ASSISTment : a teacher uses the internet to collect, share and respond to data from her students.

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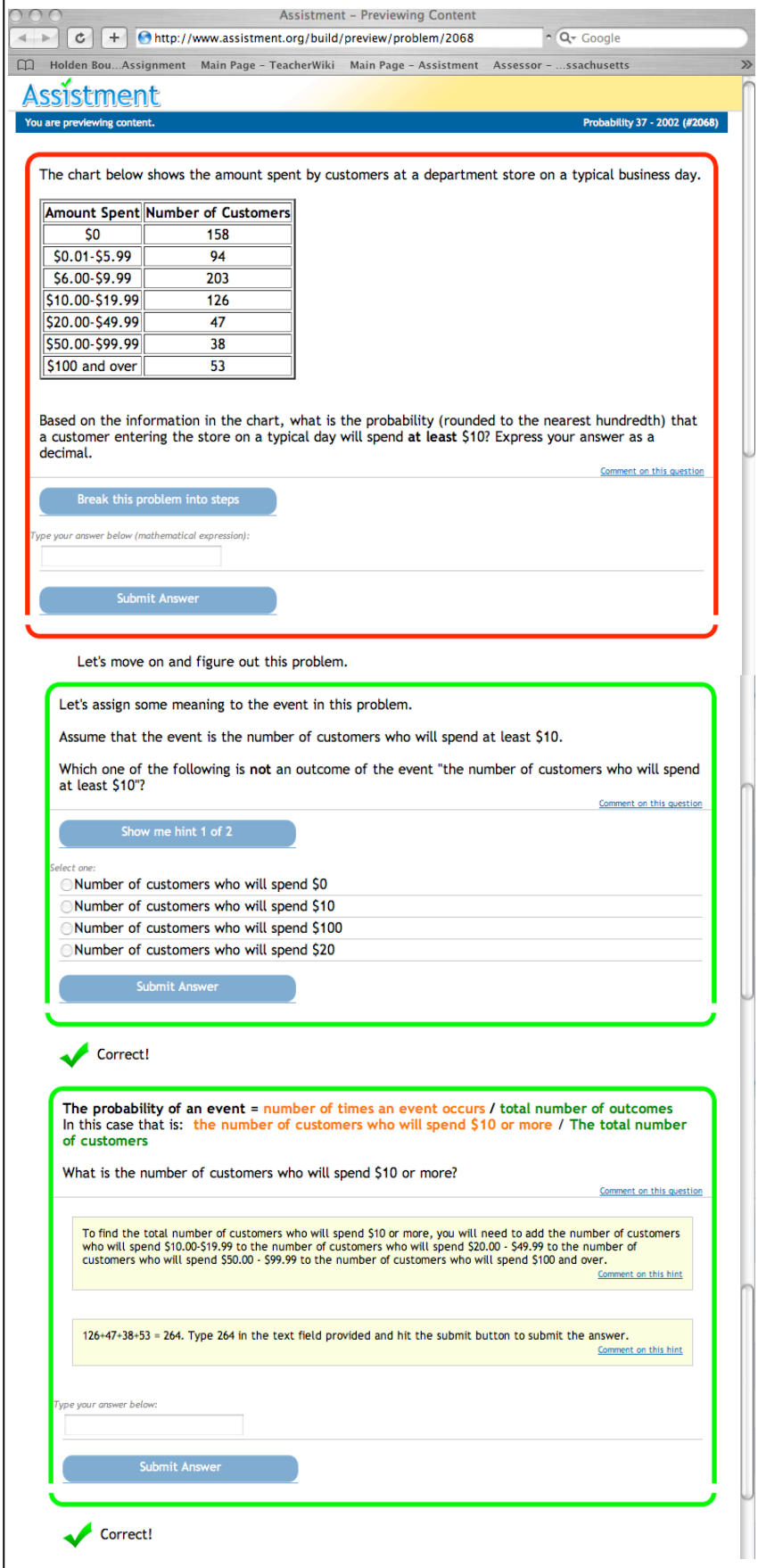
Imagine being able to walk into school in the morning before students arrive and look at a spreadsheet on your computer that shows how well your students did on their homework the night before. Before any student walks through the door you know exactly which homework problems kids understood and what problems were the most difficult as well as their commonly wrong answers. Immediately you know what material to cover in class to clear up students' misconceptions. This is just one possible use of a new computer website called ASSISTment. In this article we will describe four ways one teacher, Ms Christine O'Connor, an 8th grade teacher, is using ASSISTment to enhance her teaching.

ASSISTment is an Internet based tool that was developed at Worcester Polytechnic Institute in Worcester Massachusetts and Carnegie Mellon University in Pittsburgh Pennsylvania, in conjunction with local schools. The program allows teachers to assign over 1,400 problems with tutoring and build their own problems with or without tutoring. The 1400 pre-made problems include released problems from local state exams in 6th, 8th and 10th grade and quizzes that are tied directly with the Connected Mathematics 2 Curriculum (CMP2) used by many local schools (Lappan et al. 2006). Over 4,000 students use ASSISTment each year, mostly in local schools but since this is an Internet based tool there are users as far away as New Mexico. Due to research funding from the federal government teacher accounts are free for cooperating schools.

