

1 Grade Nudge Software Overview

Despite the proliferation of learning management systems, it is common for students to ask the instructor their grade during the semester. If the students don't know their grade when deciding the level of effort to impart on an assignment, they may be choosing non-optimally.

We solve this problem with “Grade Nudge,¹” a Google App Script that runs within the user's (instructor's) Google Drive. This software requires a Gmail enabled Google account (a Google account is Gmail enabled if you can send e-mail from the account). Examples include all @gmail.com Google accounts or accounts provided by your educational institution where Google is your e-mail provider.

Grade Nudge sends a treatment message via e-mail to each student in your class. This treatment indicates not only the student's current grade, but the possible grade outcomes given various scores on an upcoming assignment. Smith et al. (2018) showed with a randomized trial that this message increased student homework performance by a half-letter grade. The message reads as follows:

Hi [Name],

As of now, you have a(n) [Grade] in the class. This assignment is worth [Points] points. If you get more than [X] on this assignment, your class grade will increase to a(n) [Higher Grade]. If you get less than [Y] on this assignment, your grade will drop at least one grade. Not doing this assignment will result in a(n) [Lower Grade].

Here, [Name] is the student's name, [Grade] is the student's current grade, [Points] is the number of points the assignment is worth, [X] is the minimum number of points necessary to move one grade higher, [Higher Grade] is a grade higher than the student's current grade and [Y] is the maximum points the student could receive and still drop a grade. [Lower Grade] is the updated grade of the student assuming they choose not to do the assignment.²³

¹A link to the free application in the Google Chrome Web Store is available at <https://bensresearch.com/nudge/>. Additionally, a direct link to the software is provided.

²‘This assignment’ can be replaced with a custom assignment name under the advanced settings (middle column).

³The treatment message is simplified when achieving a higher grade is impossible or when a zero on the assignment will not result in a lower grade. For instance, a student with the highest possible grade in the course will not see the third sentence of the treatment message. Similarly, if a zero on the assignment will not result in a grade reduction, the fourth and fifth sentence will be omitted from the treatment. This selective transparency is designed to induce students to work harder in the course without causing unintended

The software feature set is as follows:

1. Create and share documents within Google Drive for each student
2. Create custom grade messaging at the bottom of each assignment or by e-mail
3. E-Mail the students' grade outcomes

2 The Program

The instructor can launch the software from the grade nudge website (<https://bensresearch.com/nudge/>). The first time the program is run it will ask your permission to access your Google account. *Note that the Google account you use will determine the 'from' address your students see when they receive the nudge.* Once you grant the program permission, you will be forwarded to the program interface (Figure 1).

The interface is broken into five major sections: delivery, files, assignment value, messaging options, and e-mail. The nudge application can deliver the treatment to the students in four different ways: the instructor can send the nudge via e-mail without the assignment, share the assignment as a Google document, attach the assignment as a PDF or save the nudge to a column within the gradebook spreadsheet. If you are using nudge with a large class, please see Appendix B. Each of the aforementioned methods have different computational limits that may come into play when sending the nudge to a large number of students.

The most feature-rich delivery option is to share the Google document with the student. This option grants the student read/write access to a copy of the assignment while the instructor maintains ownership. Prior to the due date, the student can work on the assignment directly in the Drive environment. Because the instructor maintains ownership of the document, if the student asks for help, the instructor can comment directly in the document. Once the due date is reached, the instructor can grade the assignments directly within Drive. As shown by Figure 2, each student file is placed within a single folder to ease the organization of files for the instructor.

The attach PDF option is intended for classes using a physical turn-in procedure. With this setting, the student receives the assignment (and nudge), but cannot edit the assignment file directly. The e-mail only option, the most commonly used delivery option, helps facilitate

consequences for low value assignments.

