact of the Pandemic on Student Learning

Our analysis shows that the impact of the pandemic on K-12 student learning was significant, leaving students on average five months behind in mathematics and four months behind in reading by the end of the school year [2020-2021].

...districts oscillated among virtual, hybrid, and in-person learning... Students faced multiple schedule changes, were assigned new teachers midyear, and struggled with glitchy internet connections and Zoom fatigue.

...students were not given the opportunity this year to complete all the learning they would have completed in a typical year. The majority simply learned less than they would have in a typical year...

Students who move on to the next grade unprepared are missing key building blocks of knowledge that are necessary for success.

See References: McKinsey & Company

Challenges Measuring and Validating Learning

Calendared assessments, notably high-stakes examinations that determine admission or advancement to new education levels and institutions, are thrown into disarray when schools close.

Strategies to postpone, skip or administer examinations at a distance raise serious concerns about fairness, especially when access to learning becomes variable.

See References:
UNESCO - Adverse consequences of school closures

Students Falling Behind

CBC News questionnaire - responses from N=9,500 educators:

"We're definitely not on track. We've been struggling to get through all of the curricular outcomes. Students who normally perform really well are struggling," said Peter Zajiczek, who teaches math at Western Canada High School.

Around 65 per cent of respondents who identified as teachers say they are behind in the curriculum, and around 60 per cent of respondents said that fewer students are meeting learning objectives.

See References:

CBC News - Calgary educators concerned students are falling behind, cheating more during pandemic

Cheating on the Rise

CBC News questionnaire - responses from N=9,500 educators:

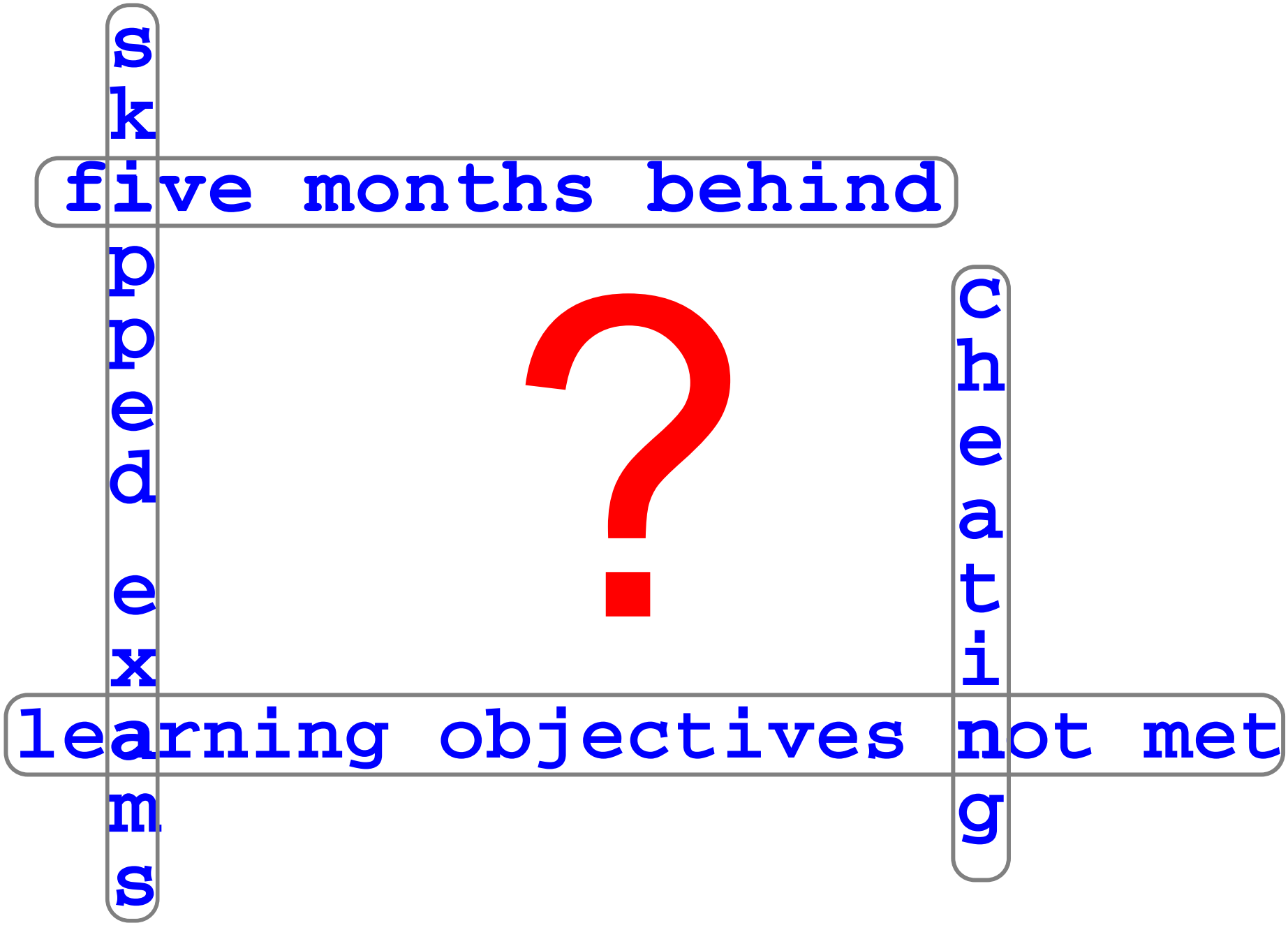
Many teachers worry that more students are cheating.

"It's definitely increased a lot. We're seeing a lot of kids using apps like Photomath for math teachers. There's a lot of worry about kids sharing exams or quiz questions when they're at home because we can't monitor them all"

"...in some cases, students or the parents can hire impersonators to take tests and exams on behalf of the students"

See References:

CBC - Calgary educators concerned students are falling behind, cheating more during pandemic


skipped exams
five months behind
?
cheating
learning objectives not met

POLL:
Remedial Math Options for First Year Students

Which statement do you agree with most?

- Students were admitted to University/Post-Secondary Institutions with a sufficiently high average so remedial math options are not required for first-year students.
- Universities/Post-Secondary Institutions have an obligation to offer remedial math options for first-year students.
- It is the instructor's responsibility to offer remedial math help to students in their classes.

Administrative Tools

Assessments

(Just In Time)

First-Year Calculus Classes at UW

MATH 104 : Introductory Calculus for Arts and Social Science (ARTS)
MATH 116 : Calculus 1 for Engineering (ENG)
MATH 117 : Calculus 1 for Engineering (ENG - ECE, SE, NANO)
MATH 118 : Calculus 2 for Engineering (ENG)
MATH 119 : Calculus 2 for Engineering (ENG - ECE, SE, NANO)
MATH 124 : Calculus and Vector Algebra for Kinesiology (HEALTH)
MATH 127 : Calculus 1 for the Sciences (SCI)
MATH 128 : Calculus 2 for the Sciences (SCI)
MATH 137 : Calculus 1 for Honours Mathematics (MATH)
MATH 138 : Calculus 2 for Honours Mathematics (MATH)
MATH 147 : Calculus 1 (Advanced Level) (MATH)
MATH 148 : Calculus 2 (Advanced Level) (MATH)

Administrative Tools for Identifying Struggling Students

BEFORE THE TERM STARTS

- Identify class composition by Faculty or Program
- Identify class composition by Year of Program

AFTER THE TERM STARTS

- Strongly recommend using an LMS (Learning Management System)
- Identify absentee students using the LMS "last accessed" feature
- Identify procrastinators using the LMS "attempt logs" feature

Identify Class Composition by Faculty or Program

Calculus 1

REGISTRAR COURSE ROSTER

Sort on Faculty

Student ID	Last Name	Given Names	Faculty	Department	Program	Year
1	XXXXX	XXXXX	SCI	PHYS	PHYSASTRHC	2A
2	XXXXX	XXXXX	ART	ACC	AFMPHC	3B
3	XXXXX	XXXXX	VPA	VPA	CFMHC	2B
4	XXXXX	XXXXX	SCI	SCIDEAN	SCI3G	2A
5	XXXXX	XXXXX	SCI	PHYS	MTHPHYSSHC	1B
6	XXXXX	XXXXX	ART	ARTSDEAN	ARTSPD	NL
7	XXXXX	XXXXX	MAT	CS	CSBHC	1A
8	XXXXX	XXXXX	MAT	MATHDEAN	MATHHC	2A
9	XXXXX	XXXXX	MAT	MATHDEAN	MATHHC	1A
10	XXXXX	XXXXX	ART	ARTSDEAN	ARTS4G	2B
11	XXXXX	XXXXX	MAT	MATHDEAN	MATHFARMHC	2A
12	XXXXX	XXXXX	MAT	MATHDEAN	MATHH	1B
13	XXXXX	XXXXX	MAT	MATHDEAN	BUSMATHC	2A
14	XXXXX	XXXXX	SCI	PHYS	MTHPHYSSHC	2B
15	XXXXX	XXXXX	MAT	MATHDEAN	MATHH	1B
16	XXXXX	XXXXX	ENV	GEOG	GEOGAVTNH	2A
17	XXXXX	XXXXX	AHS	HLTHGERON	HLTHHC	3A