The name ASSISTment comes from its dual purpose. First, it ASSESSES by immediately logging answers, right or wrong, into a database and creating reports for teachers. Second, it ASSISTS students by telling them immediately if they got the problem right or wrong. If the answer is wrong they are given hints and scaffolding questions to help them work out the problem (Figure 1). The description in this article of how ASSISTment is used in a class will show how teaching is improved by allowing teachers to spend their time analyzing data instead of grading and compiling it. Also, when a student is being assessed they do not have to wait until someone grades their work to know how they are doing or to get help. An added benefit of having the computer grade the work and log results in a database is the ability to share these results instantly with the whole class.


Assistment – Previewing Content
http://www.assistment.org/build/preview/problem/2068
Google
Holden Bou...Assignment
Main Page – TeacherWiki
Main Page – Assistment
Assessor – ...ssachusetts
Assistment
You are previewing content.
Probability 37 - 2002 (#2068)
The chart below shows the amount spent by customers at a department store on a typical business day.
Amount Spent | Number of Customers
$0 | 158
$0.01-$5.99 | 94
$6.00-$9.99 | 203
$10.00-$19.99 | 126
$20.00-$49.99 | 47
$50.00-$99.99 | 38
$100 and over | 53
Based on the information in the chart, what is the probability (rounded to the nearest hundredth) that a customer entering the store on a typical day will spend at least $10? Express your answer as a decimal.
Comment on this question
Break this problem into steps
Type your answer below (mathematical expression):
Submit Answer
Let's move on and figure out this problem.
Let's assign some meaning to the event in this problem.
Assume that the event is the number of customers who will spend at least $10.
Which one of the following is not an outcome of the event "the number of customers who will spend at least $10"?
Comment on this question
Show me hint 1 of 2
Select one:
Number of customers who will spend $0
Number of customers who will spend $10
Number of customers who will spend $100
Number of customers who will spend $20
Submit Answer
Correct!
The probability of an event = number of times an event occurs / total number of outcomes
In this case that is: the number of customers who will spend $10 or more / The total number of customers
What is the number of customers who will spend $10 or more?
Comment on this question
To find the total number of customers who will spend $10 or more, you will need to add the number of customers who will spend $10.00-$19.99 to the number of customers who will spend $20.00 - $49.99 to the number of customers who will spend $50.00 - $99.99 to the number of customers who will spend $100 and over.
Comment on this hint
126+47+38+53 = 264. Type 264 in the text field provided and hit the submit button to submit the answer.
Comment on this hint
Type your answer below:
Submit Answer
Correct!

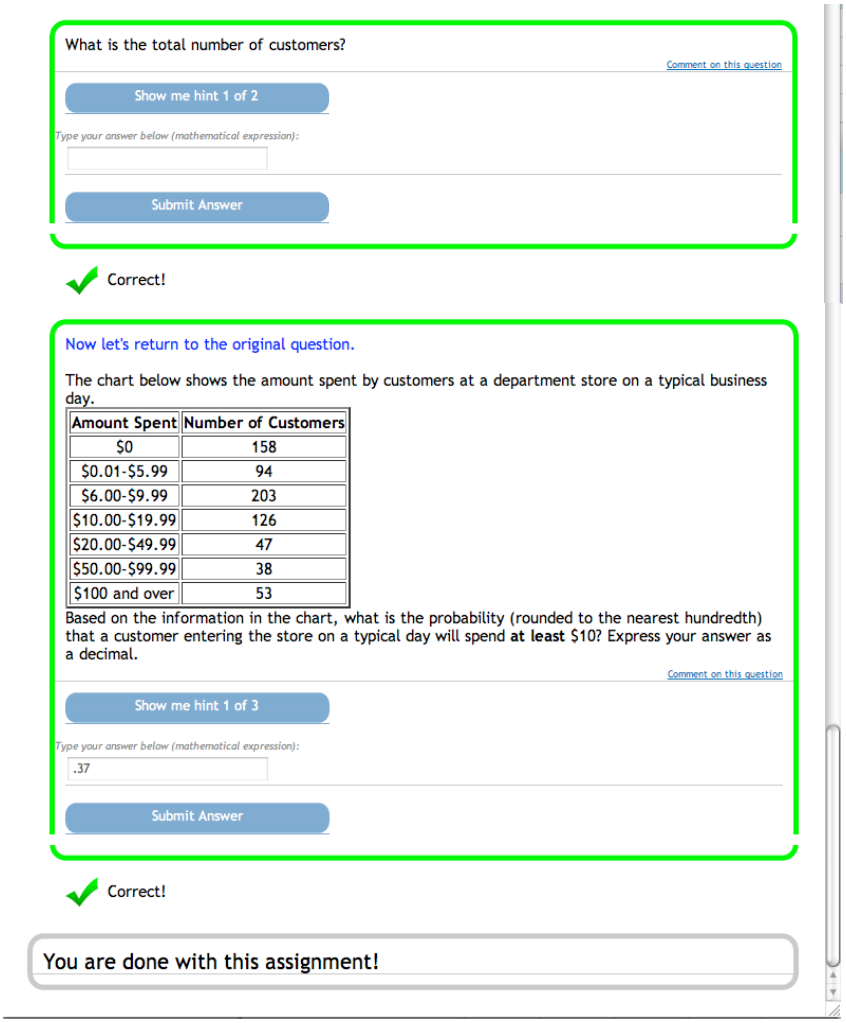


Figure 1. This is an ASSISTment problem including the tutoring questions. Hints are available for all questions, but are only shown in the second question. The original question is number 37 from the 2002 Massachusetts Comprehensive Assessment System (MCAS) (Massachusetts Department of Education, 2002)

Ms O'Connor works in a school district that encourages teachers to utilize technology and parents set a high standard for the school's use of technology. ASSISTment helps Ms O'Connor take advantage of much of this technology. She uses the computer lab along with a LCD projector and electronic smart board in the school media center. Her team of teachers also shares a bank of 11 laptops as well as a LCD projector, so she has access to technology in her classroom. Ninety percent of her students have reliable access to a computer with the Internet at home; the other 10% are able to do the online portion of the homework in the morning when they get to school.