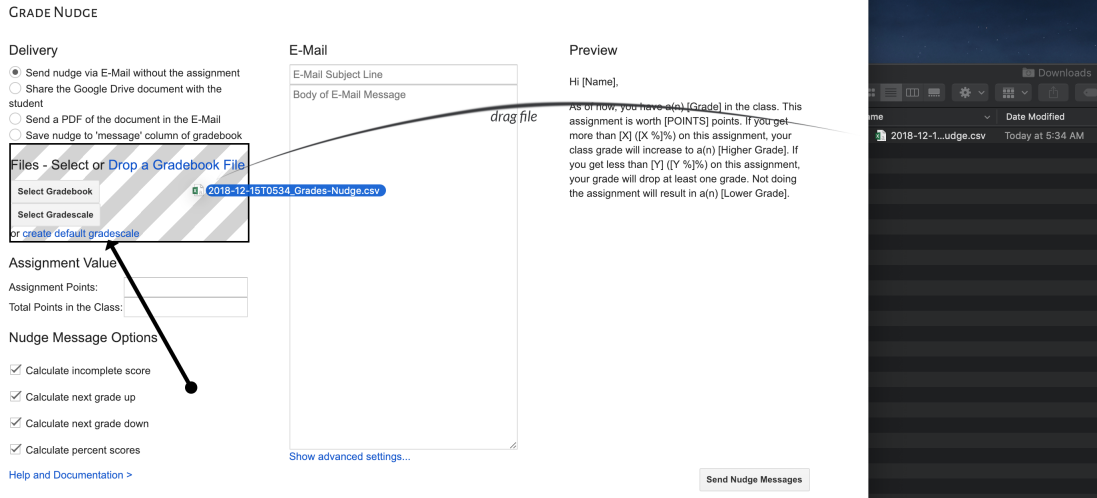


Figure 1: The ‘Nudge’ interface running within Google Chrome. An exported LMS (e.g. Canvas, Blackboard, Moodle) gradebook is dragged onto the files section of the software.

online homework systems, projects, or exams where the nudge cannot be sent as a part of the assignment.

Finally, saving the nudge to the gradebook allows the instructor to use some alternative means of delivering the nudge beyond what our program provides. For instance, some instructors might send the nudge as a text message (SMS) using a third party tool. Alternatively, a high school instructor might use this feature in combination with Microsoft Office’s mail merge to send physical reports to parents.

After selecting the delivery method, the instructor must provide gradebook information to the software. This information can be provided in two ways: upload the exported LMS gradebook or use a manually created gradebook saved in Google Drive.

If your institution uses Canvas, Blackboard, or Moodle, the user can simply drop the exported

My Drive > Sample Assignment ▾			Owner	Last modified ↓
Name				
Sample Assignment - Jill - [redacted]	[redacted]	me	10:34 pm	
Sample Assignment - Joe - [redacted]	[redacted]	me	10:34 pm	
Sample Assignment - Jane - [redacted]	[redacted]	me	10:34 pm	

Figure 2: Files created by the nudge software. Nudge creates a folder taking the name of the assignment and creates an individual file for each student.

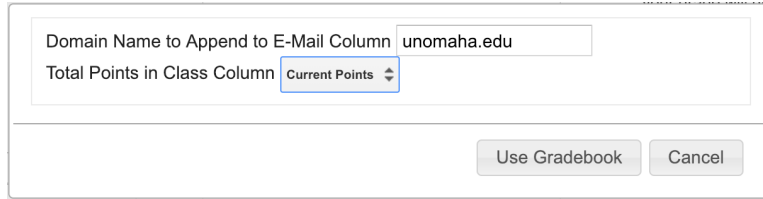


Figure 3: A dialogue window asking the user which column contains the total points in the class. In many gradebook files the full email address of each student is not provided. However, the email address can be created by combining the login or username field with a domain name. If this is the case, the software will ask for the domain name.

gradebook CSV onto the Grade Nudge interface (see Appendix A for information on how to use exported gradebook files from other systems). In Figure 1 an exported CSV gradebook file is dragged on to the files section of the Grade Nudge interface. This file is automatically interpreted by the software and the user is presented with dialogue box similar to Figure 3. The user can then select which column contains the total points for the class. If full email addresses are included in the file, the software will use this information (and not alert the user). However, in many gradebook files the full email address of each student is not provided. However, the email address can be created by combining the login or username field with a domain name. If this is the case, the software will ask for the domain name.