Student ID	Last Name	Given Names	Faculty	Department	Program	Year
17	XXXXX	XXXXX	AHS	HLTHGERON	HLTHHC	3A
2	XXXXX	XXXXX	ART	ACC	AFMPHC	3B
6	XXXXX	XXXXX	ART	ARTSDEAN	ARTSPD	NL
10	XXXXX	XXXXX	ART	ARTSDEAN	ARTS4G	2B
16	XXXXX	XXXXX	ENV	GEOG	GEOGAVT	2A
7	XXXXX	XXXXX	MAT	CS	CSBHC	1A
8	XXXXX	XXXXX	MAT	MATHDEAN	MATHHC	2A
9	XXXXX	XXXXX	MAT	MATHDEAN	MATHHC	1A
11	XXXXX	XXXXX	MAT	MATHDEAN	MATHFAR	2A
12	XXXXX	XXXXX	MAT	MATHDEAN	MATHH	1B
13	XXXXX	XXXXX	MAT	MATHDEAN	BUSMATH	2A
15	XXXXX	XXXXX	MAT	MATHDEAN	MATHH	1B
1	XXXXX	XXXXX	SCI	PHYS	PHYSASTI	2A
4	XXXXX	XXXXX	SCI	SCIDEAN	SCI3G	2A
5	XXXXX	XXXXX	SCI	PHYS	MTHPHYS	1B
14	XXXXX	XXXXX	SCI	PHYS	MTHPHYS	2B
3	XXXXX	XXXXX	VPA	VPA	CFMHC	2B

Identify Class Composition by Student Year

Calculus 1

REGISTRAR COURSE ROSTER

Student ID	Last Name	Given Name	Faculty	Department	Program	Year
1	XXXXX	XXXXX	SCI	PHYS	PHYSASTRHC	**2A**
2	XXXXX	XXXXX	ART	ACC	AFMPHC	**3B**
3	XXXXX	XXXXX	VPA	VPA	CFMHC	**2B**
4	XXXXX	XXXXX	SCI	SCIDEAN	SCI3G	**2A**
5	XXXXX	XXXXX	SCI	PHYS	MTHPHYSSHC	**1B**
6	XXXXX	XXXXX	ART	ARTSDEAN	ARTSPD	**NL**
7	XXXXX	XXXXX	MAT	CS	CSBHC	**1A**
8	XXXXX	XXXXX	MAT	MATHDEAN	MATHHC	**2A**
9	XXXXX	XXXXX	MAT	MATHDEAN	MATHHC	**1A**
10	XXXXX	XXXXX	ART	ARTSDEAN	ARTS4G	**2B**
11	XXXXX	XXXXX	MAT	MATHDEAN	MATHFARMHC	**2A**
12	XXXXX	XXXXX	MAT	MATHDEAN	MATHH	**1B**
13	XXXXX	XXXXX	MAT	MATHDEAN	BUSMATHC	**2A**
14	XXXXX	XXXXX	SCI	PHYS	MTHPHYSSHC	**2B**
15	XXXXX	XXXXX	MAT	MATHDEAN	MATHH	**1B**
16	XXXXX	XXXXX	ENV	GEOG	GEOGAVTNH	**2A**
17	XXXXX	XXXXX	AHS	HLTHGERON	HLTHHC	**3A**

Sort on Year of Program

Student ID	Last Name	Given Names	Faculty	Department	Program	Year
7	XXXXX	XXXXX	MAT	CS	CSBHC	**1A**
9	XXXXX	XXXXX	MAT	MATHDEAN	MATHHC	**1A**
12	XXXXX	XXXXX	MAT	MATHDEAN	MATHH	**1B**
15	XXXXX	XXXXX	MAT	MATHDEAN	MATHH	**1B**
5	XXXXX	XXXXX	SCI	PHYS	MTHPHYSSHC	**1B**
16	XXXXX	XXXXX	ENV	GEOG	GEOGAVTNH	**2A**
8	XXXXX	XXXXX	MAT	MATHDEAN	MATHHC	**2A**
11	XXXXX	XXXXX	MAT	MATHDEAN	MATHFARMHC	**2A**
13	XXXXX	XXXXX	MAT	MATHDEAN	BUSMATHC	**2A**
1	XXXXX	XXXXX	SCI	PHYS	PHYSASTRHC	**2A**
4	XXXXX	XXXXX	SCI	SCIDEAN	SCI3G	**2A**
10	XXXXX	XXXXX	ART	ARTSDEAN	ARTS4G	**2B**
14	XXXXX	XXXXX	SCI	PHYS	MTHPHYSSHC	**2B**
3	XXXXX	XXXXX	VPA	VPA	CFMHC	**2B**
17	XXXXX	XXXXX	AHS	HLTHGERON	HLTHHC	**3A**
2	XXXXX	XXXXX	ART	ACC	AFMPHC	**3B**
6	XXXXX	XXXXX	ART	ARTSDEAN	ARTSPD	**NL**

