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Screen Time & Notifications

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Overview of Lesson

New updates to smartphones have allowed us access to increasingly more information, including user data. In this lesson, students will collect data on the hours of screen time on their smartphones and represent it visually, as well as describe the shape, center, and spread. Finally, students will add another variable of the number of notifications to determine if there is a correlation between the two quantities.

Type of Data

- Two quantitative variables
- Data generated or collected as a class

Learning Objectives

- ID.A.1: Represent data with a plot on the real number line (dot plots, histograms, and box plots).
- ID.A.3: Interpret differences in shape, center, and spread in the context of data sets, accounting for possible effects of extreme data points (outliers).
- ID.B.6: Represent data on two quantitative variables on a scatter plot and describe how the variables are related.
- ID.C.7: Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data.
- ID.C.8: Compute (using technology) and interpret the correlation coefficient of a linear fit.
- ID.C.9: Distinguish between correlation and causation.

Audience

- Grade 9-12 students, GAISE Level C students
- *Prerequisites:* Prior to this lesson, students should have experience with calculating averages and square roots, converting between minutes and hours, plotting points on a coordinate plane, and writing linear equations. Students should have experience collecting and organizing data in a readable format (i.e. a table) and displaying that data. Students should also have basic experience using statistical software for graphs and calculations, e.g. R or RStudio.

Time Required

100-150 minutes or two to three 50-minute class periods. If rushed for time, the regression line equation can be given rather than calculated, or discussions can be shortened, depending on teacher priorities.

Technology and Other Materials

- *Technology:* statistical software R or RStudio, Stapplets, or CODAP
- *Technology:* G-suite applications, e.g. Google Forms and Google Sheets

Lesson Plan

Introduction & Context

With the release of their iOS 12 in 2018, Apple introduced the Screen Time feature, which was meant to monitor screen time and allow parents to apply controls to their children's phones (Apple, Inc., 2021). It also happens to provide data about notifications, app usage, screen checks, and screen time. Students begin by recording data for daily usage measured in screen time over fourteen days and then represent their quantities visually in a box plot, histogram, or dot plot. Students then compile their numbers, generate the same charts using statistical software, and compare them to their individual charts. After calculating pertinent quantities, students will discuss the data's shape, center, and spread and interpret them in context. To introduce a second variable, the teacher will lead a discussion about what might affect screen time, leading to the notifications variable. Comparing the number of notifications to the amount of screen time with a scatter plot has students calculate the equation of the line of best fit and use software for the correlation coefficient. By the end of the lesson, students should be able to answer the question, "*Could app notifications have an effect on screen time?"* and justify their reasoning.

The Screen Time feature is used for iPhones, and the Android equivalent is called Digital Wellbeing, also found in the Settings app/menu. However, students must manually turn on the feature before the phone will record the data. So, devices must be checked at least two weeks prior to the start of the lesson for the students to have access to that data.

Day 1: Visual Representations of Data for One Variable

Opening (5-7 minutes): Open the class with a question to get students talking about screen time, such as "Is screen time beneficial or harmful?" Give students about one minute or two to think about it independently, then give them another two minutes to share with a partner. While students are discussing, walk through the room and note any interesting points. Have a few students from each side state their case and explain briefly. If no student mentions it, ask whether the amount of screen time is a factor. When the discussion is complete, tell students they will analyze their own screen time individually and as a class.

Work Session (40 minutes):

The teacher will	*The students will*
• Hand out the data collection sheet (see Attached Materials). • Tell students how to navigate to the Screen Time feature (if they don't already know).	• Navigate to the weekly view of the Screen Time feature on their phones and view two weeks previous. *If a student does not have access to the Screen Time feature for whatever reason, you can provide a sample set prepared in advance.
• Help students if necessary with recording values and dates. • Introduce the types of visual representations for one variable (dot plot, histogram, and box plot) and how to create them. Ask students what each graph can tell us about the data.	• Record daily screen time totals for the last two weeks (Sunday to Sunday) • Take notes on lesson
• Have students create a graph with their screen time data on the data collection sheet with rulers and pencils. (students can choose which graph to make) • Help students with their graphs and answer questions	• Create a graph with the screen time data on the data collection sheet with rulers and pencils. Justify why they chose the graph they did (Questions 2a-c) • Compare graphs with a classmate who used the same type of graph (Question 3)
• Share a link with students to share their data and compile it with their classmates. (I suggest creating a Google Form and posting the link or QR code)	• Submit their data to the class file from the charts
• When student responses are in one file, share the file with students to import into a statistical software program (RStudio, CODAP, etc.).	• Open the RStudio software on student devices. If students do not have devices, then project from the teacher's computer. • Import the dataset from class into the statistical program.
• Help students with creating the three graphs in RStudio. • Have students answer questions about the class graphs compared to their own. Share some samples that seem to match and some that have marked differences.	• Create a dot plot, histogram, and box plot in RStudio with the screen time dataset. • *Exit Ticket:* Answer questions about the class graphs compared to their own. (Questions 4-5)

Closing (5 minutes): As an exit ticket and formative assessment, have students respond to the questions at the end of their data collection sheet. Collect students' data collection sheets, check for errors in their graphs, and read the responses to the final questions. Respond and give feedback where needed before the next class and make a note of responses to highlight for the next day. Namely comments about shape, center, or spread.

