TECHNOLOGY tips

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Using QR Codes in Classrooms

For years, many schools and districts have had strict policies banning the use of students' personal electronic devices in classrooms. However, some schools are beginning to embrace the educational value of handheld Web-enabled devices that students already bring to school each day. As teachers begin to explore the educational opportunities that smartphones and other devices offer, we need to remember that the utility of any tool is only as good as our understanding of how to use that tool. This article attempts to introduce two simple ways in which QR codes can be used successfully in the classroom.

Edited by Andrew Benzing

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Quick response (QR) codes (see **fig. 1**) were developed twenty years ago in Japan (Rikala and Kankaanranta 2012). These two-dimensional bar codes are recognizable by their square shape and black modular patterns on a white background. Their patterns hold up to 4296 alphanumeric characters of information, which may be in the form of URL addresses, business cards, or any other information (Law and So 2010). In the United States, QR codes can be commonly seen on everything from restaurant menus to museum exhibits, advertising flyers and brochures, and wearable T-shirts, most often leading customers to a Web address for more information.

Newer smartphones may come with a QR reader preinstalled, but for those that do not, several free QR reader apps can be downloaded and used in seconds. Because the only equipment necessary to operate a QR reader application is a built-in camera, iPads® and other tablets may also be used. These options may be helpful for teachers who cannot allow students to use cell phones in their classrooms or when a larger screen is appropriate for easier reading.

Fig. 1 This is the QR code to access *Mathematics Teacher* on the NCTM website.

HOW TO GENERATE QR CODES

Many websites offer free and easy-to-use ways to generate QR codes. The codes generated in this article used the site http://www.qrstuff.com/, which will provide a code for many different data types, including website URLs, YouTube™ videos, email, and Instagram®, to name a few. **Figure 2** shows a screen shot that demonstrates the use of the QRStuff® website to generate a code.

In step 1, users select a data type (see **fig. 2**, col. 1). Here **Website URL** has been selected. In step 2, the site asks for content, specifically the URL (see **fig. 2**, col. 2). To ensure accuracy, it is usually easier to open a new window or tab with the website and to copy and paste the address. As soon as the content is entered, the QR code at the right automatically updates. In step 3, the foreground color has as a default setting black but can be changed to any other color by clicking on the appropriate hue and brightness or by typing a hex color code into the box. A button below the code allows users to download a .png image file containing the code, but because the code is simply an image, some may find it easier to use a screen-clipping copy-and-paste function. Once the QR code is copied to the clipboard, it can be included in

worksheets, websites, or any presentation software.

Some codes used in the worksheets are also shortened. (The shorter the code, the more easily it is read by the mobile device). Although QRStuff.com offers a shortener, it may be easier or preferable to the user to use a separate link-shortener website, such as https://bitly.com/shorten/ (see **fig. 3**). **Figure 4** shows the difference between a code for the full URL (**fig. 4a**) and for the shortened code (**fig. 4b**).

USE QR CODES TO FIND REAL-WORLD INFORMATION

Web quests, in which learners actively use the Internet to look up information for short- or long-term classroom projects, quickly became popular after being developed in 1998 (Halat 2010). The following activity combines the use of QR codes with the idea of the Web quest. Students are expected to look up information related to the question that they are trying to answer but are also given a clear direction in a classroom that needs to make every minute count.

At the top of the worksheet shown in **figure 5** and available at **www.nctm.org/mt**, a contextual question is presented: Can Bill race against a car over a short distance and win? Instead of presenting all the numerical information in the text, students are expected to make decisions and look up information as they would in a Web quest. However, allowing students to roam the entire Internet often leads to off-task behavior and frustration. Students use the QR codes and leading questions on the worksheet to look up the necessary information to complete the task. Doing so keeps them focused on the problem at hand but does not take away from the need for them to read through and choose relevant information.

The worksheet in **figure 5** was made by pasting the QR images next to the appropriate questions. Focus and organization are important when creating documents that include multiple QR codes; be sure that each code is pasted by its intended question. Students can become frustrated and disengaged quickly if the codes are wrong.

Allowing students to work in pairs

Fig. 2 Three steps help users on the QRStuff website generate a code.