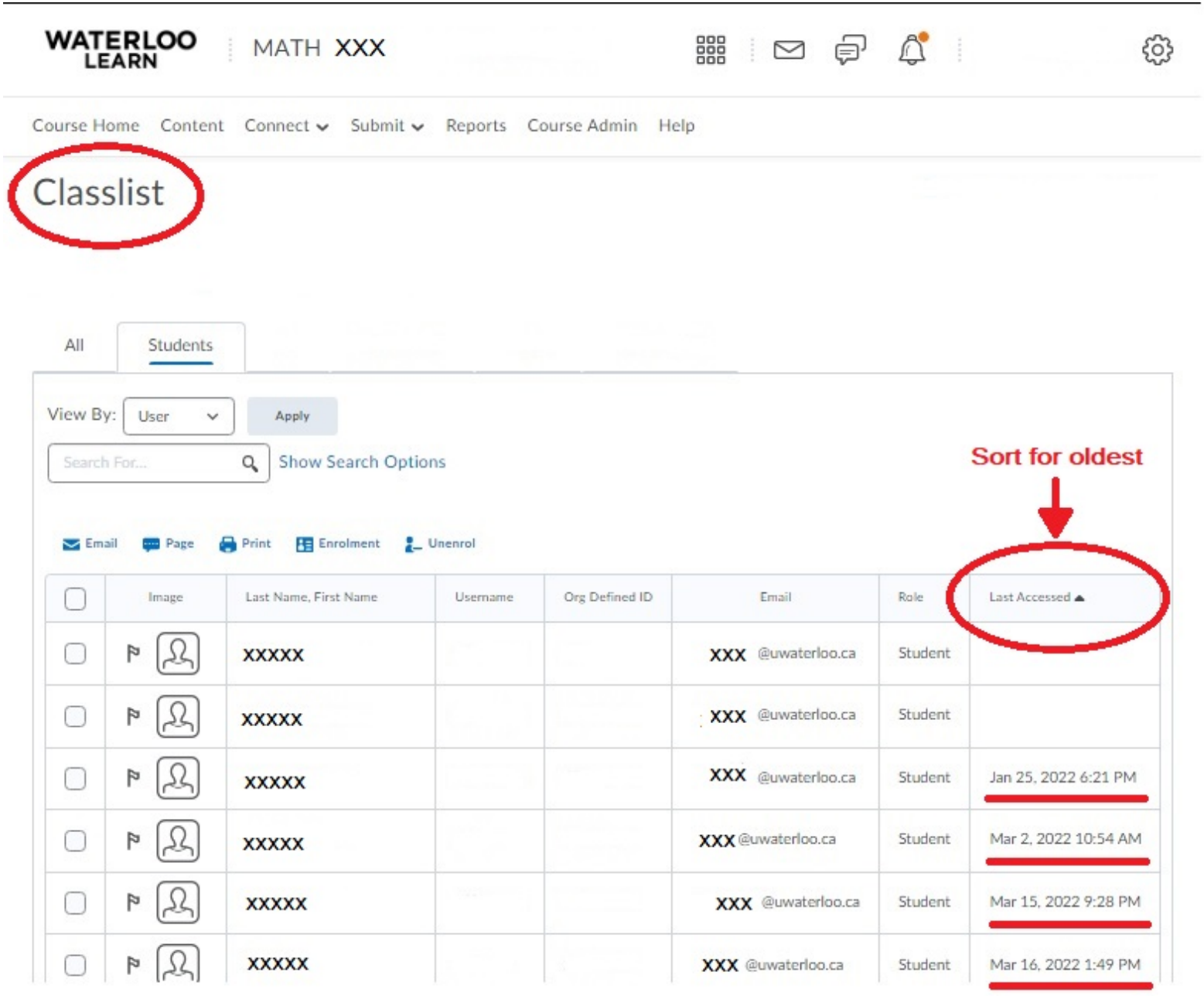
Use the Features of Your LMS

Moodle

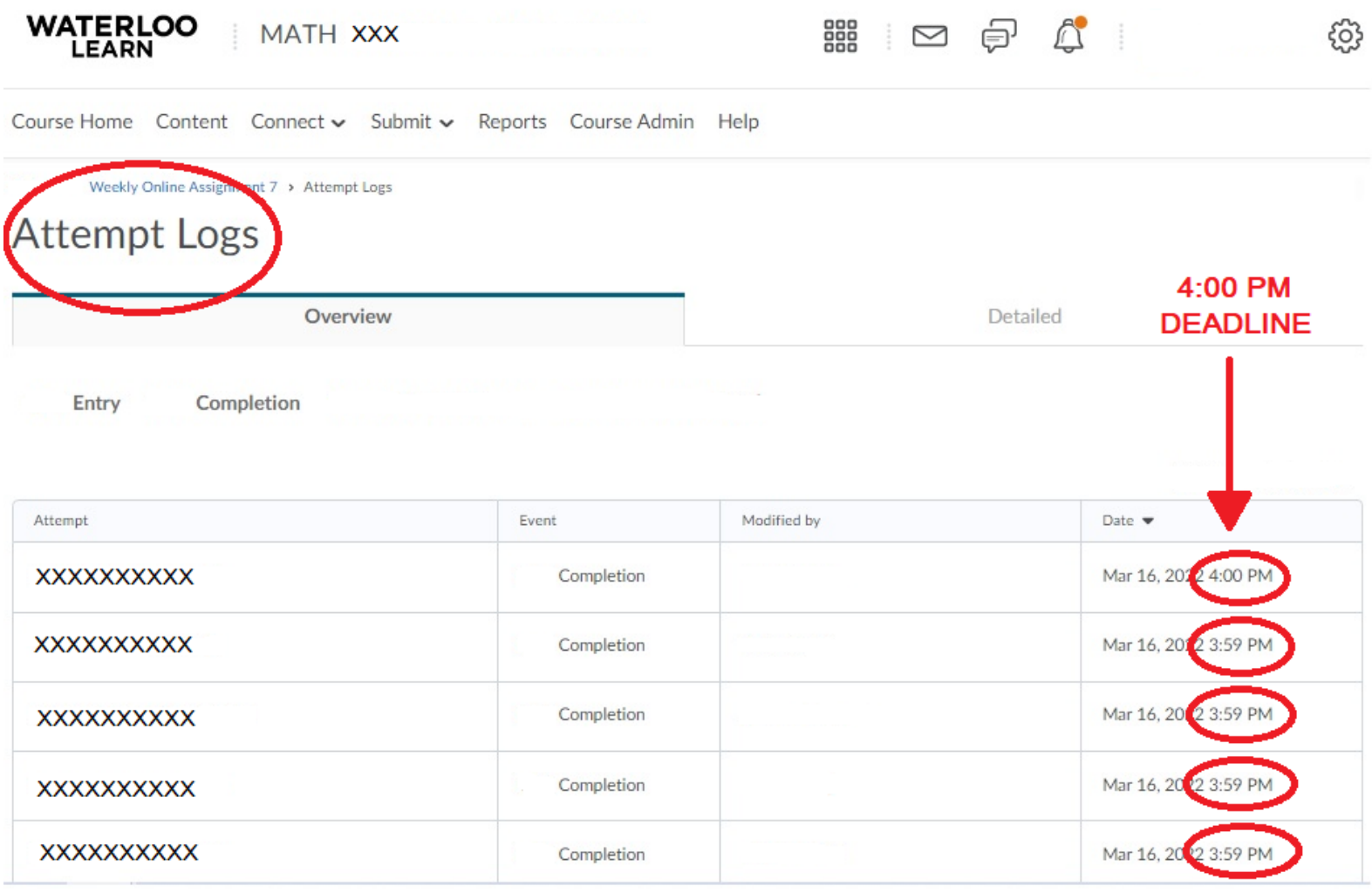
Blackboard Learn

Desire2Learn / Brightspace

Identify Absentees



Identify Procrastinators



POLL:
Using Assessments to Identify Struggling Students

Do you regularly mark any portion of the assignments in your class?

- Yes
- No

Final Grade Calculation

35% Weekly Online Assignments

30% Regular Assignments, Maple Labs and Mid-term Assessment

35% Final Exam

Weekly Online Assignments

35% weight in total; so worth it to the student to complete.

Low stakes; individual assignments weighted from 1% - 5%.

$\sim$9 per term/one per week (except for major assignment/midterm weeks).

40 - 60 questions: true/false, multiple select, matching, fill-in-the-blank...

Questions are high school review, from reading assignment, basic concept check of current week's lectures, and a few challenge questions.

Open book. Can ask me questions. Can post questions in Discussion Group. Goal 85% class average.

Questions provided at least 1 week in advance via downloadable PDF.

Easy to set-up/grade/quick statistics by creating "bubble sheet" in the LMS.

The LMS “Bubble Sheet”

Weekly Online Assignment

Part 1: True and False

Instructions: Using the printed copy of the electronic assignment for this week, enter your answer for each question on the following electronic answer sheet.

Question 1 (1 point)

Select either *true* or *false* for question #1.

- ◯ True
- ◯ False

Question 2 (1 point)

Select either *true* or *false* for question #2.

- ◯ True
- ◯ False

Question 3 (1 point)

Select either *true* or *false* for question #3.

- ◯ True

The LMS “Bubble Sheet”

Weekly Online Assignment

Part 2: Multiple Choice

Instructions: Using the printed copy of the electronic assignment for this week, enter your answer for each question on the following electronic answer sheet.

Question 27 (1 point)

Choose your answer for multiple choice question #27.

- ◯ a.
- ◯ b.
- ◯ c.
- ◯ d.

Question 28 (1 point)

Choose your answer for multiple choice question #28.

Weekly Online Assignment Completion Rates

Calculus 2							
Student	OA1	OA2	OA3	OA4	OA5	OA6	OA7
	1%	2%	3%	4%	5%	5%	5%
1	95	95	94	100	85	98	93
2	93	94	98	100	95	93	83
3	88	92	98	98	85	90	97
4	97	98	98	98	100	98	97
5			85	89			84
6	97	98	100	100	100	98	97
7	93	97	87	100	100	98	93
8	93	97	100	100	95	100	95
9	95	100	100	98	100	100	100
10	83	95	89	94	95	86	83
11	97	98	91	98	100	93	93
12	97	100	96	94	95	98	91
13	95	98	96	100	100	98	97
14	100	98	100	100	100	100	95
15	92	63	87	98	100	86	97
16	88	98	98	100	100	100	98
17	92	97	100	100	100	97	95
18	93	98	98	100	100	100	100
19	95	92	91	96	100	98	84
20	97	98	100	100	100	100	98
21	80	95	89	96	90	88	81
22	64	83	64	72		63	61
23	72	92	68	94	100	84	74
24	95	100	96	98	100	98	93
25	95	100	98	98	100	100	90
26	93	97	98	100	100	91	93
27	100	97	89	98	95	97	93
28	100	98	98	100	95	98	95
29	100	98	100	100	100	100	97
30	100	98	98	98	95	95	90
31	95	92	87	91	90	93	98
32	92	95	100	96	100	98	90
33	88	97	94	98	80	91	88
34		91	85	100	85	91	
35			89	96	95	93	86
36	97	95	100	94	100	95	98
37	93	100	89	98	90	91	83

Mathematics is not a spectator sport

Weekly Online Assignment Completion Rates

Calculus 2							
Student	OA1	OA2	OA3	OA4	OA5	OA6	OA7
	1%	2%	3%	4%	5%	5%	5%
223	95	97	100	100	95	100	100
224	95	98	100	96	100	95	86
225	92	98	100	100	100	97	90
226	98	100	98	98	100	98	95
227	85	84	89	87	90	97	91
228	92	95	98	96	95		93
229	97	98	98	98	100	100	98
230	83	88	77	89	80	76	74
231	95	100	100	100	100	100	95
232	85	84	68	85	75	90	78
233	85	86	96	91	75	81	59
234	93	98	91	98	95	93	90
235	97	98	100	100	100	95	97
236	98	97	98	98	95	90	90
237	95	97	96	100	100	100	90
238	93	98	98	100	100	98	84
239	95	95	91	98	95	100	93
240	86	86	100	98	90	97	84
241	86	97	96	100	95	100	88
242	97	89	87	89	100	91	86
243	92	97	100	96	95	93	84
244	95	95	91	100	100	100	100
245	86	95	96	98	100	86	95
246	95	97	100	100	100	93	91
247	98	98	100	100	100	100	97
248	98	98	100	100	100	100	98
249	97	98	100	100		100	97
250	97	100	100	100	100	100	100
251	92	95	94	98	100	97	93
252	97	98	96	98	100	100	100
253	97	98	100	98	100	100	100
254	71	88	94	89	80	84	76
255	97	100	98	100	100	98	93
Submitted	**241**	**249**	**252**	**255**	**250**	**248**	**249**

Total Students

Total Assignments Submitted

SUCCESS as a motivator!

Weekly Online Assignment Question Creation

Recall:

40 - 60 true/false, multiple select, matching, etc... per assignment.

Questions are high school review, from reading assignment, basic concept check of current week's lectures, and a few challenge questions.

Weekly Online Assignment Question Creation ... includes Just-In-Time Review

Sample True/False Questions

- The function $f(x) = e^x$ has the horizontal asymptote $x = 0$ as $x \to -\infty$.
- $\frac{1}{100000} < \frac{1}{100001}$
- $0.00000010 < 0.00000050$
- $2 \leq 3$
- $\frac{1}{n} < \frac{1}{2n}$

Weekly Online Assignment Question Creation ... includes Just-In-Time Review

True/False Example

_____ The function $f(x) = e^x$ has the horizontal asymptote $x = 0$ as $x \to -\infty$.

False, since the horizontal asymptote is $y = 0$.

Weekly Online Assignment Question Creation ... includes Just-In-Time Review

True/False Example

_____ The function $f(x) = e^x$ has the horizontal asymptote $x = 0$ as $x \to -\infty$.

Multiple Choice Related Example

Find the area of the region bounded by $y = x^2 + 1$ and $y = 2$.

