MOBILE APPS IN THE MATH CLASSROOM FOR INCREASING INTERACTION

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Introduction

Instant feedback on the level of understanding of students can be made in real time using mobile apps. In this paper, we will illustrate the use of commonly available tools which can turn one-way lectures into two-sided participation without interrupting the flow of the presentation of material.

The following apps that will be covered in this paper:

- **Google Forms and Sheets**: available for free to everyone; use generic form to record answers
- **Remind Messaging App**: text message students for free; not required to collect phone number
- **Padlet** : online collaborative bulletin board
- **Desmos**: mobile graphing app

Google Forms and Sheets

Students using their smartphones in class can be a distraction primarily because they are not using it for anything related to the course. A simple way to remedy this is to have them use their phone to respond to questions. Using a generic Google form, students are asked a question, and they respond through their phones. The instructor can see their responses in real time in the related spreadsheet and clear up any misunderstanding about a problem. This approach also helps students who are otherwise shy about participating in class. Figure 1 shows a simple, generic Google form that accepts responses to questions in the classroom.

Figure 2 shows a screenshot of the question and a summary of responses to a question about $\frac{f}{g}\ (x)$ and its domain. The question text was written on the board as follows: Find $\frac{f}{g}$ and its domain if $f(x) = \sqrt{x+6}$ and $g(x) = x$?

One can see from the responses that many students have not quite grasped the meaning of domain of a function. At this point, the instructor can go over the wrong answers anonymously, since the students cannot see each other's responses. Students who typed in

the wrong answers are not penalized and come away with a better understanding, and hopefully, will not make the same mistake on an exam.

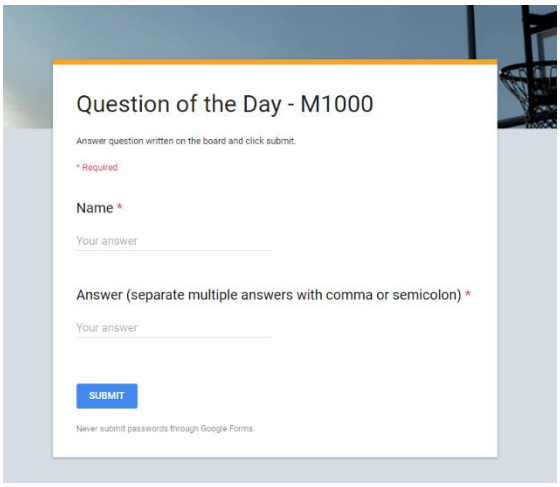


Figure 1 : Google Form Question of the Day

11:36:23	Sqrt(x)/x+2; [0,infinity)
11:36:28	Square root of x/ x+2
11:36:55	sqrt (x)/x+2, (-infin, 2) u (2, infin)
11:37:06	Sqrt (x)/ x+2 Domain: (-2,0)u(0,infinity)
11:37:09	Sqrt(x)÷x+2 domain (0,infinity)
11:37:17	1/squareroot of x (x+2) domain: (-infiniti,infiniti) U (0,-2) U (-infiniti,-2)
11:37:25	sqrt(x)/x+2 ; (-inf,0)U(0,Inf)
11:37:53	(-infnt, -2)U(-2,0)U(0,infnt)

Figure 2: Results in Google Sheets

Google forms can also be used with an interactive graphing activity, allowing students to answer questions relating to more conceptual aspects of mathematics. Such activities can be very useful in inquiry based learning, as discussed in [2].

Remind Messaging App

This is a free app through remind.com. The instructor sets up a class under their account, and students sign onto the class by texting the class code to a phone number. Instructors can thus easily text message students without any cell phone numbers being revealed.
It's an easy way to notify students of class delays, exam dates etc. It can also be used in class to share links to relevant web sites while the instructor is lecturing on the material.

Figure 3 shows a message with a link to poultry consumption data, which the students can access while the instructor poses questions relating to the data.