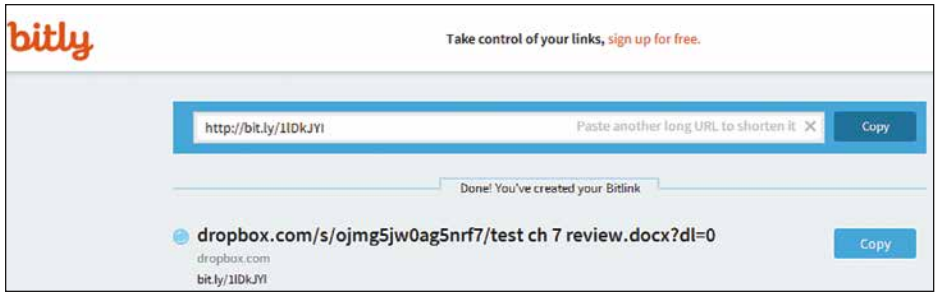

Fig. 3 This screen shot shows how to use the bitly URL shortener website.

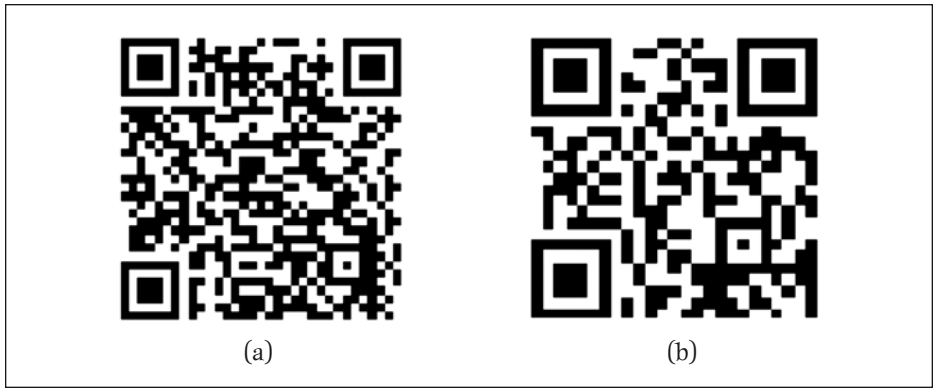

Fig. 4 The code on the left gives the full URL for a Dropbox file; the code on the right gives a shortened code for the same file.

or groups of three is generally advantageous, especially if this is their first time using QR codes in the classroom or if some students in the class do not have a device to read the codes. However, after the teacher has given a brief overview, students generally need very little help in using the code reader, even the first time. On most phones, they align the code in the area depicted on the screen (see **fig. 6**) and click. The website will automatically load, and students begin reading to find the answer to the question.

As with any relevant technology, the use of QR codes to look up information in combination with a good task can help students to stay engaged with the task. Using QR readers is easy, allowing students to focus completely on the task or activity presented without undue effort to manage the technology. Students also appreciate looking up actual times on a website rather than

Name(s)_____ Date_____

Telephone Pole Race

Bill says he can run a race against a car and win! The race will be from one standard spaced telephone pole to the next. Use the QR codes below to find information you can use to determine who will win.

1. This code gives how far apart telephone poles are generally spaced.

How many feet apart are the telephone poles spaced?_____

2. This code gives how fast different cars accelerate. Pick a car and tell how fast it goes from 0 to 60._____

What is its acceleration, in feet per second squared?_____

3. Use either of these codes to get information about the speed of sprinters. How fast does your sprinter finish the 100m dash?_____

How many feet per second does your sprinter travel?

_____

4. This code gives a website where you can perform unit conversions.

Fig. 5 The worksheet provides QR codes and guiding questions to support the task. (For a full-size version of this worksheet, see the online component to this article.)

Fig. 6 A student uses the QR reader for the Telephone Pole Race.

teacher-generated data, and respond as active consumers of information instead of passive recipients (Gradel and Edson 2012). This access to the source of information eliminates some doubt that students generally express at a "real-life" problem presented in class. It also presents the opportunity to discuss practical significance of the original problem and the assumptions that are made, as encouraged by the National Council of Teachers of Mathematics (NCTM) in *Principles and Standards for School Mathematics* (2000) and other standards.

USE QR CODES TO OPEN SPECIFIC FILES

With the concept of the flipped classroom increasing in popularity (e.g., Gradel and Edson 2012), the Standard for Mathematical Practice of using "appropriate tools strategically" (SMP 7, CCSSI 2010, p. 7) may easily be expanded to include tools for research and learning as well as implementing mathematics. QR codes help teachers more efficiently give students access to materials, including videos, applets, and documents that they may need for a class.