(a) $\frac{4}{3}$ (b) $\frac{2}{3}$ (c) $\frac{11}{9}$ (d) $\frac{5}{3}$ (e) None of these

Weekly Online Assignment Question Creation ... includes Just-In-Time Review

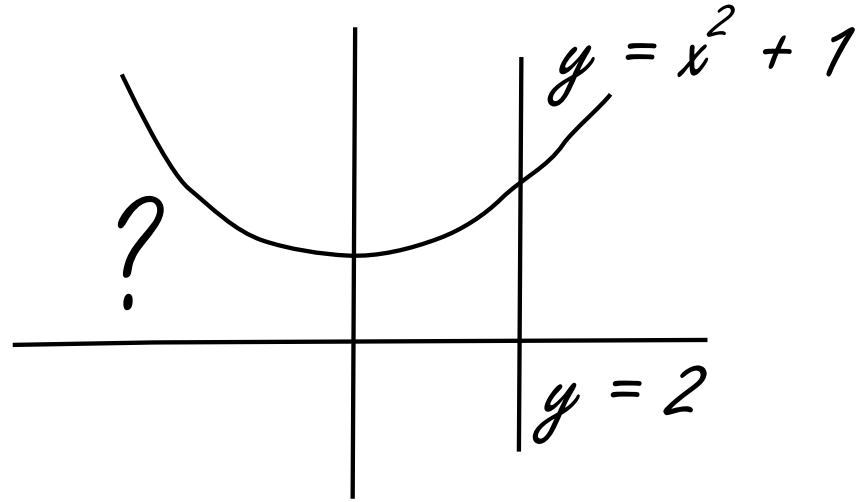
Multiple Choice Related Example

Find the area of the region bounded by $y = x^2 + 1$ and $y = 2$.

(a) $\frac{4}{3}$ (b) $\frac{2}{3}$ (c) $\frac{11}{9}$ (d) $\frac{5}{3}$ (e) None of these

Student wrote:

Hello Professor,
I am confused by question 16, I am not sure how this region is bounded, can you clarify this for me?



Identifying Issues through Assessments

Example: Multiple-select Question

Let R be the region in the first quadrant bounded by the graph of $f(x) = x^2$ and the lines $y = 1$ and $x = 0$. Which of the following solids would have the largest volume?

a) The volume of the solid S obtained by revolving R around the x-axis.

b) The volume of the solid S obtained by revolving R around the line $y = 1$.

c) The volume of the solid S obtained by revolving R around the y-axis.

d) The volume of the solid S obtained by revolving R around the line $x = 1$.

e) The volume of the solid S obtained by revolving R around the line $y = \frac{1}{2}$.

Identifying Issues through Assessments

Problem 1:
Find the volume of the solid obtained by revolving the region R around the x-axis.

and on the same assignment...

Problem 2:
Find the volume of the solid obtained by revolving the region R around the line $y = 0$.

Question from Student: Is the line $y = 0$ the same as the x-axis?

Identifying Issues through Assessments

True/False Example

$$\underline{\qquad} \quad \frac{1}{1001} < \frac{1}{1000}$$

Identifying Issues through Assessments

Example: Multiple-select Question

We know $\lim\limits_{n\to\infty} \frac{3n}{n+4} = 3$. We can show that

$$\left|\frac{3n}{n+4} - 3\right| = \left|\frac{3n-(3n+12)}{n+4}\right| = \left|\frac{-12}{n+4}\right| < \frac{12}{n}.$$

If we require $\left|\frac{3n}{n+4} - 3\right| < \frac{1}{10^5}$, then we should choose

a) $n \geq \frac{10^5}{12}$

b) $n \geq 12 \cdot 10^5$

c) $\frac{10^5}{12} \geq n$

d) $12 \cdot 10^5 \geq n$

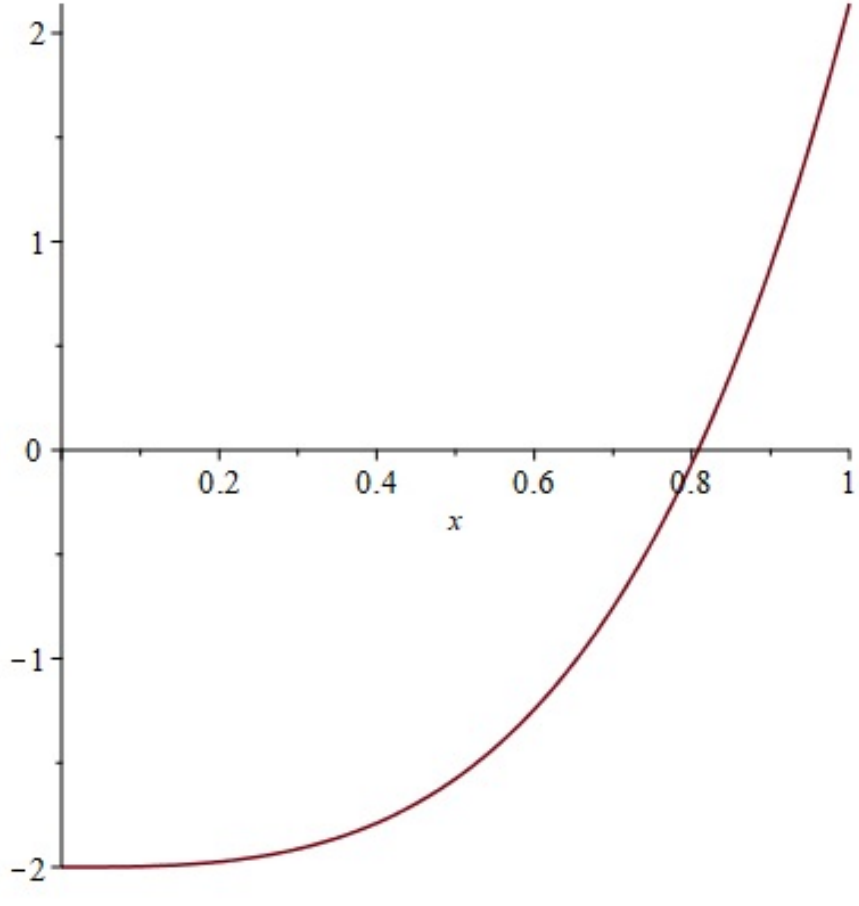
Identifying Issues through Assessments

The polynomial $f(x) = x^5 + \pi x^3 - 2$ has one real zero. If $f(x_0) = 0$, use Maple's `plot` command and an appropriate plot range to estimate x_0 to 8 decimal places.

```
> restart:
> f := x -> x^5 + Pi*x^3 - 2;
```

$$f := x \mapsto x^5 + \pi x^3 - 2$$

```
> plot(f(x), x=0..1);
```



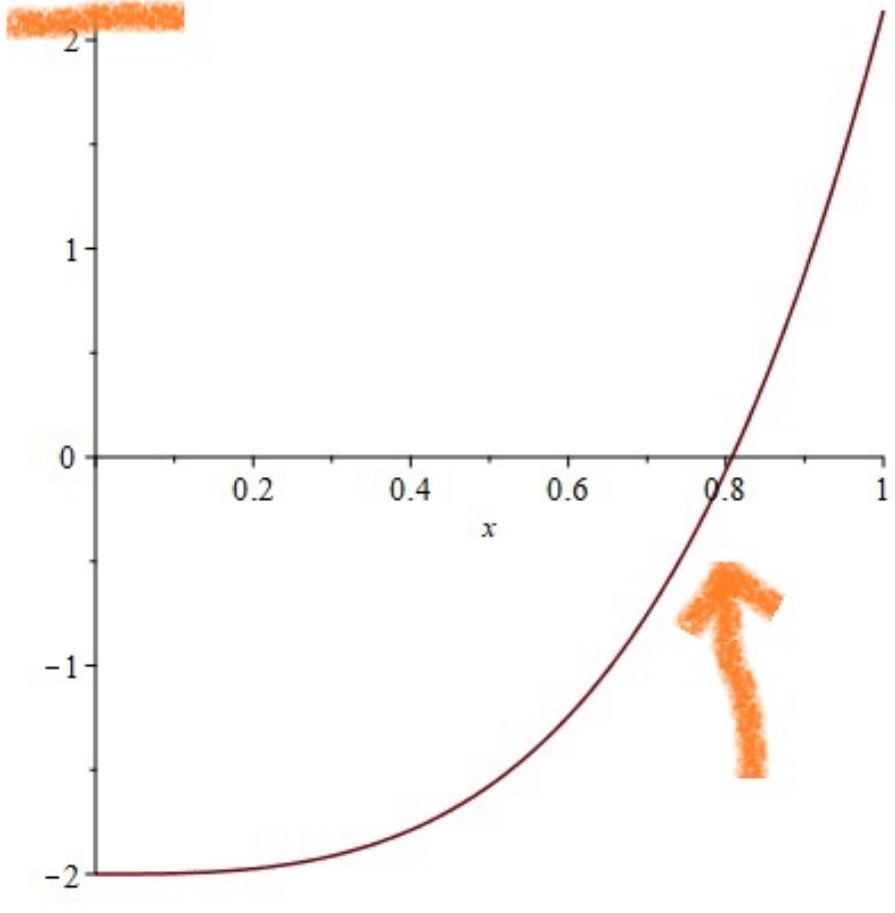
Identifying Issues through Assessments

The polynomial $f(x) = x^5 + \pi x^3 - 2$ has one real zero. If $f(x_0) = 0$, use Maple's `plot` command and an appropriate plot range to estimate x_0 to 8 decimal places.

```
> restart:
> f := x -> x^5 + Pi*x^3 - 2;
```