ASSISTment is a tool which has many uses in the classroom. The four main ways Ms O'Connor uses ASSISTment will be described here. They are online homework, public display of student work, formative assessment, and the instant response system.

Online homework

ASSISTment allows teachers the ability to create customized problem sets for nightly homework assignments. Figure 2 is an example of an assignment that was sent home for students to complete in their notebooks and enter in ASSISTment. This is an assignment from the unit Looking for Pythagoras of the curriculum Connected Mathematics Project (Lappan et al. 2006). All the student sees on the computer is the page and number of the problem they are supposed to solve. They use their book to find the problem, solve it in their notebook and then input the answer into ASSISTment online. This is an example of how computer technology enhances a typical classroom routine. ASSISTment grades each response right or wrong and informs the student right away. Students are encouraged to go back and revisit their work if the problem is wrong. Ms O'Connor also leaves a message for the students reminding them that they can go to the online class discussion board to ask for help from fellow students. This connection between the class discussion board and the online homework works well since both depend on using a computer connected to the Internet.

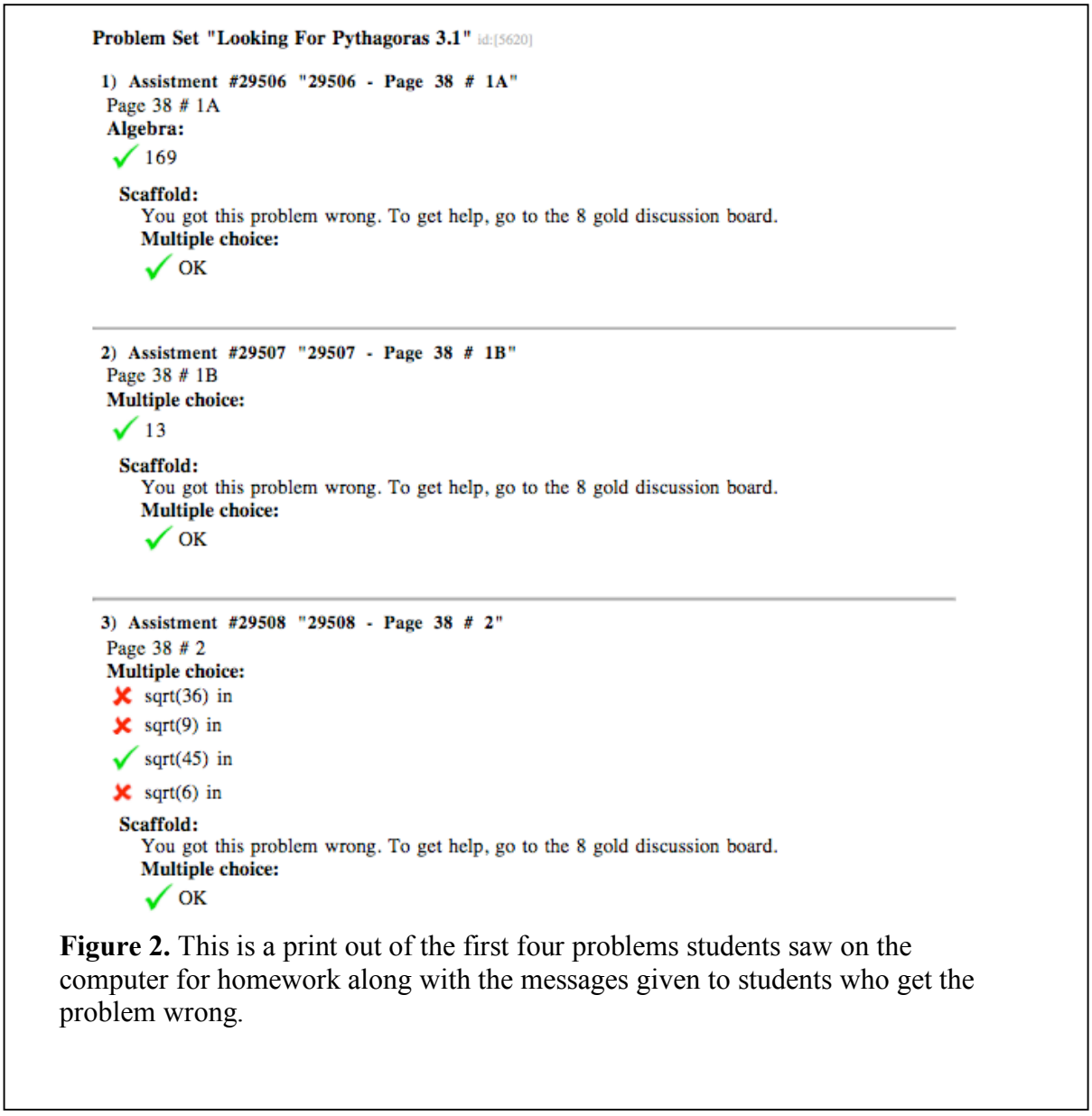
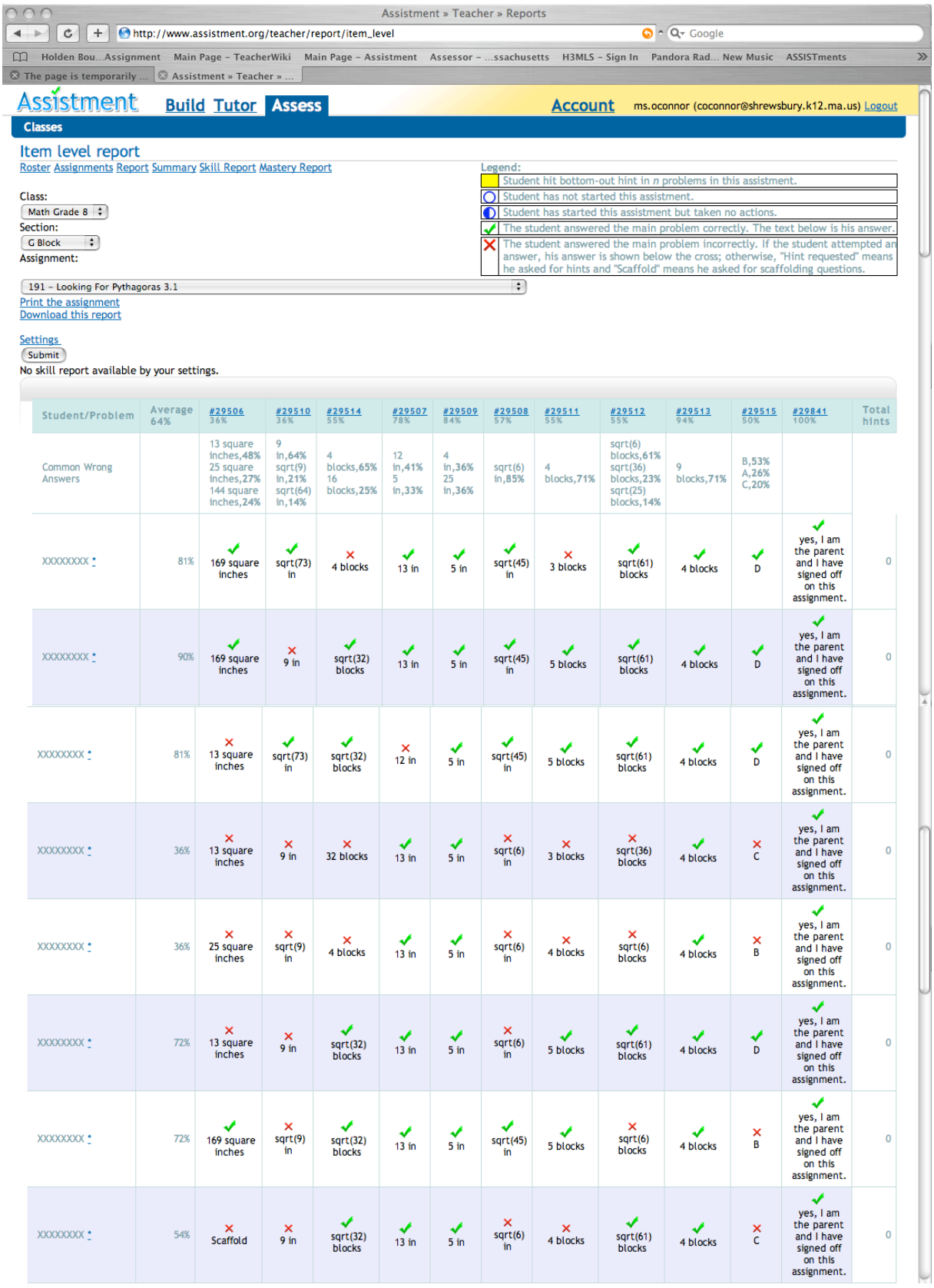


Figure 2. This is a print out of the first four problems students saw on the computer for homework along with the messages given to students who get the problem wrong.

The data is logged into the ASSISTment database and immediately shows up on the reports in the teacher's account. Figure 3 shows the report that goes with investigation 3.1 of the Looking for Pythagoras unit. As every problem in the system is given a number when it is created, students and teachers get used to logging these numbers so they can reference them in the system. Notice for problem #29506 only 36% of the students got a correct answer. The item report showed that 48% of the wrong answers were "13 square inches." Figure 4 shows the item from the book referred to in item #29506. In response to the data Ms O'Connor did a 10-minute activity the next day in class targeting the skill of drawing a square on a grid and finding its area. Then she had the students fill out an exit card asking them to use dot paper to find the hypotenuse of a triangle by first finding the area of the square. Figure 5 shows the work of a student who did not get item #29506 correct for homework.

The most powerful part of using ASSISTment to log homework answers is the ability for the classroom teacher to know well before class time who did homework, how well it was done, and which problems need to be reviewed. Using the technology of ASSISTment made homework a much stronger learning experience for the students.