Day 2: Interpretations of Data for One Variable

Opening (5 minutes): Return the data collections sheets to students and give them about five minutes to look over the feedback and make any necessary corrections to their graphs or conclusions.

Work Session (40 minutes):

The teacher will	*The students will*
• Show the selected responses from the previous day on the board. Ask the students to identify similarities and differences among the group.	• Describe similarities and differences among a group of graphs.
• Place students in groups of 2-3 and give them a set of histograms and dot plots to sort. Walk around and monitor progress. If students are having difficulty, have them take a closer look at the shape of the graphs.	• Sort graphs into smaller groups.
• When students have their groups set, ask a couple groups to share their categories and reasoning. Allow groups to adjust their categories if needed.	• Share categories if asked.

• Give each group a second set of box plots to add to their groups. Encourage them to compare common features of each type of graph.
  ○ Where would the middle be?
  ○ How wide is the IQR?
*If categories need to be adjusted at this point, guide students to think about the shape, center, and spread of the data.
	• Sort new graphs into the previous categories.

• With the whole class, introduce the concepts of shape, center, and spread using the graphs from the categories. • Instruct students on calculating the mean, median, and standard deviation.	• Take notes on lesson.
• Have students use their data on screen time to classify the shape, determine which measures of center and spread are needed, and calculate the corresponding values. • As time permits, have students trade data sets with each other and repeat the calculations.	• Use the data on screen time to classify the shape, determine which measures of center and spread are needed, and calculate the corresponding values.

Closing (5 minutes): On a notecard, have students answer the questions

- How might an outlier affect the center and spread of a data set?
- In our dataset of screen time hours, what could be a possible explanation for an outlier?

Collect cards as students leave and read responses. Set aside students for small group re-teaching if needed.

Day 3: Line of Best Fit for Data with Two Variables

Opening (5 minutes): Ask students what things might affect the amount of screen time, either increasing or decreasing? Record students responses as they answer. If no one mentions notifications, ask them *How do app developers get you to keep using their app after downloading it?* When they can connect the number of notifications to screen time, ask them if they think there's a relationship between screen time and the number of notifications. Write the question on the board: *Could app notifications have an effect on screen time?*

Work Session (40 minutes):

The teacher will	*The students will*
• Ask students what type of graph they might want to use if we suspect there is a relationship between two quantities? Guide answers until they say something about a coordinate plane or something similar.	• Answer questions about what type of graph to use.
• Project a table of x and y values with a linear relationship and ask students to tell you what the relationship is between x and y.	• Determine the relationship between x and y from the table on the board.
• Project a graph of the same x and y values and ask students to tell you what the relationship is between x and y.	• Determine the relationship between x and y from the graph on the board.
• Instruct students on scatter plots and how to create one.	• Take notes on the lesson.
• Have students go back to their Screen Time feature and look at the notifications data and add it to the data collection sheet.	• Navigate to the weekly view of the Screen Time notifications feature on their phones and view two weeks previous. *If a student does not have access to the Screen Time feature for whatever reason, you can provide a sample set prepared in advance.
• Assist students in recording data or locating the information as needed. • Have students create a scatter plot of their data	• Record daily notification totals for the same time frame as the previous record (Sunday to Sunday). (Question 6)
• Share a link with students to share their data and compile it with their classmates. (I suggest creating a Google Form and posting the link or QR code)	• Create a scatter plot with the data (Question 7) • Submit their data to the class file from the charts
• Demonstrate using a scatter plot to determine a line of best fit and writing its equation.	• Take notes on lesson
• Have students estimate a line of best fit for their scatterplots and write its equation.	• Estimate a line of best fit and write the equation. (Questions 8-10)
• Import the class data into a statistical program and generate a scatterplot, then project it on the board. • Use a statistical program to determine the linear regression equation and write it on the board.	
• Ask students who was the closest to the class equation and why there may be variation among the samples.	• Evaluate accuracy compared to class population. (Question 11)
• Use a statistical program to demonstrate how to	• Calculate the correlation coefficient for their

calculate the correlation coefficient, then have students do the same with their graphs.	samples.(Question 12)

Closing (5 minutes): Ask students the question from the beginning of class: *Could app notifications have an effect on screen time?* And use evidence to justify their answer. (Question 13) Collect responses from students and give feedback based on answers.

*Answers may vary, but students should understand that the higher the coefficient is, the stronger the correlation. But correlation is not causation.

Additional Materials

- Data collection handout
- Sorting cards

Reflections and Additional Recommendations

- Re-engagement: For students who are struggling, consider giving them templates for calculations or R code/functions.
- Extension: Students who are ready for more could use the +/- 1.5*IQR calculations to test potential outliers or construct a hypothesis test for whether their sample is representative of the population.
- Sample data sets can be constructed from teacher phone data or supplied from peers from another class.

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