A default gradescale file can be created and selected by clicking the “create default gradescale” button (see where the black arrow is pointing in Figure 1). This is the standard gradescale used by most institutions. If you need to modify this gradescale, once the file is created, a link to the file will appear near the top of the interface. The LMS gradebook file reading and default gradescale features are demonstrated in a YouTube video available here: <https://www.youtube.com/watch?v=Z3Qfbj-Bo60>.

As an alternative to using the LMS gradebook file and creating the default gradescale file, the user can create these files manually (the details of these files are covered in Section 3 of this document). The user can select their manually created gradebook and gradescale files by clicking the appropriate buttons in the files section. If the user is using a delivery option other than e-mail or the message column, the user will also need to select a homework template (explained in Section 4).

Below the files section, the user must specify the value of the upcoming assignment and the total number of possible points in the class (not including the upcoming assignment). This is due to the fact that the gradebook does not contain either piece of information (it contains how many points each student has earned so far in the class, not how many points

Hi Joe,
 Here's your next assignment.
 As of now, you have a(n) C- in the class. This assignment is worth 30.00 points. If you get more than 24.90 on this assignment, your class grade will increase to a(n) C. If you get less than 21.00 on this assignment, your grade will drop at least one grade. Not doing the assignment will result in a(n) F.

(a)

Assignment 1

You own a small general store. Unfortunately, due to family obligations, you have to employ your idiot brother. His latest screw-up is that he spent a week calculating the demand for luxury chocolate and eggs, but he forgot to label the graph. Which is which? Why?

Hi Joe,
 As of now, you have a(n) C- in the class. This assignment is worth 30.00 points. If you get more than 24.90 on this assignment, your class grade will increase to a(n) C. If you get less than 21.00 on this assignment, your grade will drop at least one grade. Not doing the assignment will result in a(n) F.

(b)

Figure 4: In panel (a) we see an example e-mail containing both the message from the instructor and the nudge treatment. In panel (b) we see the assignment shared to the student.

were possible).

Finally, the instructor can modify both the e-mail sent to the student and the elements of the nudge. By default, the student is informed of both positive and negative grade outcomes. However, if the instructor chooses, the message can be adjusted to include only the desired components by selecting or deselecting the boxes in the lower left corner. The treatment message immediately follows the e-mail message optionally written by the instructor in the middle column.

Once the instructor has completed filling out the interface, clicking ‘Send Nudge Messages’ will deliver the treatment to the students. Figure 4 is an example of how the student might see the nudge message. First, like most delivery options, the student sees the nudge message as part of an e-mail message (Figure 4a). However, in this example, the instructor chose to share an assignment with resulted in the treatment being appended to the bottom of the assignment (Figure 4b). This increases the likelihood the treatment will be seen by the student.

3 The Spreadsheets

As an alternative to directly using the exported LMS gradebook, the user can manually create two files within their Google Drive: the gradebook and the gradescale. Figure 5 is an

example gradebook.

	A	B	C
1	name	email	points
2	Jane		100
3	Joe		70
4	Jill		80

Figure 5: Each student in the gradebook must have a name, email and the current number of points they have in the class.

Nudge looks for four columns: ‘name’, ‘email’, ‘points’, (optionally) ‘replacement’, and (optionally) ‘possible’.⁴The name is used to personalize the message to the student, the e-mail address is used to send the message and the points column is used to calculate the grade outcomes. Nudge will ignore any column it does not recognize. Therefore, the instructor can use their entire gradebook spreadsheet as long as it contains the required three columns.

The gradescale spreadsheet (Figure 6) indicates the minimum percentage necessary to achieve a particular grade. It contains two columns: grade and threshold. Both columns are required and any additional columns will be ignored.⁵

⁴The software looks for a column named ‘replacement’ for when the assignment in question could replace an existing score already in the gradebook. For instance, suppose you give three midterm exams and drop the lowest score. Currently, you are sending a grade nudge to your students for the third exam. In this case, the points column includes the performance of the students on the first two midterms; this exam will replace the lowest score if it is higher. In this scenario, to properly nudge the students, one should include a column named ‘replacement’ with the lowest midterm exam score for each student. Google Sheets includes a function (MIN) to easily find the lowest score amongst a set of columns (e.g. exams). If you drop more than one assignment, you can use the function SMALL.