Student/Problem	Average 64%	#29506 36%	#29510 36%	#29514 55%	#29507 78%	#29509 84%	#29508 57%	#29511 55%	#29512 55%	#29513 94%	#29515 50%	#29841 100%	Total hints
Common Wrong Answers		13 square inches,48% 25 square inches,27% 144 square inches,24%	9 in,64% sqrt(9) in,21% sqrt(64) in,14%	4 blocks,65% 16 blocks,25%	12 in,41% 5 in,33%	4 in,36% 25 in,36%	sqrt(6) in,85%	4 blocks,71%	sqrt(6) blocks,61% sqrt(36) blocks,23% sqrt(25) blocks,14%	9 blocks,71%	B,53% A,26% C,20%		
XXXXXXXX *	81%	✓ 169 square inches	✓ sqrt(73) in	✗ 4 blocks	✓ 13 in	✓ 5 in	✓ sqrt(45) in	✗ 3 blocks	✓ sqrt(61) blocks	✓ 4 blocks	✓ D	✓ yes, I am the parent and I have signed off on this assignment.	0
XXXXXXXX *	90%	✓ 169 square inches	✗ 9 in	✓ sqrt(32) blocks	✓ 13 in	✓ 5 in	✓ sqrt(45) in	✓ 5 blocks	✓ sqrt(61) blocks	✓ 4 blocks	✓ D	✓ yes, I am the parent and I have signed off on this assignment.	0
XXXXXXXX *	81%	✗ 13 square inches	✓ sqrt(73) in	✓ sqrt(32) blocks	✗ 12 in	✓ 5 in	✓ sqrt(45) in	✓ 5 blocks	✓ sqrt(61) blocks	✓ 4 blocks	✓ D	✓ yes, I am the parent and I have signed off on this assignment.	0
XXXXXXXX *	36%	✗ 13 square inches	✗ 9 in	✗ 32 blocks	✓ 13 in	✓ 5 in	✗ sqrt(6) in	✗ 3 blocks	✗ sqrt(36) blocks	✓ 4 blocks	✗ C	✓ yes, I am the parent and I have signed off on this assignment.	0
XXXXXXXX *	36%	✗ 25 square inches	✗ sqrt(9) in	✗ 4 blocks	✓ 13 in	✓ 5 in	✗ sqrt(6) in	✗ 4 blocks	✗ sqrt(6) blocks	✓ 4 blocks	✗ B	✓ yes, I am the parent and I have signed off on this assignment.	0
XXXXXXXX *	72%	✗ 13 square inches	✗ 9 in	✓ sqrt(32) blocks	✓ 13 in	✓ 5 in	✗ sqrt(6) in	✓ 5 blocks	✓ sqrt(61) blocks	✓ 4 blocks	✓ D	✓ yes, I am the parent and I have signed off on this assignment.	0
XXXXXXXX *	72%	✓ 169 square inches	✗ sqrt(9) in	✓ sqrt(32) blocks	✓ 13 in	✓ 5 in	✓ sqrt(45) in	✓ 5 blocks	✗ sqrt(6) blocks	✓ 4 blocks	✗ B	✓ yes, I am the parent and I have signed off on this assignment.	0
XXXXXXXX *	54%	✗ Scaffold	✗ 9 in	✓ sqrt(32) blocks	✓ 13 in	✓ 5 in	✗ sqrt(6) in	✗ 4 blocks	✓ sqrt(61) blocks	✓ 4 blocks	✗ C	✓ yes, I am the parent and I have signed off on this assignment.	0

Figure 3. Item report the teacher used to study the results of the homework from Figure 2.

1. A right triangle has legs of length 5 inches and 12 inches.
   a. Find the area of a square drawn on the hypotenuse of the triangle.
   b. What is the length of the hypotenuse?

Figure 4. Problem from the Connected Mathematics Project Curriculum that is referenced in ASSISTment item #29506 (Lappan et. al, 2006, Looking for Pythagoras page 38).

