A Problem Solving Process that Scales

Unit 1. Your Virtual World

Revision Date: Jan 04, 2020
Duration: 1 50-minute session

Lesson Summary

Summary

Previous lessons in the "Your Virtual World" have investigated the impact of computer innovations on society. In this lesson, students will learn how using technology can enhance our abilities to solve larger and broader problems (problem solving). The lesson begins by examining reCAPTCHAs, which most students will be familiar with, but they may not realize how they solve two significant problems. It continues with solving problems at scale with distributed computing and crowdsourcing.

Learning Objectives

CSP Objective

- *EU IOC-1 - While computing innovations are typically designed to achieve a specific purpose, they may have unintended consequences.*
  - LO IOC-1.E - Explain how people participate in problem-solving processes at scale.

Math Common Core Practice:

- MP1: Make sense of problems and persevere in solving them.
- MP2: Reason abstractly and quantitatively.

Common Core ELA:

- RST 12.4 - Determine the meaning of symbols, key terms, and other domain-specific words and phrases
- WHST 12.1 - Write arguments on discipline specific content

NGSS Practices:

- 8. Obtaining, evaluation, and communicating information

Key Concepts

- Distributed computing solutions can be used to solve problems, collect data, assist with collaboration, and assist scientific research.
- Strategies for effective collaboration and the selection of the right online tools greatly enhance the ability to solve problems.
- A computer program or its results may be rapidly shared with a large number of users and can have widespread impact on individuals or groups.

Outcomes

- Students will learn how computers are used to aggregate the computational power of individuals to solve large-scale problems through citizen science activities.
- Students will participate in a citizen science project. Aggregate problem-solving is sometimes called "crowdsourcing."

Essential Questions

- How does computing enhance human communication, interaction, and cognition?

Teacher Resources

Student computer usage for this lesson is: **required**

For the Student

- Access to the website Zooniverse:
    - https://www.zooniverse.org/#/projects (https://www.zooniverse.org/#/projects)
- Access to the article Crowdsourcing, For the Birds
    - http://www.nytimes.com/2013/08/20/science/earth/crowdsourcing-for-the-birds.html?pagewanted=all&_r=0 (http://www.nytimes.com/2013/08/20/science/earth/crowdsourcing-for-the-birds.html?pagewanted=all&_r=0)
- Access to the website Akinator.com or 20Q
    - http://en.akinator.com/ (http://en.akinator.com/)
    - http://www.20q.net/ (http://www.20q.net/)

For the Teacher

- Access the video Fight Spam and Save Shakespeare to show to the class
    - https://www.youtube.com/watch?v=VoybhowC4LE (https://www.youtube.com/watch?v=VoybhowC4LE)

- Additional Videos about Crowdsourcing:
    - https://www.youtube.com/watch?v=Buyub6vIG3Q (https://www.youtube.com/watch?v=Buyub6vIG3Q)
    - https://www.youtube.com/watch?v=-38uPkyH9vI (https://www.youtube.com/watch?v=-38uPkyH9vI)
- Crowdsourcing websites:
    - http://dailycrowdsource.com/training/crowdsourcing/what-is-crowdsourcing (http://dailycrowdsource.com/training/crowdsourcing/what-is-crowdsourcing)
    - http://education.nationalgeographic.com/education/idea/citizen-science-projects/ (http://education.nationalgeographic.com/education/idea/citizen-science-projects/)
    - https://www.zooniverse.org/ (https://www.zooniverse.org/)

Lesson Plan

Getting Started (5 min)

Think-Pair-Share: Solving problems with reCAPTCHA

1. Show an image of a reCAPTCHA (by visiting a website that employs this technology or from an image search).
2. Direct students to describe for their elbow partner when and where they have encountered this on the web and discuss why it is used. Discuss how quickly a program can be distributed online and make a difference to many people across the world.
3. As a class, view the video Fight Spam and Save Shakespeare and discuss:
    - What two problems are being solved with reCAPTCHA?
    - How has reCaptcha used the aggregate computing power of millions of people to solve problems in digitizing old books?
    - What other aggregate/crowdsourced solutions to problems come to mind?

Say: Today we are going to examine Crowdsourcing a strategy for enlisting the work of many people to identify problems, solve problems and share solutions via the internet. And we are going to examine how computing technology facilitates the collection and creation of this information.