$$f := x \mapsto x^5 + \pi x^3 - 2$$

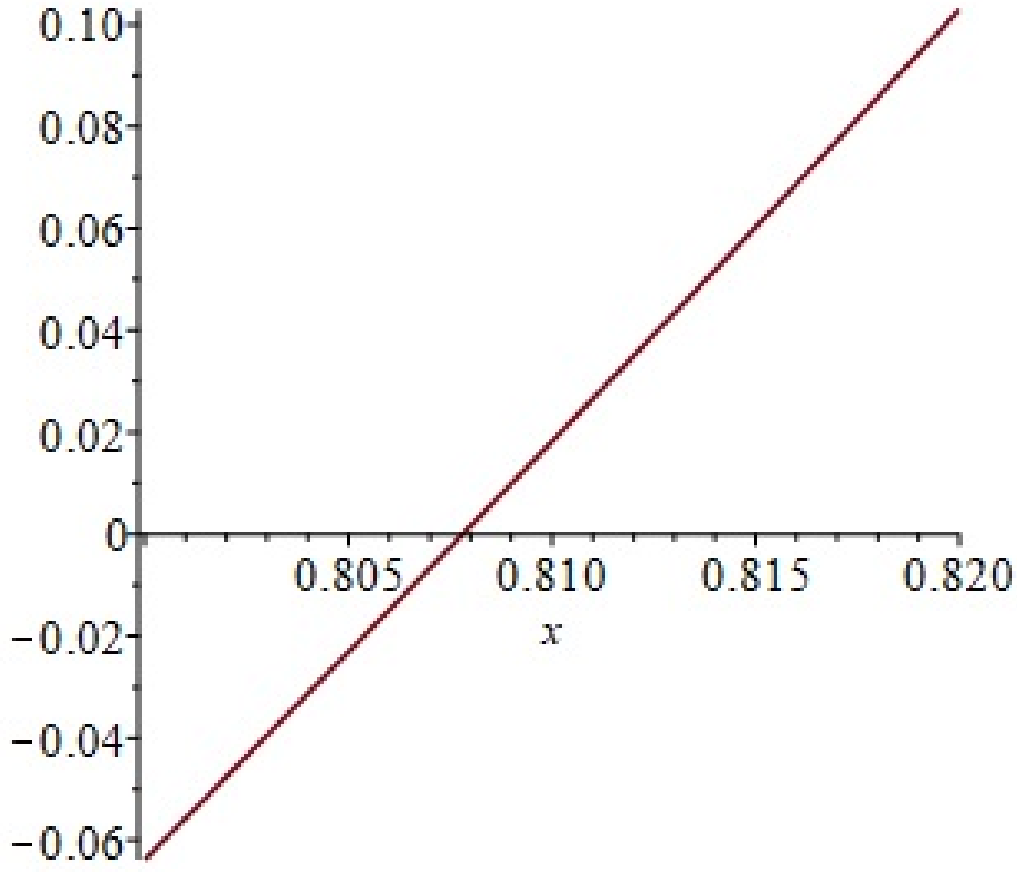
```
> plot(f(x), x=0..1);
```



Identifying Issues through Assessments

The polynomial $f(x) = x^5 + \pi x^3 - 2$ has one real zero. If $f(x_0) = 0$, use Maple's `plot` command and an appropriate plot range to estimate x_0 to 8 decimal places.

```
> plot(f(x), x=0.8..0.82);
```



Identifying Issues through Assessments

The polynomial $f(x) = x^5 + \pi x^3 - 2$ has one real zero. If $f(x_0) = 0$, use Maple's `plot` command and an appropriate plot range to estimate x_0 to 8 decimal places.

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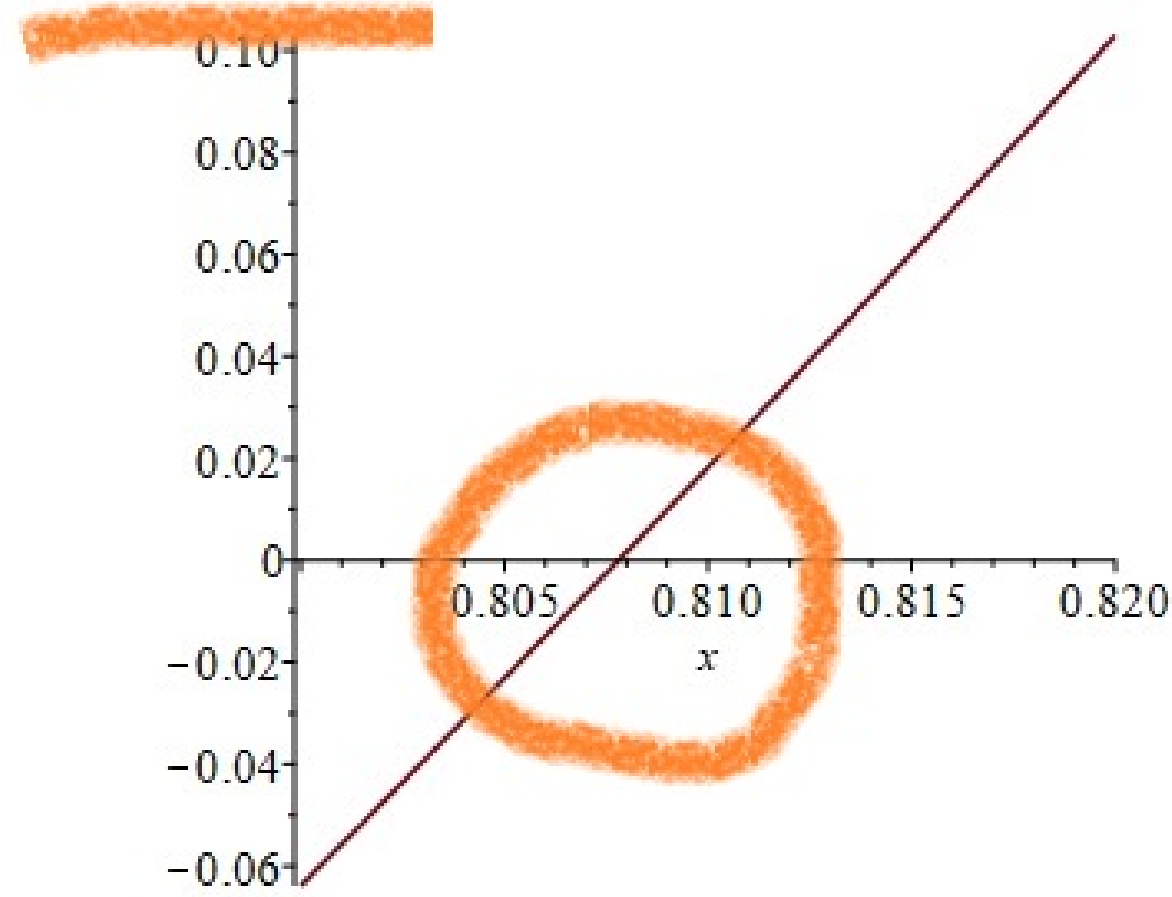

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> plot(f(x), x=0.807..0.808);
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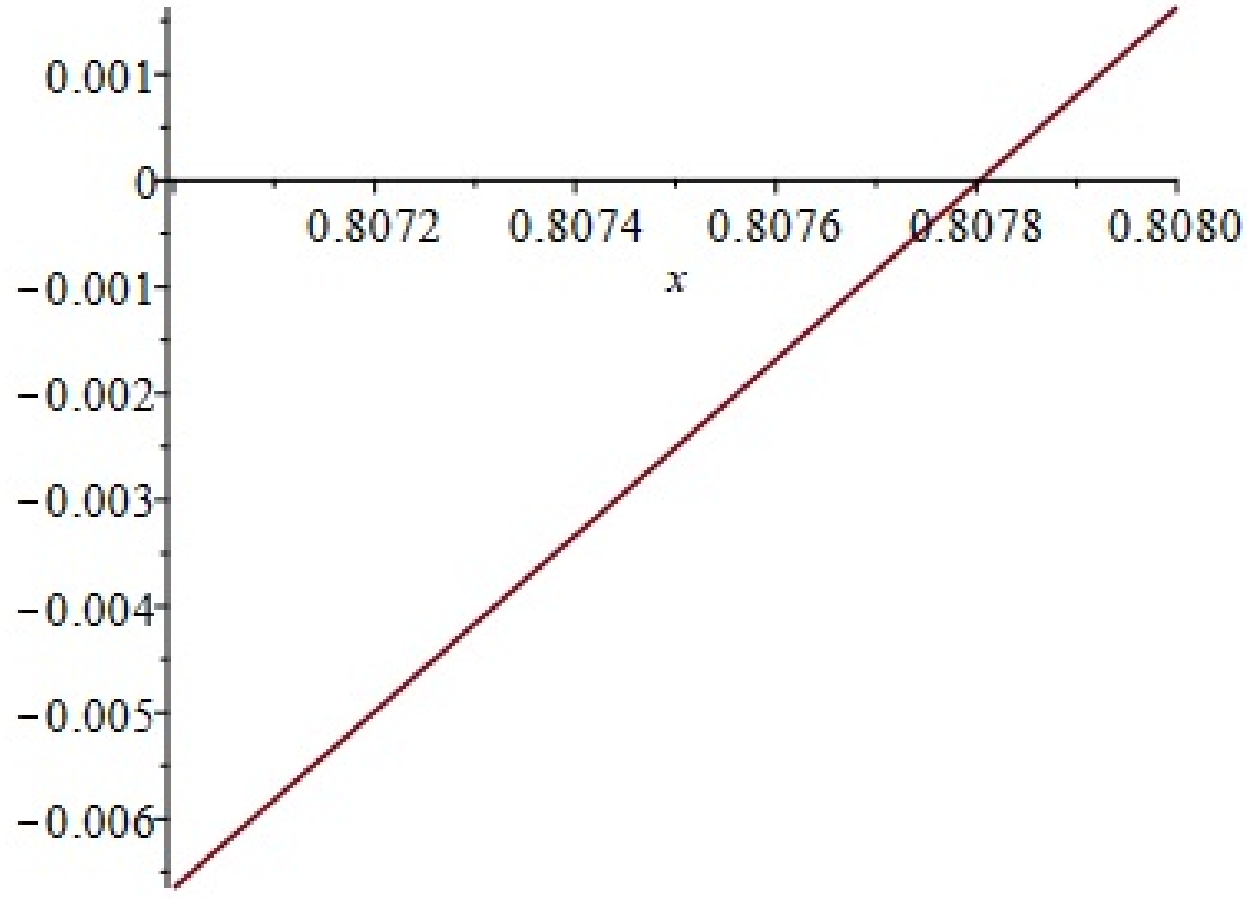