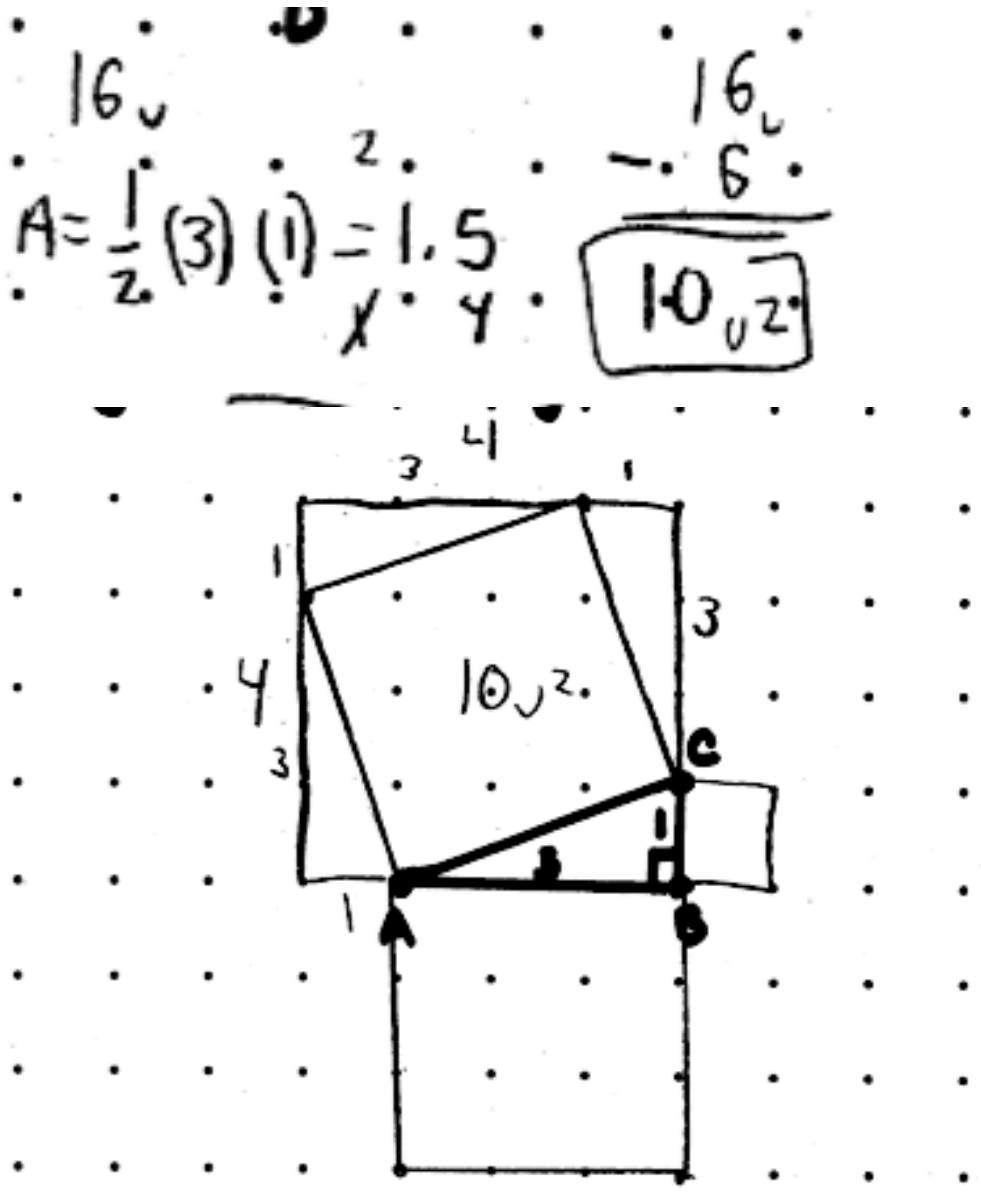
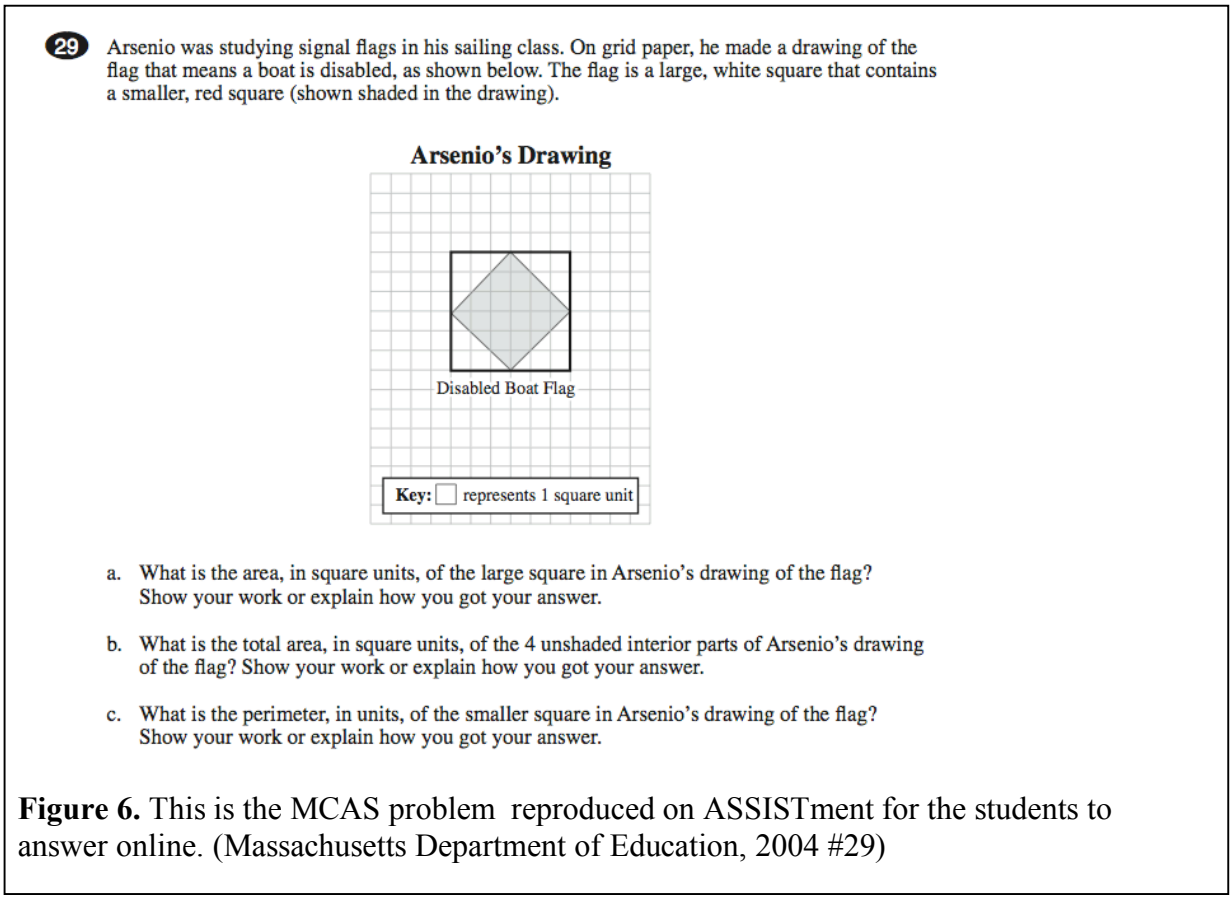


