Scaling feedback using learnr and gradethis in an introductory R course

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Several learning activities that were performed in person had to be changed into an online approach due to the COVID-19 pandemic. Several people that otherwise could not attend an in-person activity were able to join in the online activities. The increasing number of participants presents challenges, and the one we approach in this article is checking and giving feedback to homework assignments in R courses.

Checking and giving feedback to homework assignments usually are time-consuming activities, and as such, they might make it harder to give timely feedback. Mine Cetinkaya-Rundel gave a talk at the RStudio Global Conference 2021, in which she presented an approach for giving feedback at scale that is both meaningful and timely (Çetinkaya-Rundel 2021). We tried this approach in an introduction to programming with R class with 50 students, and here we present the main strengths and challenges we have faced so far.

In this course, we adopted interactive online homework assignments to provide formative assessment after each class. The process of reviewing and evaluating whether the students could answer the exercises correctly enabled instructors and students to qualify the understanding of contents discussed in class. Feedbacks and answers were steadily available while students answered to the assignments.

We structured our homework assignments using a blend of R packages to enable interactivity, steadily available feedbacks, and scalable review of several assignments. For the interactivity part, we used the package {learnr} (Schloerke et al. 2021), a tool that enables the creation of interactive tutorials by using R Markdown documents (Allaire et al. 2021) and Shiny Apps (Chang et al. 2021). The package {gradethis} (Aden-Buie et al. 2021) was designed to be used in {learnr} tutorials and was used to incorporate steadily available exercise feedback. The package {learnrhash} (Rundel 2020) was used to generate a compressed text-based representation of the answers (called *hash*), that students could copy and paste to submit their answers to the exercises. At the end of each homework, each student could send information such as their names, emails, and the hash code created by {learnrhash} (Rundel 2020) through Google Forms.

By using the package {googlesheets4} (Bryan 2021), we were able to import the answers sent by the students through Google Forms. We developed a reproducible report to present the results of homework assignments using R Markdown (Allaire et al. 2021) and the package {pagedown} (Xie et al. 2021). Two examples of the information presented in the report were the percentage of students that submitted their answers through Google Forms and the percentage of students that answered to each exercise correctly. This report was designed to be used only by the instructors of the course.

We asked the students to answer the homework assignments before the following class, so the instructors could review the report and identify concepts that should be revised in class. At the beginning of each class, we reviewed the concepts that we identified when using the reproducible report, and we also solved the exercises in order to explain and answer any questions left.

Distributing the learnr tutorials at scale can be a challenge, so we provided three options for the students:

1. An R package to store the learnr tutorials, available on GitHub (https://github.com/);
2. A project in RStudio Cloud (https://rstudio.cloud/), with the package installed, so students could make a copy of the project and use it;
3. A deployed version in *Shinyapps.io* (https://www.shinyapps.io/) using a Starter Plan (which costs $9.00 per month + taxes).

Some of the strengths that we found while using this approach are:

1. We have data that can help identifying the misunderstanding gaps that should be clarified or filled through revision of contents.
2. Although we spend some time before the course adapting the exercises from .R files to structured exercises in a learnr interactive tutorial, during the course we did not spend time correcting and giving feedback on the homework for each student.
3. We chose to create hints in the exercises, but did not show the solutions within the learnr tutorial. The students reacted positively to the possibility to see the hints, which were not possible to create when we used the .R files for the homework.

We also faced some challenges that we are still working on improving:

1. Some of the students faced encoding errors when they used the tutorials directly in their RStudio sessions, when installing the package from GitHub.
2. Considering that it is an introductory course, some of the students faced difficulties installing the package from GitHub. We had to help each one of them to install it by using Zoom share screen feature, and talking through the installation problems.
3. A {learnr} interactive document is not the same environment in which usual R programming happens, such as an IDE like RStudio or VSCode, and some learners might have a hard time understanding how they are related. Learners who can correctly answer homework assignments might not realize how to apply their knowledge on longer codes, such as R scripts.
4. The packages {learnr} (Schloerke et al. 2021), {gradethis} (Aden-Buie et al. 2021) and {learnrhash} (Rundel 2020) were designed in English; therefore, all the messages, buttons, and other words are written in English. The maintainers of the package {learnr} (Schloerke et al. 2021) are making great efforts to support additional languages in the tutorials, and part of the interface already has support for it. Considering that this course is taught in Brazilian Portuguese, and the package {gradethis} (Aden-Buie et al. 2021) is still only available in English, we made a fork of the package and translated the internal messages into Brazilian Portuguese, called {gradethisBR}.

We are aware of the remaining work to do in order to improve the support of additional languages in the learnr tutorials that use this approach. However, this is important to facilitate the use of learnr by more non-English speakers in forthcoming courses and classes. We understand that {gradethisBR} is a temporary package and will be better if this feature is native in {gradethis}. Thus, we want to help improving {gradethis} to support additional languages as well, such as Brazilian Portuguese, Spanish, German and others.

References

10 Aden-Buie, Garrick, Daniel Chen, Garrett Grolemund, and Barret Schloerke. 2021. "Gradethis: Automated Feedback for Student Exercises in Learnr Tutorials." https://pkgs.rstudio.com/gradethis/.

Allaire, JJ, Yihui Xie, Jonathan McPherson, Javier Luraschi, Kevin Ushey, Aron Atkins, Hadley Wickham, Joe Cheng, Winston Chang, and Richard Iannone. 2021. "Rmarkdown: Dynamic Documents for r." https://pkgs.rstudio.com/rmarkdown/.

Bryan, Jennifer. 2021. "Googlesheets4: Access Google Sheets Using the Sheets API V4." https://github.com/tidyverse/googlesheets4.

Chang, Winston, Joe Cheng, JJ Allaire, Carson Sievert, Barret Schloerke, Yihui Xie, Jeff Allen, Jonathan McPherson, Alan Dipert, and Barbara Borges. 2021. "Shiny: Web Application Framework for r." https://shiny.rstudio.com/.

Çetinkaya-Rundel, Mine. 2021. "Feedback at Scale." Online. https://www.rstudio.com/resources/rstudioglobal-2021/feedback-at-scale/.

Rundel, Colin. 2020. "Learnrhash." https://github.com/rundel/learnrhash.

Schloerke, Barret, JJ Allaire, Barbara Borges, and Garrick Aden-Buie. 2021. "Learnr: Interactive Tutorials for r." https://rstudio.github.io/learnr/.

Xie, Yihui, Romain Lesur, Brent Thorne, and Xianying Tan. 2021. "Pagedown: Paginate the HTML Output of r Markdown with CSS for Print." https://github.com/rstudio/pagedown.