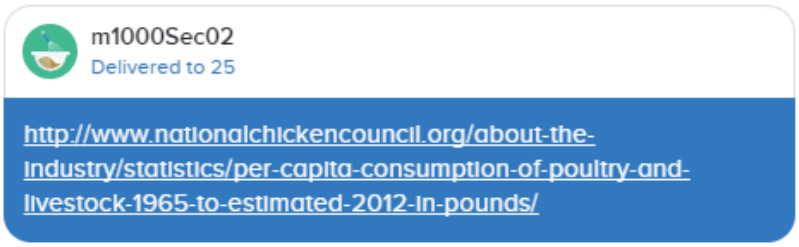


Figure 3: Link shared through the Remind App

The app is easy to manage and offers an excellent way to interact with students both in and out of class.

Padlet Collaborative Bulletin Board

Padlet is an app that allows both instructors and students to collaborate online. In addition to plain text, one can upload videos, links, images. In the example on this demo padlet, a link to data for poultry consumption is given along with data on food expenditure as a share of income. See Figures 4 and 5. One of the objectives is to get students to give their ideas on trends in the data and to relate the two pieces of information given. Using padlet can be a way of getting instructors to go beyond the textbook when discussing word problems.

Figure 4: Padlet Post with Link to Poultry Data

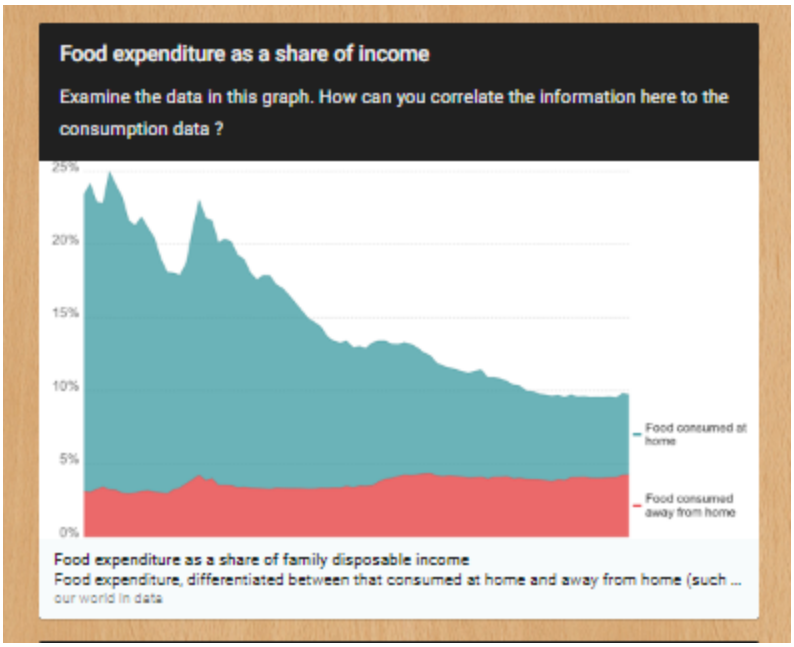
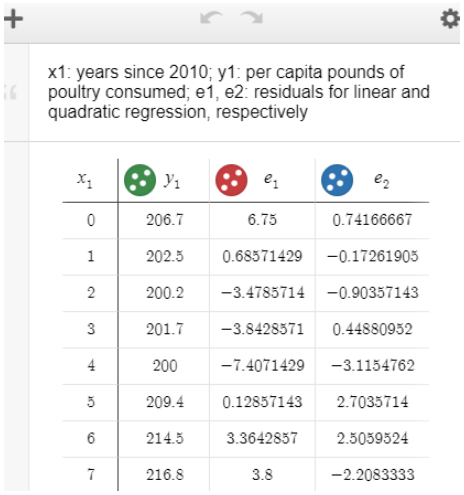


Figure 5: Padlet Post with Link to Income Data

Desmos Graphing App

The Desmos graphing app is a very versatile graphing tool that functions well on multiple platforms. Details of the functionality of the app is discussed in [1] and is also readily available through their website. Figures 6,7, and 8 illustrate the use of the app's ability to take the poultry consumption data, discussed previously, and plot the points as well as perform linear and quadratic regression. Integrating padlet with Desmos enhances the level of understanding as students can now explore different aspects of the problem and decide which type of regression fits the data the best.