Figure 5. This is an image of one student's exit card demonstrating an understanding of how to draw a square off a diagonal line segment and how to find its area.

Making student work public

The technology embedded within ASSISTment allows teachers the opportunity to provide instant and interactive feedback on written student work. The state exam that Ms O'Connor's students take each year includes what are called open response questions. These questions ask students to explain their work as well as get an answer. Seeking new ways to involve her students in the grading process for open response questions, Ms O'Connor assigned one particular question, straight from the state exam, involving the concepts of area and perimeter (see Figure 6). Students were asked to complete a written copy and then to record their answers online at home via ASSISTment.



29 Arsenio was studying signal flags in his sailing class. On grid paper, he made a drawing of the flag that means a boat is disabled, as shown below. The flag is a large, white square that contains a smaller, red square (shown shaded in the drawing).

Arsenio's Drawing

a. What is the area, in square units, of the large square in Arsenio's drawing of the flag? Show your work or explain how you got your answer.

b. What is the total area, in square units, of the 4 unshaded interior parts of Arsenio's drawing of the flag? Show your work or explain how you got your answer.

c. What is the perimeter, in units, of the smaller square in Arsenio's drawing of the flag? Show your work or explain how you got your answer.

Figure 6. This is the MCAS problem reproduced on ASSISTment for the students to answer online. (Massachusetts Department of Education, 2004 #29)

When students returned to class the next day, Ms O'Connor had already looked at the results and made the decision to focus on the responses to part C. Only 15% of the students got that question correct where more than 80% were correct on parts A and B. Ms O'Connor projected a selection of five anonymous student responses on a smart board in the media center. Figure 7 shows two of these responses, one a correct answer of '17 units' and one the incorrect answer of '12 units'. Students then logged into ASSISTment and scored each response with a grade from 1 to 4 along with a comment. They used the student number to describe which response they were commenting on. Ms O'Connor provided instant peer feedback by projecting student comments reported in the ASSISTment report. Figure 8 shows some student responses, and you can see that not everyone agreed on the grade to give. This led to a productive class discussion on scoring rubrics and identified the different requirements to receive a grade of 4, 3, 2, or 1.

72131	the perimeter is 12 i got his by knowing how many side lengths there were then multiplying by 4 (3*4) =12
70315	The perimeter is 4 times the square route of 18. i found the area of the four triangles (18) then subtracted that by the total area (36). I got 18 as the area of the shaded square and each side is the square route of 18 and there are 4 sides so you multiply the square route of 18 by 4.

Figure7. Examples of two student responses to question C in the problem from Figure 6.

72866	72134 i think it is a 2 because there is somewhat of an explanation but the answer is wrong. they had math vocab and an equation
70292	72131 I would give this person a 2. Even though the answer is wrong it is well explained
70291	72131 This explanation should get around a 2, i think because they tired to explain what they did well but the answer wasn't correct
73522	72131-2, very plain response. No vocabulary used. Didn't thoroughly explain answer.
71989	72131- i would give this person a 1 because its like a sentence with no good explanation and no vocabulary
71992	72131) I would give this person a 1. this is because they had the wrong answer and they had no vocab and did not show correct work.
71983	72131- This should be a 1 also because there is not a good explanation and the answer is wrong.
71985	72131- i think this person deserved a 1 because it has little detail and it also has the wrong answer.
71982	70315. Well this is explained correctly except they did not simplify their answer. This would probably be a four even though it is not simplified. It is correct though.
71995	70315- 4. Very Well explained.
73668	70315 - 4 because they go into good detail and they use good vocabulary
71987	70315 This person would get a 3 because it has numbers with some explanation and has math vocabulary.
71978	70315 - I would give this person a 3.0 because they answered the question correctly and gave evidence on how they got their answer but they could have used more vocabulary words and they could have gone more beyond.

Figure 8. These are the student's grades from 1 – 4 on the student responses from Figure 7.