Guided Activities (40 min)

Part 1 (10 min) - Tracking birds with citizen science

As a class, read the following from the paragraph from the NY Times article *Crowdsourcing, For the Birds.*

> Tens of thousands of birders are now what the lab calls "biological sensors," turning their sightings into digital data by reporting where, when and how many of which species they see. Mr. Martinka's sighting of a dozen herons is a tiny bit of information, but such bits, gathered in the millions, provide scientists with a very big picture: perhaps the first crowdsourced, real-time view of bird populations around the world.

Watch the video What is Crowdsourcing?. https://www.youtube.com/watch?v=Buyub6vIG3Q (https://www.youtube.com/watch?v=Buyub6vIG3Q) (2:50)

Point out distributed computing to solve big science problems:

Display some examples from a service like BOINC that lets you help cutting-edge science research using your computer. BOINC downloads scientific computing jobs to your computer and runs them invisibly in the background. It's easy and safe.

About 30 science projects use BOINC; examples include Einstein@Home (https://einsteinathome.org/), IBM World Community Grid (https://worldcommunitygrid.org/), and SETI@home (https://setiathome.berkeley.edu/). These projects investigate diseases, study global warming, discover pulsars, and do many other types of scientific research.

Part 2 (15 min) - Participate in citizen science

Citizen science is scientific research conducted at least in part by individuals from many different locations who contribute relevant data to research using their own computing devices. You don't need to be a scientist to contribute to citizen science.

- Direct students to the Zooniverse website: https://www.zooniverse.org/#/projects (https://www.zooniverse.org/#/projects)
- Allow students to choose and participate in a project
- Discuss how their participation could help scientists and how the internet could help the process scale to large projects.
- Identify components of citizen science.
    - A problem people can help solve.
    - A way for people to participate that leverages the internet
    - A way to turn the data into knowledge. Students brainstorm possible methods to turn collected data into information

Part 3 (15 min)

Turning data into information

Direct students to Akinator.com or 20Q and play an online game that aggregates human information. Teachers may have students do this independently or work together as a whole class.

- Discuss how the game acts intelligently.
- Discuss how computer intelligence can supplement human intelligence.
- Discuss how adding human input can make the game more intelligent.

The Power of Human / Computer collaboration

Direct students to Kickstarter.com. Students choose what they think is worthy of funding and respond to the following

- Describe the project they chose and why they think it should be funded
- Explain the value - in addition to money - the project developers cant get from the response to their Kickstarter campaign

Wrapup (5 min)

Watch Video: Crowdsourcing and Crowdfunding Explained (3:48)
https://www.youtube.com/watch?v=-38uPkyH9vI (https://www.youtube.com/watch?v=-38uPkyH9vI)

While students watch the video they take notes about crowdsourcing including:

- how people participate
- how the internet helps crowdsourcing scale

Homework:

Students describe how people participate in a problem-solving process that scales using examples from citizen science (or another example of problem-solving.

Additional Crowdsourcing Examples

Wikipedia

The purpose of this activity is for students to contribute their knowledge to the aggregated collection of knowledge known as "Wikipedia."

- Divide the class into pairs or small groups.
- Investigate how Wikipedia pages are modified and then identify a topic they would like to revise.

Waze

http://allthingsd.com/20130719/after-waze-what-else-can-mobile-crowdsourcing-do/ (http://allthingsd.com/20130719/after-waze-what-else-can-mobile-crowdsourcing-do/).

Sentiment Analysis

https://www.datacamp.com/community/tutorials/simplifying-sentiment-analysis-python (https://www.datacamp.com/community/tutorials/simplifying-sentiment-analysis-python)

Search Trends as Predictors

https://trends.google.com/trends/?geo=US (https://trends.google.com/trends/?geo=US)

Picture Stitching

"Picture Stitching" is the practice of blending hundreds of photos to create one huge detailed picture.

Stitched 365-gigapixel image of Mont Blanc created by stitching together 70,000 images http://www.in2white.com/# (http://www.in2white.com/) .

Geo-referenced 3D model of Zurich (https://geoawesomeness.com/geo-referenced-3d-model-zurich-city-created-crowdsourced-photogrammetry-lite/)

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Evidence of Learning

Formative Assessment

Can students imagine additional possible crowdsourcing or citizen science projects?

How does online collaboration improve problem solving abilities?

Summative Assessment

Sample assessment questions:

- Explain the dual purposes of a reCAPTCHA.
- Explain how people can add value to citizen science projects, using several examples.
- Explain how people can add value to an on-line guessing game.
- Create a possible flow chart or description of how data collected online can be used to help computers learn.