Alternatively, after a whole-class lesson or unit, students can be held accountable to review and practice independently. The worksheet shown in **figure 7** is a study guide for an upcoming test. The nature of the questions is different from the previous example, but the worksheet was made in the same way—by generating a QR code for a URL and then pasting the code into the document. To access this document, scan the link in **figure 4** or use http://bit.ly/1lDkJYI.

The three codes at the top of the page each link to a YouTube™ video that students may view for extra help concerning a topic on the worksheet. In the image (see **fig. 7**), the student is viewing the first video while working on a related problem. Because this worksheet is a study guide for an upcoming test, a QR code has been placed at the end of the second page to link to the answer key so that students may check their answers. Because QR codes can hold a large amount of alphanumeric data,

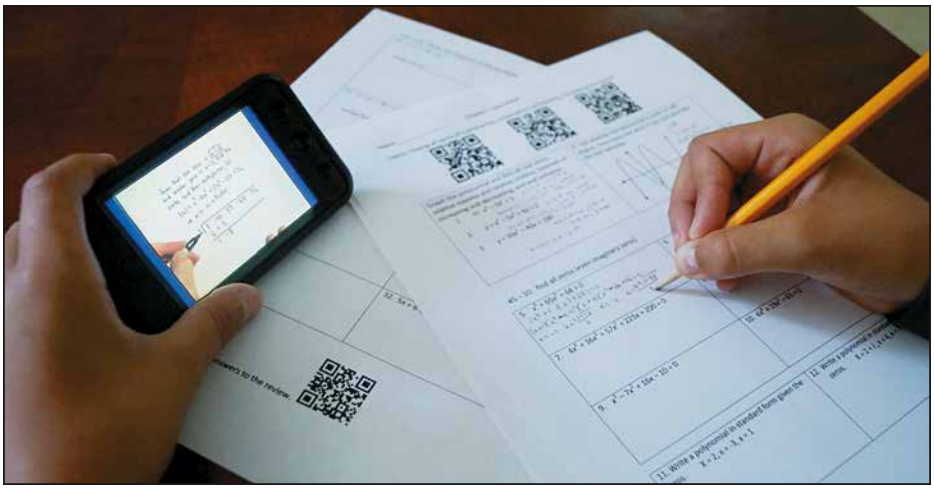

Fig. 7 A student uses the QR code link to a YouTube video for extra help.

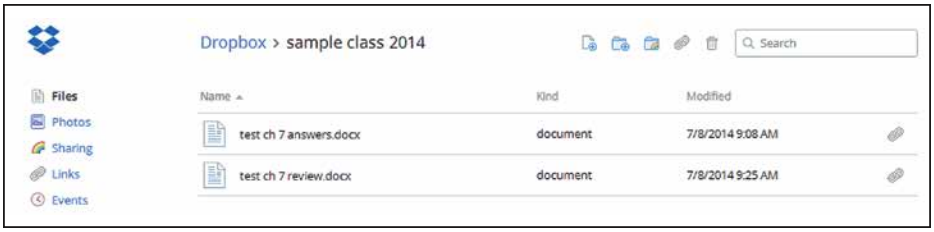

Fig. 8 Dropbox file links appearing as icons may be used to create QR codes that lead directly to documents.

teachers may find it advantageous to explore a variety of options for their use, such as linking to a file that is stored in a cloud space such as Dropbox®, Google Drive™, or Edmodo®; linking to a class website; or storing the answers directly in the code.

From the class Dropbox folder (see **fig. 8**), a teacher can click on the link icon at the right of each file to generate a URL, which then can be either shortened or used in its entirety to create a QR code. This process is an easy, fast, and accessible way for teachers to distribute documents and files to all students in a class using cell phones or even iPads® without emailing or managing a sharing system.

AN ENHANCEMENT TO LEARNING

With practice and some creativity, teachers may find the possibilities for using QR codes in the classroom as endless as the ways in which the Internet may be used. As with many technologies, QR codes provide an enhancement of other useful resources. In an efficient and flexible way, they allow students to view information independently or collaboratively.

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more4U

A full-size version of the worksheet shown in figure 5 can be found with this article online at **www.nctm.org/mt**. More4U content is a benefit for NCTM members only.