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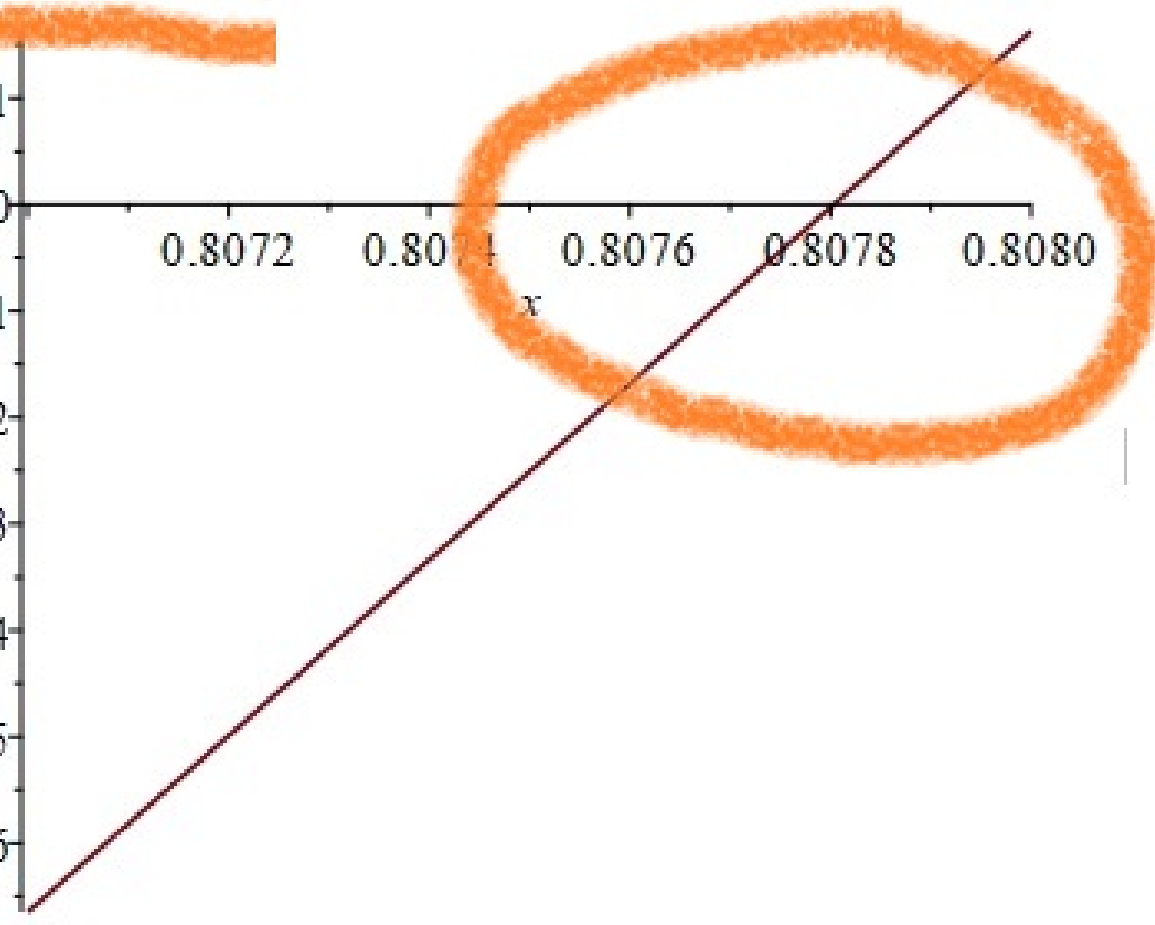

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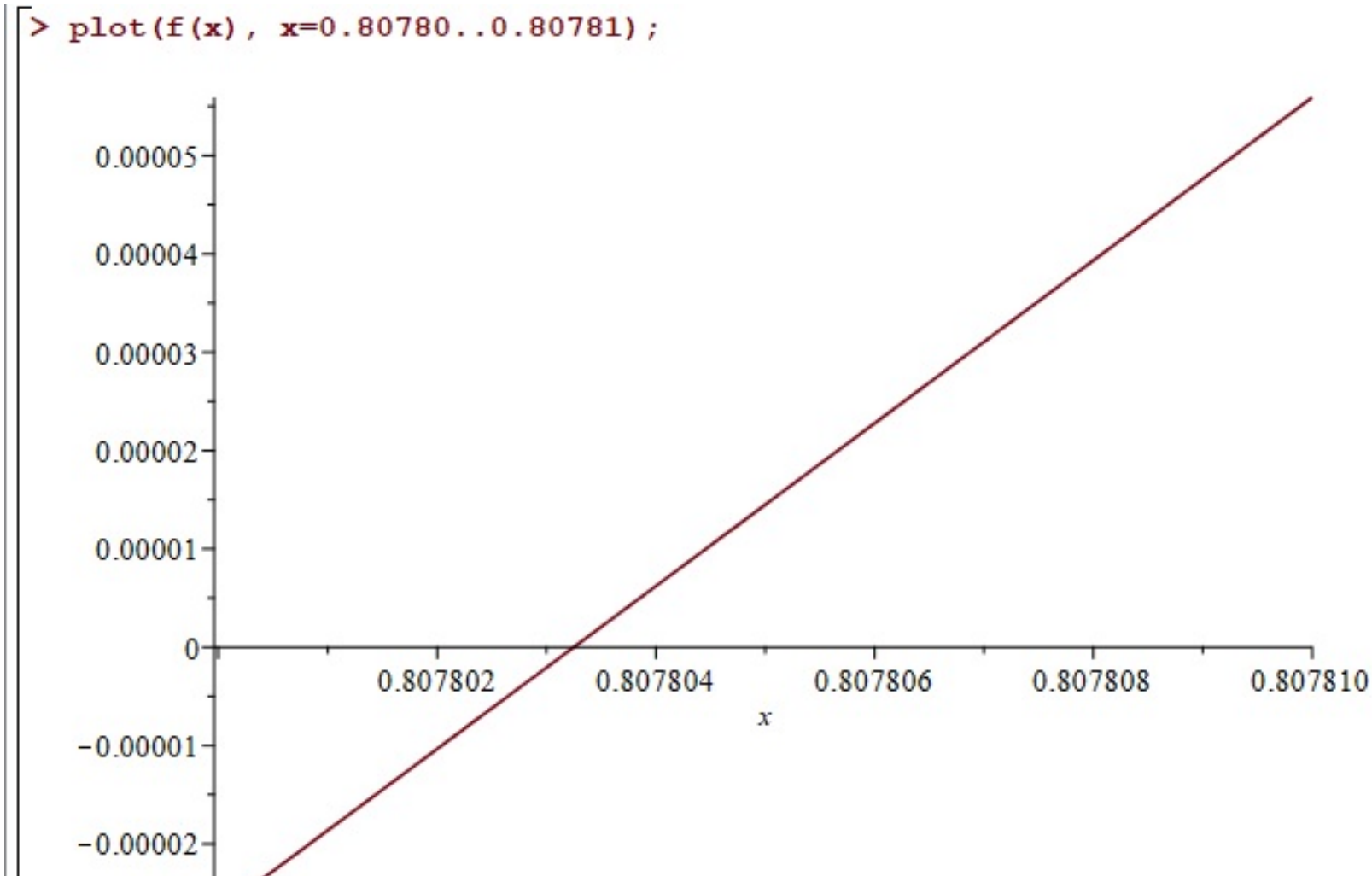