The column ‘possible’ (or ‘possible points’) is used when the number of possible points (total points in the class) varies from student to student. This is rare in a university setting. However, in K-12, it is possible for a student to have entered the course mid-semester and thus be excused from a number of assignments. If a number is specified in the ‘possible points’ column, this value will override the value in the ‘total points in the class’ field for that one student. If a negative number is placed in the possible ‘possible points’ column, Grade Nudge will assume the student was excused from this number of points and calculate that students personalized total (e.g. Class X has 600 total points, but student Y missed an assignment worth 200 points. Entering “-200” in the possible points column for student Y would calculate the current total for student Y as: $-200+600=400$.). The advantage of specifying points in negative (relative) terms is the column need not be updated throughout the semester.

⁵A sample gradescale can be downloaded at <http://downloads.bensresearch.com/gradescale.csv>.

	A	B
1	Grade	threshold
2	A	0.93
3	A-	0.9
4	B+	0.87
5	B	0.83
6	B-	0.8
7	C+	0.77
8	C	0.73
9	C-	0.7
10	D+	0.67
11	D	0.63
12	D-	0.6
13	F	0

Figure 6: The gradescale spreadsheet contains two required columns: grade and threshold.

4 The Assignment

The assignment document is only required if the instructor delivers the assignment as a PDF or as a shared document (explained in more detail in Section 2).

Because the assignment document is simply a Google Drive document, it can contain nearly anything. See Figure 7 for an example.

References

Smith, B., White, D., Kuzyk, P., and Tierney, J. (2018). Improved grade outcomes with an e-mailed “grade nudge”. *The Journal of Economic Education*, 49(1):1–7.

Appendices

A Automatic Data Joining from Multiple Spreadsheets

Popular LMS systems, such as Canvas, Blackboard, and Moodle, automatically calculate and export a total points column taking into account the specific grading policies of the course. Moreover, the exported gradebooks from these systems contain student e-mail ad-

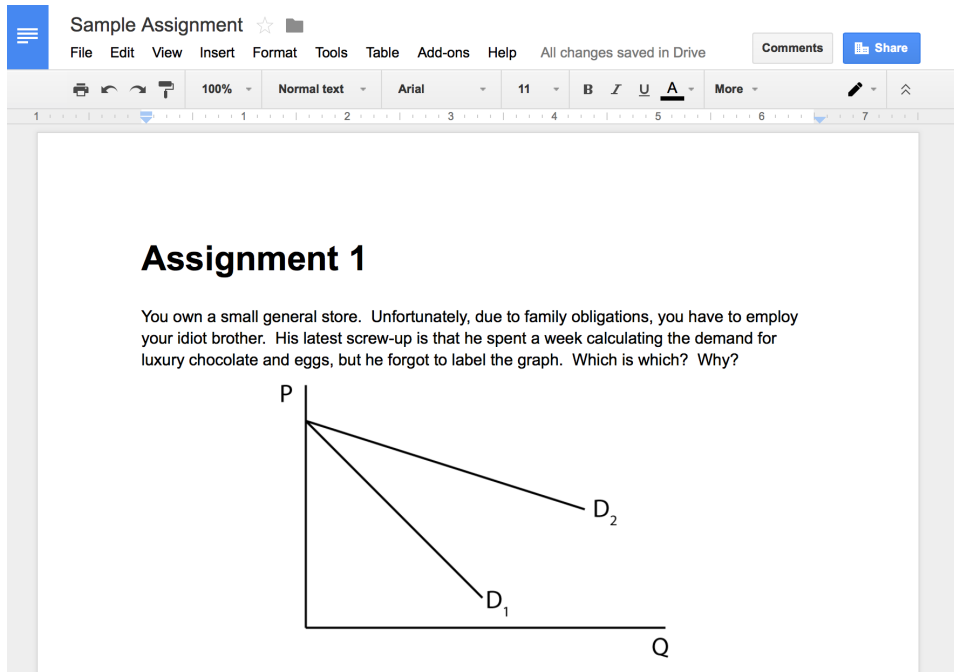


Figure 7: An example assignment file. The assignment file is a Google Drive document. The assignment file will be duplicated and customized for each student.