Instant response system

Principles and Standards for School Mathematics states in its process standards that students should communicate their mathematical understanding with their peers and teachers (NCTM, 2000). One problem with trying to do this in a large group setting is the discussion often involves just a handful of students, leaving out the rest of the class. One way to alleviate this problem is to use an electronic instant response system. Students input their answers into a device and their responses are projected onto a screen in the classroom for the teacher to assess instantly with the whole class. Ms O'Connor uses ASSISTment as an electronic instant response system. To do this, she loads a problem set with empty open

response boxes for the students to write in. Then in preparation she writes a list of questions ready to project in front of the class. As with most plans in teaching, the questions she actually asks are not always the ones planned. She was able to modify the question on the fly using her laptop. Figure 9 shows the list of questions she ended up asking in an introductory discussion to a unit on exponential growth. She wanted students to recall what they knew about linear equations so they could compare linear and exponential functions. A laptop was given to each group of four in her class. Students logged on and pulled up the assignment of empty questions. When the students finish their responses they click 'submit' and their writing showes up on the teacher report projected in front of the room. Figure 10 shows the response from one group to question number 6 and 7. Question 6 is "Describe a situation that's non linear. What is the dependent variable? What is independent variable? What is their relationship?" Question 7 is an example of an added direction she came up with on the spot in response to the students' work on question 6. This activity allowed students to use written and verbal communication to recall what they knew about linear and non linear equations and everyone was held accountable for participating in the discussion. Ms O'Connor went away with a written record of the students' understanding of linear relationships at the beginning of the unit on exponential growth.

1. How do you recognize the equation of a line?
2. How do you recognize the graph of a line using a table?
3. Can you think of an example of a situation that's linear?
4. Clarify your answer.
5. Tell me the slope, y intercept.
6. Describe a situation that's non-linear. What is the dependent variable? What is independent variable? What is their relationship?
7. Clarify you work.

Figure 9. Questions asked by the teacher and responded to by groups of students on the ASSISTment System.

Group number	**Student response to Question 6**: Describe a situation that's non-linear. What is the dependent variable? What is independent variable? What is their relationship?	**Student response to Question 7**: Clarify you work.
Group 1	Phillipee wants a Big-Mac everyday. On weekdays, it costs $2.50. On weekends, it costs $3.00. However, it costs $1.50 on Wednesday.	dependent variable would be the cost and the weekday would be the independent variable. The relationship is not linear between x and y
Group 2	Greg made $2 one day then $400 the next day do work	The independent variable is the time/days (x axis) the dependent variable is the money earned (y axis)
Group 3	every time zack talks he gets a penny. he talks a different amount each day amount of pennies is the dependent variable because he talks a different amount each day	the number of pennies is the independent variable(x axis) and how much he talks each day is the dependent variable(y axis) how many pennies he gets each day depends on how much he talks

Figure 10. Student responses to questions 6 and 7 from Figure 9

At her school, Ms O'Connor has access to two sets of 24 i-Respond Lite clicker devices, but they only report multiple choice and short numerical answers. She chooses to use ASSISTment instead as an electronic instant response system, because with ASSISTment she can include open response answers that allow her students to practice their communication skills

Formative assessment

Ms O'Connor uses the ASSIST portion of ASSISTment when she wants to quickly assess her students while allowing them to get help at the same time. One example of this use is reviewing for the state test given in May. She recognizes that some topics included in the test were covered in 6^{th} and 7^{th} grade and are not covered in her 8th grade curriculum. One such topic is probability. In order to assess how well her students remember probability and to give them needed practice, she assigns problems from previous years. Figure 1 shows an example of one problem from the probability review problem set assigned to students with tutoring.

At the end of class, Ms O'Connor was able to bring up the item report and start analyzing the data. She did not have to spend any time grading. She also knew that the students who needed help had received it from ASSISTment. She found that only 25% of her students got #2068 correct (see Figure 11) on their first try. She also knew that the answer '126', was the most common wrong answer. She knows students received help on the problems and she knows the deficit in knowledge does not lie in the problems that 90% to 100% of

students got right, but in the more complex two-step problems. These problems also include the side skills of reading a histogram, rounding and understanding vocabulary. Using her LCD projector she can quickly share this data with her students and get them thinking about what they need to review leading up to the state exam. The ability to assess students and analyze the data efficiently allows Ms O'Connor to spend her time preparing lessons and addressing the students' needs.

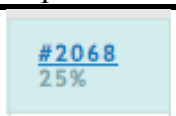
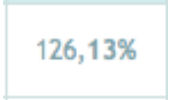
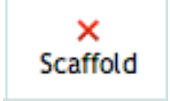
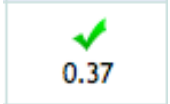
Description	Section of Item Report
ASSISTment number 2068 25% correct	
Common wrong answer: 13% of all wrong answers were the number 126.	
This student did not even try the problem, instead he or she just requested help and got scaffolding questions.	
This student did not even try the problem, instead he or she just requested help and got scaffolding questions.	
This student imputed the correct answer of 0.37.	
This student imputed the incorrect answer of 244/699. This was not a common wrong answer.	
This student imputed 518 which was the wrong answer. Then during 3 of the scaffolding questions he or looked at all the hints which includes the last hint that gives the answer to the scaffolding question.	

Figure 11. The top 5 rows of the item report for item 2068

Conclusion

In the year since Ms O'Connor started using ASSISTment regularly, her general techniques of teaching have not changed. Homework is given, class discussions are held, and assessments are graded. What has changed, however, is the manner in which Ms O'Connor accomplishes tasks. Using ASSISTment Ms O'Connor collects and organizes data on homework quickly and early, allowing her to make plans before students enter the classroom. She shares student responses expeditiously and written explanations anonymously to provoke discussion about what is quality work and what is not. She polls students quickly on any question she wants during a discussion and shares with the class the results of this questioning. Finally, students get immediate assistance as she assesses them. ASSISTment has enabled Ms O'Connor to inform and improve her instruction and the expected learning outcomes of her students in an efficient, productive manner.

Reference:

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