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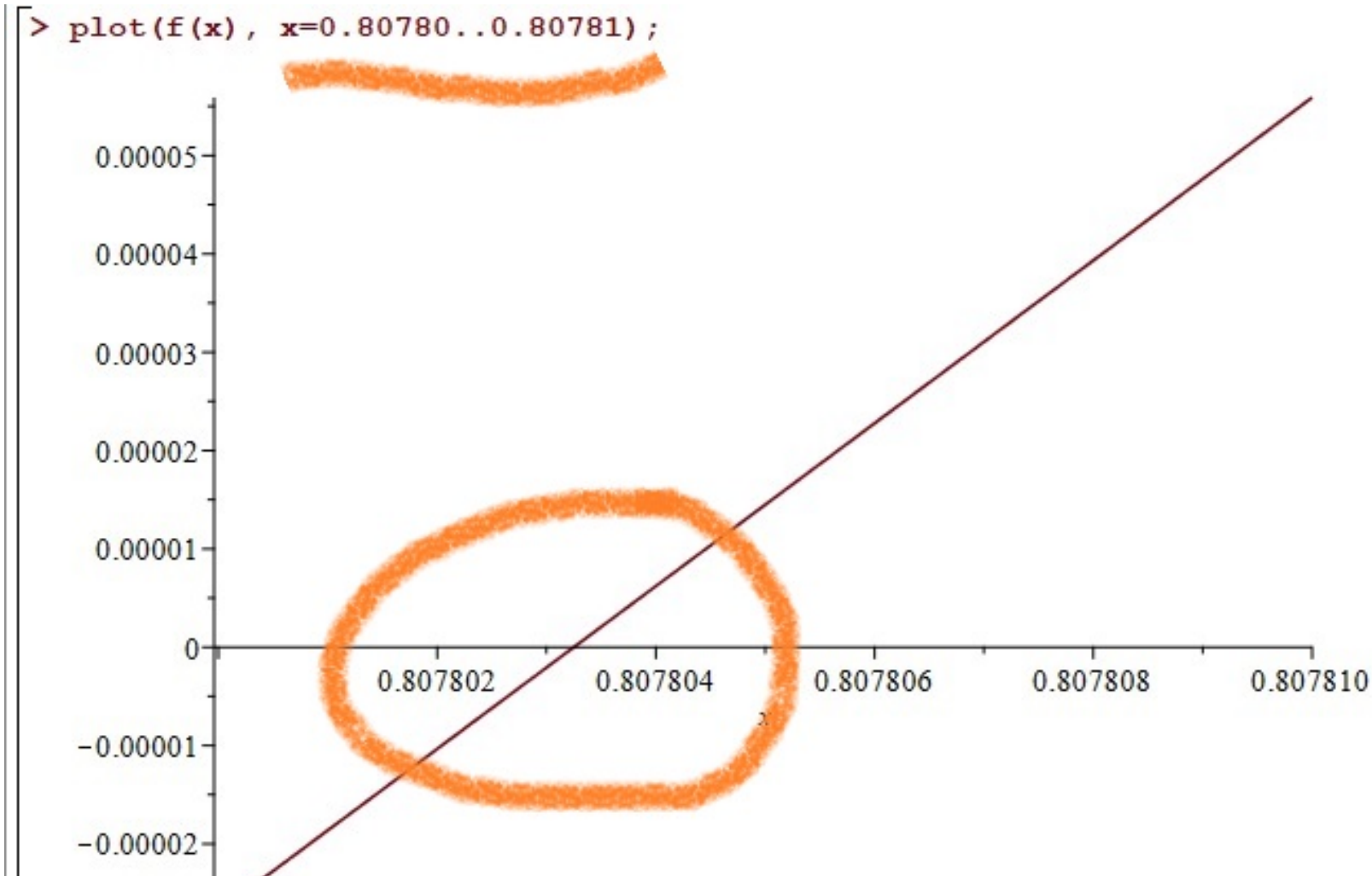


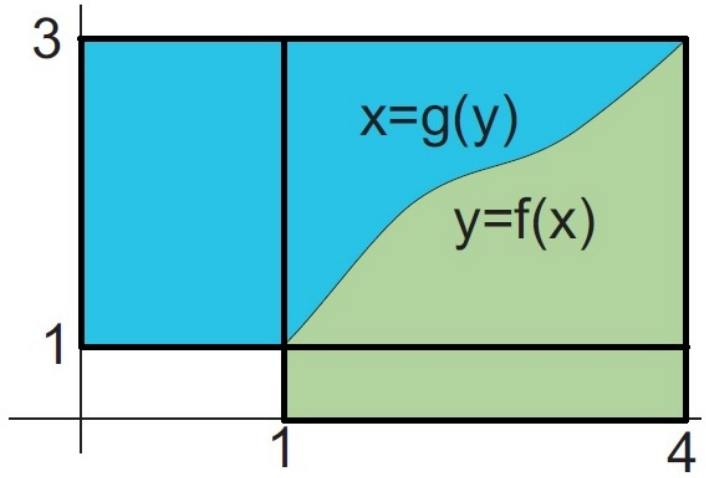
Identifying Issues through Assessments

True/False Example

$_____ \quad 2 \leq 3$

Identifying Issues through Assessments

Assume that $f(x)$ is continuous and strictly increasing on $[1, 4]$ with $f(1) = 1$ and $f(4) = 3$. Let $g(y) : [1, 3] \to [1, 4]$ be the inverse of $f(x)$ on $[1, 4]$. Note: $g(y)$ is also continuous and increasing on $[1, 3]$ and as such integrable on $[1, 3]$.



Question: By using the geometric interpretation of the integral, determine if the following statement is True or False.

$$3 \leq \int_1^4 f(x)\,dx \leq 9$$

Identifying Issues through Assessments

Question: By using the geometric interpretation of the integral, determine if the following statement is True or False.

$$3 \leq \int_1^4 f(x)\,dx \leq 9$$

Graded Student Solution:

Because $f(x)$ is continues and strictly increasing on $[1, 4]$, $\int_1^4 f(t)dt \neq 3$ and $\int_1^4 f(t)dt \neq 9$. Therefore, we have

$$3 < \int_1^4 f(t)dt < 9$$

ok

The statement is a False statement.

0 x

If $a<b$, then $a \leq b$ is also true

Identifying Issues through Assessments

True/False Example

_____ $\frac{1}{n} \leq \frac{2}{n}$

Identifying Issues through Assessments

Example: Multiple-select Question

Let

$$f(x) = \begin{cases} 0 & \text{if } x \in [0,1] \setminus \{\frac{\sqrt{2}}{2}\} \\ 1 & \text{if } x = \frac{\sqrt{2}}{2} \end{cases}.$$

Let $P^{(n)} = \{0 = t_0 < t_1 < \cdots < t_i < \cdots < t_{n-1} < t_n = 1\}$ denote the n-regular partition of $[0,1]$. Which of the following statements are true?

a) The right-hand Riemann sum $R_n = \sum_{i=1}^{n} f(\frac{i}{n}) \cdot \frac{1}{n} = 0$ for all $n \in \mathbb{N}$.

b) The left-hand Riemann sum $L_n = \sum_{i=1}^{n} f(\frac{i-1}{n}) \cdot \frac{1}{n} = 0$ for all $n \in \mathbb{N}$.

c) If $S_n = \sum_{i=1}^{n} f(c_i) \cdot \frac{1}{n}$ is any Riemann sum associated with $P^{(n)}$, then $S_n \leq \frac{1}{n}$. ⟸ student correctly chooses (c)

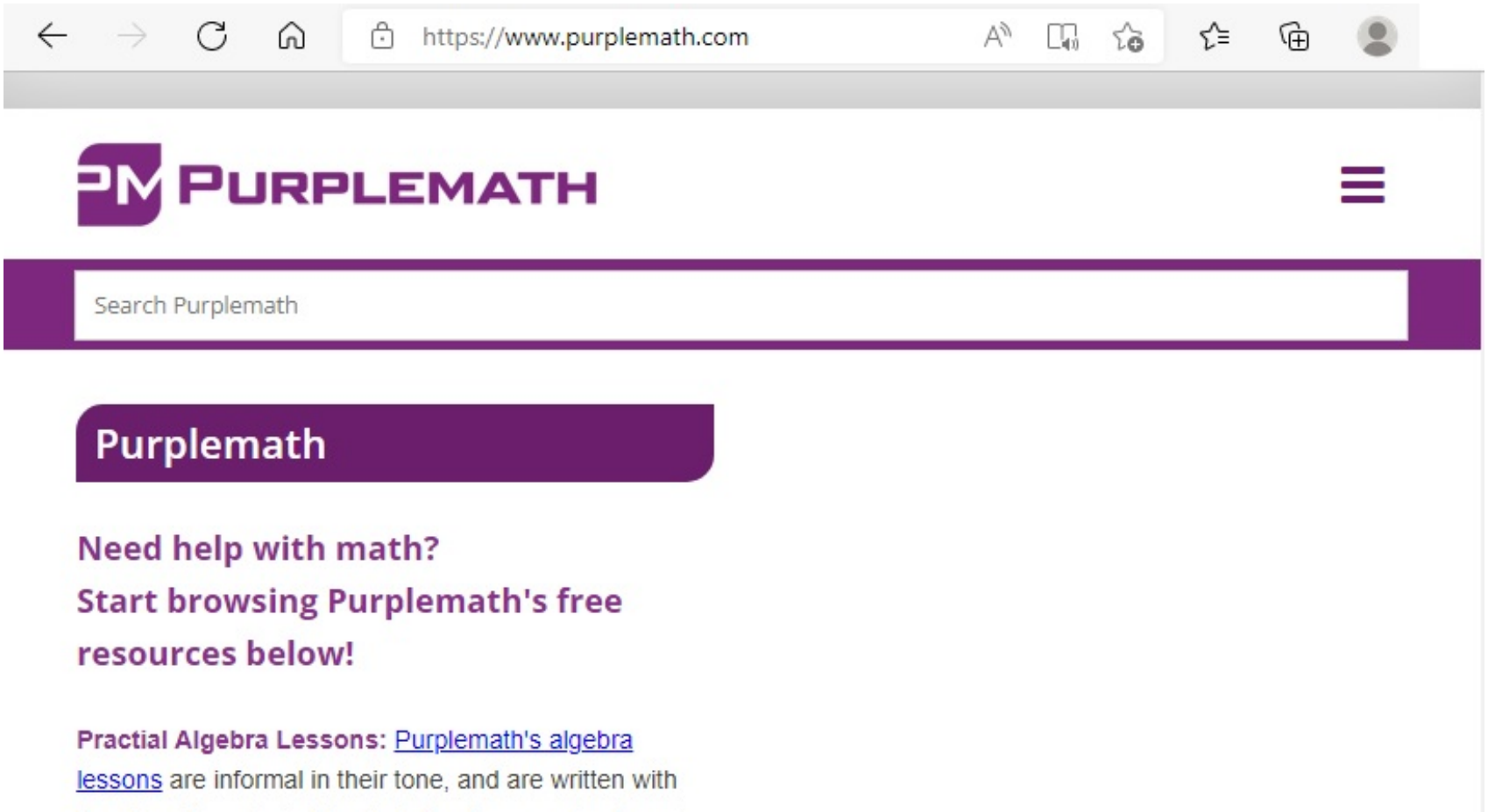
d) If $S_n = \sum_{i=1}^{n} f(c_i) \cdot \frac{1}{n}$ is any Riemann sum associated with $P^{(n)}$, then $S_n \leq \frac{2}{n}$. ⟸ student INCORRECTLY does NOT choose (d)