	Assignment One	Assignment Two	Assignment Three	Assignment Four
George Washington	7	8	7	6
John Adams	9	8	7	9
Benjamin Harrison	8	6	6	8

(a)

	E-Mail
George Washington	nudge3@unomaha.edu
John Adams	nudge1@unomaha.edu
Benjamin Harrison	nudge2@unomaha.edu

(b)

Figure 8: In panel (a) we see a gradebook lacking student e-mail addresses or a total points column. In panel (b) we see a separate exported file containing name and e-mail addresses.

dress information. While these systems dominate the LMS market, there are a number of other LMS systems that might be used at your institution – particularly in K-12.

Not all LMS systems export e-mail address information in the exported gradebook. Consider Figure 8. The gradebook contains the student names and assignments, but no email addresses (Figure 8a). However, name and email addresses can be exported as a separate file (Figure 8b). Grade Nudge can automatically join these data sets.

Instead of selecting a single file from the computer’s file system and dropping it onto the Grade Nudge interface, the user can select *both* the gradebook and email data file and drop both files (simultaneously) onto the Grade Nudge interface. Grade Nudge will use the names in both spreadsheets to join the data together. This feature requires that both spreadsheets have a full name column with a column labeled ‘name’, ‘student’, ‘student name’, or ‘full

name’. If the first column of the spreadsheet has a blank header (as is the case in Figure 8), this column will be treated as the name column.

If a specific gradebook file does not contain a total column, one can be generated by Grade Nudge. Figure 8a contains assignment points, but lacks a total points column. Given this gradebook, Grade Nudge would offer a column named ‘Total - Calculated by Grade Nudge (Caution)’, which is the sum of all columns for each row. This feature should be used with caution; if the gradebook file contains category sums or numbers that aren’t assignment totals (e.g. id numbers), the calculated total will be incorrect.

B Large Classes, Usage Limits and G Suite

Nudge is a Google Apps Script that runs using the initiating user account (your Google account) on Google’s infrastructure. The advantage of this approach is that the software is able to send e-mail as you, integrates deeply with Google Drive and is inexpensive for the developer to provide to the world (thus allowing it to be provided with no charge or advertising). The disadvantage to this approach is that the nudge software is subject to the usage limits that Google has imposed on your user account.⁶ Two usage limits are of concern when using the nudge software: a daily e-mail quota and a six minute execution limit.

B.1 The Consumer E-Mail Sending Limit

Google imposes a 100 e-mail a day sending limit on consumer accounts and a 1500 a day limit on their G Suite accounts. Consumer Google accounts are free accounts such as those that end in @gmail.com. G Suite accounts are Google accounts created and managed by a company, school or university. While a 1500 e-mail a day limit is likely not an issue, the consumer account 100 e-mail daily limit could be an issue if you have a class of more than 100 students or you send nudges to multiple classes on the same day. There are a few ways to mitigate this issue:

1. Check to see if your school or university has provided you a G Suite account
2. Purchase your own G Suite account (\$60 a year as of Fall 2018)

⁶These usage limits are summarized here: <https://developers.google.com/apps-script/guides/services/quotas>.

3. Split your class into smaller groups and send over multiple days
4. Save the grade nudge to a column in the gradebook and send the message through other means

If your institution already uses G Suite accounts this is clearly the easiest mitigation approach. As of Fall 2018, there are only two major players providing e-mail accounts to schools and universities in the United States: Microsoft and Google. Further, while faculty accounts are often on Microsoft Exchange, universities often complement these accounts with G Suite accounts for students as they are cheaper. This usually means that G Suite accounts also exist for faculty but they are not set up as the primary e-mail provider. Even if you don't believe you have G Suite accounts at your institution, it is worth asking your IT department.