x_1	y_1	e_1	e_2
0	206.7	6.75	0.74166667
1	202.5	0.68571429	−0.17261905
2	200.2	−3.4785714	−0.90357143
3	201.7	−3.8428571	0.44880952
4	200	−7.4071429	−3.1154762
5	209.4	0.12857143	2.7035714
6	214.5	3.3642857	2.5059524
7	216.8	3.8	−2.2083333

Figure 6: Poultry Consumption Data in Desmos

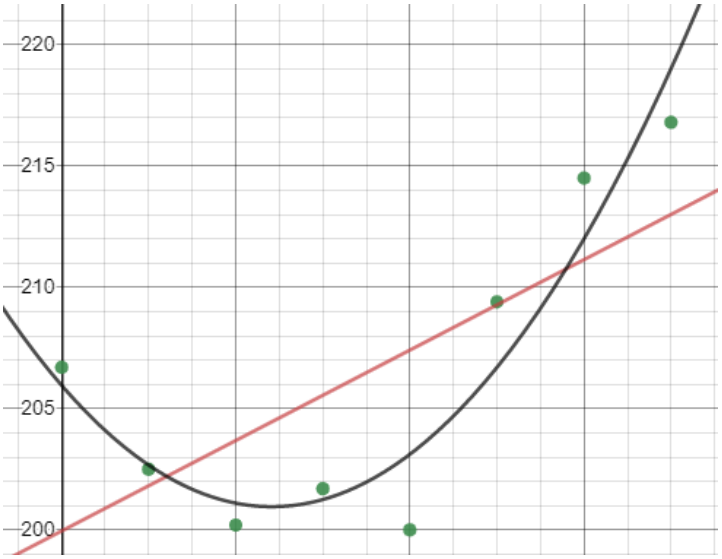


Figure 7: Desmos Plot of Data Points

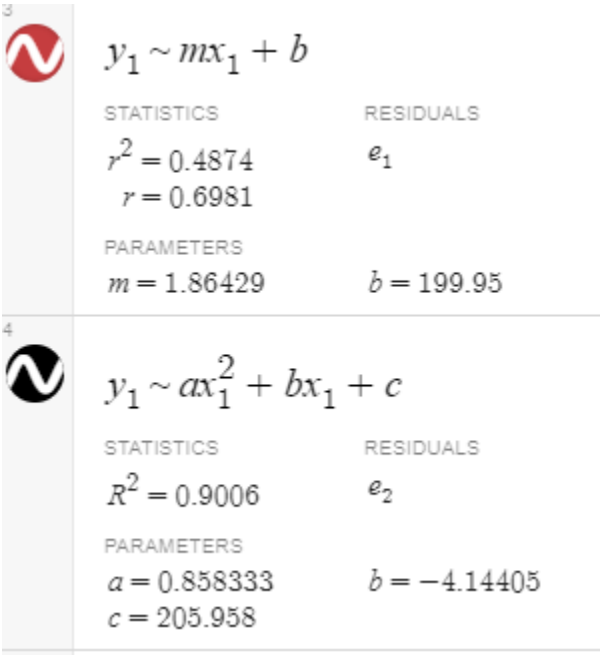


Figure 8: Linear and Quadratic Regression in Desmos

Conclusion

Using free mobile apps in a math classroom has enabled students to become engaged with the course material at a level not possible with just paper and pencil work. In addition, it

enables instructors to see right away what type of misconceptions students may have. Also, the setup of these apps require very little time on the part of both students and instructors.

Links to Apps

Google forms – http://forms.google.com
Remind app – http://www.remind.com
Padlet – http://www.padlet.com
Desmos – http://www.desmos.com

References

[1] Ebert, D. (2014). Graphing projects with Desmos. The Mathematics Teacher, 108(5), 388-391.

[2] Hagevik, R. & Cherner, T. (2016). Discipline Literacy in Science and Math Education: Utilizing Mobile Technologies and Educational Apps in an Inquiry-based Learning Environment. In *Proceedings of Society for Information Technology & Teacher Education International Conference* (pp. 2058-2064). Savannah, GA, United States: Association for the Advancement of Computing in Education (AACE). Retrieved May 30, 2019 from https://www.learntechlib.org/primary/p/171975/.