e) If $S_n = \sum_{i=1}^{n} f(c_i) \cdot \frac{1}{n}$ is any Riemann sum associated with $P^{(n)}$, then $S_n = 0$.

Just-In-Time Review

Purplemath

“free lessons are cross-referenced to help you find related material, and the ”Search” box on every page is available to help you find whatever math content you’re looking for”



Just-In-Time Review

Purplemath

Alternately, go directly to the Purplemath Index page:
`https://www.purplemath.com/modules/`

Preliminary Topics

Absolute Value
Factoring Numbers
Fractions
Geometric Formulas
LCM and GCF
Metric Conversions
Negative Numbers

Number Bases
(binary, octal, etc.)
Number Properties
(Distributive,
Associative, Commutative, etc.)
Number Types
(natural, integer, real, etc.)

Converting between Decimals, Fractions, and Percents
Place Value
Roman Numerals
Rounding (and significant digits)
Set Notation

Beginning Algebra Topics

Canceling Units
Distance Formula
Engineering Notation
Evaluation
Exponents:
- Basic rules
- Negative exponents

Midpoint Formula
Order of Operations
Polynomials
(definitions & "like terms")
Polynomials: Adding & Subtracting
Polynomials: Multiplying
Polynomials: Dividing

Simplifying with Parentheses
Slope of a straight line
Slope and Graphing
Slope and y-intercept
(their meaning in the context of word problems)
Solving Absolute Values

Just-In-Time Review

Purplemath

Google the required topic. Example: "*purplemath, exponents*"

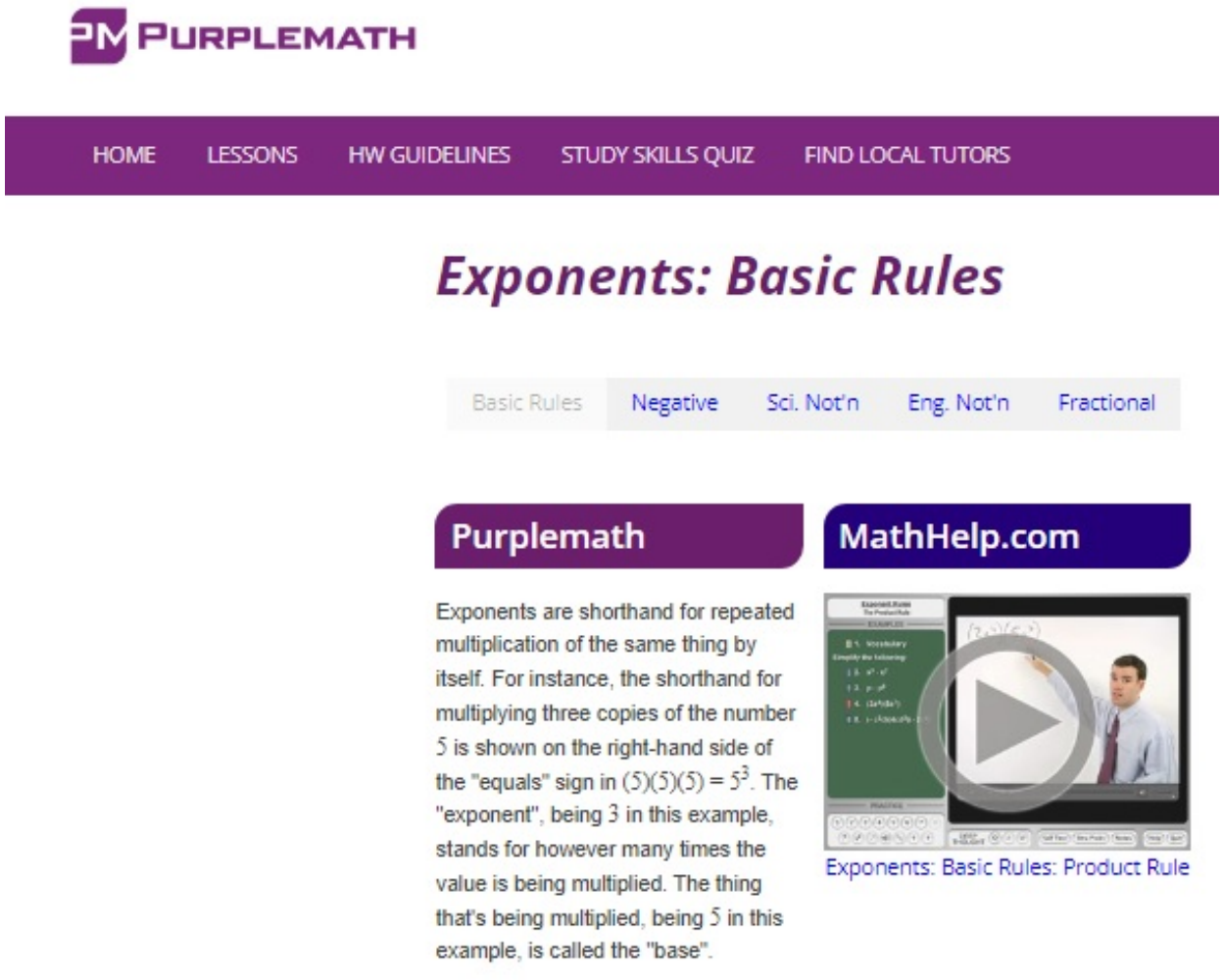


Image References

TITLE PAGE: The Earth & Moon graphic
Image Credit: NASA/JPL/USGS, courtesy NASA/JPL-Caltech.
https://www.jpl.nasa.gov/images/pia00342-the-earth-moon
https://www.jpl.nasa.gov/jpl-image-use-policy

SLIDE: University of Waterloo Territorial Acknowledgement
https://uwaterloo.ca/indigenous/

SLIDE: UNESCO
Global monitoring of school closures: Total duration of school closures
https://en.unesco.org/covid19/educationresponse#schoolclosures

SLIDE: Miami Herald
Wordle cheating is at all-time high, study shows. Where do the worst offenders live? -Mariah Rush
https://www.miamiherald.com/news/nation-world/national/article259016708.html

SLIDE: Purplemath
https://www.purplemath.com/

References and Further Reading

The state of the global education crisis: a path to recovery
A Joint UNESCO, UNICEF, and World Bank Report
https://unesdoc.unesco.org/ark:/48223/pf0000380128

Learning loss due to school closures during the COVID-19 pandemic
PNAS [Proceedings of the National Academy of Sciences]
https://www.pnas.org/doi/10.1073/pnas.2022376118

Two years ago schools shut down around the world. These are the biggest impacts.
KQED [Public Radio,Television, Digital Media and Educational Services]
https://www.kqed.org/mindshift/59194/two-years-ago-schools-shut-down-around-the-world-these-are-the-biggest-impacts

Education: From disruption to recovery
UNESCO
https://en.unesco.org/covid19/educationresponse

Adverse consequences of school closures
UNESCO
https://en.unesco.org/covid19/educationresponse/consequences

References and Further Reading (continued)

Big drop in math skills of entering students
University Affairs
https://www.universityaffairs.ca/news/news-article/
big-drop-in-math-skills-of-entering-students/

COVID-19 and education: The lingering effects of unfinished learning
McKinsey & Company
https://www.mckinsey.com/industries/education/our-insights/
covid-19-and-education-the-lingering-effects
-of-unfinished-learning

Calgary educators concerned students are falling behind, cheating more during pandemic
CBC News
https://www.cbc.ca/news/canada/calgary/calgary-educators
-concerned-students-falling-behind-cheating-1.6026878

Purplemath
https://www.purplemath.com/

Questions / Discussion Topics

- Do you anticipate more math prerequisite issues than usual in Fall 2022? If so, what are they?
- Will you incorporate some sort of high school math review in your planning for the FALL?
- Remedial Math Classes - yes or no? before term or during term? just-in-time review instead?
- Do remedial classes really help struggling students?
- Should we care about cheating?
- What are the objectives of Math courses? (instructor point of view)
- What are the objectives of Math courses? (student point of view)