Assuming you can afford the \$60 a year fee and you primarily use e-mail to deliver the nudge message, a G Suite account of your own is the next best option. A G Suite account⁷ is a Google account tied to a domain name you own. For instance, you might have a website at <http://YourName.com>. With G Suite, you can create an e-mail account such as YourFirstName@YourName.com that you can use like any other Gmail account. If you don't already have a domain name, you can purchase one as part of the G Suite sign up process.

While the marketing at <https://gsuite.google.com> is focused on small businesses, you can sign up for a G Suite account with a single user (the lowest cost, 'basic' account is sufficient). Signing up for a G Suite account can be a bit complicated, but Google provides telephone and chat support for this process on the aforementioned website.

Initially when you sign up for a G Suite account, you will be in a 14 day free trial period. Additionally, you won't have made any payments to Google. This is problematic as the consumer e-mail sending limit will be in place until you have (a) paid at least \$30 and (b) are no longer in the free trial. This can be rectified with a few steps.

In your new Gmail account select the gear in the upper right corner and select 'manage this domain'. From this console, select 'Billing' then select 'Access billing account' from the 'Actions' menu. There will be a button that says 'Pay early' allowing you to make a payment greater than \$30. Unfortunately, Google doesn't provide a button to exit the free trial, but we can force the issue by creating ten user accounts. From the three lined menu button in the upper left corner, select 'Users.' On the manage users page, select the plus button in the bottom right corner. Here you can enter fake user account information (you

⁷Can be purchased from <https://gsuite.google.com>.

will be deleting this user in a moment). Repeat this process an additional nine times. At this point a red dot will be in the upper right corner. Clicking on that dot should provide a link to leave the free trial. If it doesn't, go to a different page and come back to the users page. Once you have left the free trial, you can delete all of the fake accounts. After 24-48 hours all consumer limits will be removed from your account.

If a G Suite account is not a practical solution, you can split the class into batches and send the nudge messages over multiple days. In the nudge interface, there is a button labeled 'show advanced settings.' Here you can select to send the nudge to a subset of students. For instance, entering 1 and 50 in the two boxes would send the nudge to the first through fiftieth student in the selected gradebook. Once the Google's e-mail sending limit has reset, you could nudge students fifty-one through one hundred by entering 51 and 100.

Finally, as noted on page 3, the nudge software has the ability to save the nudge message into a column in the gradebook. If you use Microsoft Outlook for e-mail, this will provide a (admittedly less elegant) way of delivering the nudge to a large class. After running the nudge software and saving the message to a column, copy the gradebook to a Microsoft Excel sheet on your computer and save the file somewhere you can find. Now, follow the bulk e-mail instructions provided by Microsoft⁸ to send the messages using Word and Outlook.

B.2 The Six Minute Execution Limit

The six minute execution limit means that no Apps Script can run for six consecutive minutes. (This does not include the time it takes the user to enter information into the interface, only the time where the script is processing). This limit is generally inconsequential when sending the nudge via e-mail without the assignment as e-mail is relatively fast. However, the creation of Google Drive documents is computationally slow. Therefore, when using either the 'Share the Google Drive document with the student' or 'Send a PDF of the document in the E-Mail' delivery options, you might be susceptible to this limit. While it depends on the selected assignment file, in general this limit impacts classes with more than 75 students.

There is two solutions to this problem. First, you can send to a subset of the class using the limits under the advanced section of the nudge interface. For instance, you might enter 1 and 50 into the limit range section of the interface thereby sending the nudge to only the

⁸<https://support.office.com/en-us/article/Use-mail-merge-to-send-bulk-email-messages-0f123521-20ce-4aa8-8b62-ac211dedefa4>

first fifty students in the class. However, unlike the e-mail limit, the execution limit is per run. That means you could immediately send the nudge to students 51 through 100 after the first run is complete. The second option is to send the nudge via e-mail without the assignment as it is less computationally costly.