

Importance of open source

Overview

This script creates bar plots from question 2 on the survey, which is about the perceived importance of open source for different job categories and different tasks. My favorite plot is the one in the final section, “Percent more than moderately important”.

Import packages and utilities

```
project_root <- here::here() # requires that you be somewhere in the
# project directory (not above it)
# packages
suppressMessages(source(file.path(project_root, "scripts/packages.R")))
# functions and objects used across scripts
suppressMessages(source(file.path(project_root, "scripts/utils.R")))
```

Define functions

`get_percent_more_than_moderate`

- Arguments:
 - `df`: A data frame with a column named `importance_level`. Should contain only rows that you want to count. Extra columns are okay.
- Details:
 - A simple function to count what percent of rows in a data frame have an `importance_level` of more than `Moderately important`. Checks that there are no extra rows with an unexpected value in the `importance_level` column.

- Outputs:

- A vector with three items: the number of participants who selected an `importance_level` of more than `Moderately important`, the total number of eligible respondents, and a percentage: the first number / the second number *100 and rounded to 2 decimal places.

```
get_percent_more_than_moderate <- function(df) {
  # check that df has the required column
  if (!"importance_level" %in% names(df)) {
    stop("`df` must have a column named 'importance_level'.")
  }

  high_importance_cats <- c(
    "Very important",
    "Important"
  )
  low_importance_cats <- c(
    "Moderately important",
    "Slightly important",
    "Not at all important"
  )

  n_high_rows <- nrow(df %>% filter(importance_level %in% high_importance_cats))
  n_low_rows <- nrow(df %>% filter(importance_level %in% low_importance_cats))
  total <- nrow(df)
  if (n_high_rows + n_low_rows != total) {
    stop("`df` has at least one unexpected value in 'importance_level'.")
  }
  pct <- round(n_high_rows / total * 100, 2)
  return(c(round(n_high_rows), round(total), pct))
}
```

Load data

```
importance <- load_qualtrics_data("clean_data/importance_Q2.tsv")
other_quant <- load_qualtrics_data("clean_data/other_quant.tsv")
```

Wrangle data

Let's extract the columns we care about.

```
importance_and_job <- cbind(importance, other_quant$job)
names(importance_and_job)[length(names(importance_and_job))] <- "job_category"
```

Remove all rows that contain an empty string in any column. Since both questions were mandatory, I'm actually only removing people who never saw the demographic questions.

```
importance_and_job <- exclude_empty_rows(importance_and_job, strict = TRUE)
```

Across the board, how many respondents said OS was important for their learning and/or PD?

```
learning_global_vi <- nrow(importance_and_job %>% filter(Learning == "Very important"))
pd_global_vi <- nrow(importance_and_job %>% filter(`Professional Development` == "Very important"))

learning_global_vi/nrow(importance_and_job)*100
```

```
[1] 63.26531
```

```
pd_global_vi/nrow(importance_and_job)*100
```

```
[1] 63.60544
```

186/294 and 187/294, or about 63%.

How about the same statistics, but this time counting “more than moderately important”.

```
learning_global_mmi <- nrow(
  importance_and_job %>%
    filter(Learning == "Very important" | Learning == "Important")
)

pd_global_mmi <- nrow(
  importance_and_job %>%
    filter(
      `Professional Development` == "Very important" |
        `Professional Development` == "Important"
    )
)
```

```
)  
)  
  
learning_global_mmi/nrow(importance_and_job)*100
```

```
[1] 79.93197
```

```
pd_global_mmi/nrow(importance_and_job)*100
```

```
[1] 82.31293
```

Sanity check: what's the “venn diagram” of people who answered for the “job” category but aren't NR staff?

```
nrow(importance_and_job %>% filter(job_category == "Non-research Staff"))
```

```
[1] 106
```

```
nrow(importance_and_job %>% filter(job_category == "Non-research Staff" & Job != "Non-applica
```

```
[1] 104
```

```
nrow(importance_and_job %>% filter(job_category != "Non-research Staff" & Job != "Non-applica
```

```
[1] 83
```

Okay, so 104 out of 106 nr staff answered that question. 83 people who are not nr staff also answered that Q. I will discard those 83, since that question was never intended for them, based on pre-test feedback that it's hard for researchers to know what work counts as “job” but not “research”.

Let's reshape the data from wide to long format.

```
long_data <- importance_and_job %>%  
  pivot_longer(  
    cols = -job_category,  
    names_to = "importance_area",  
    values_to = "importance_level"  
)
```

Reorder factor levels for plotting.

```
long_data$importance_level <- factor(  
  long_data$importance_level,  
  levels = c(  
    "Very important",  
    "Important",  
    "Moderately important",  
    "Slightly important",  
    "Not at all important",  
    "Non-applicable"  
)  
  ordered = TRUE  
)  
long_data
```

```
# A tibble: 1,470 x 3  
  job_category importance_area      importance_level  
  <chr>        <chr>                <ord>  
1 Faculty       Research            Very important  
2 Faculty       Teaching            Very important  
3 Faculty       Learning            Very important  
4 Faculty       Professional Development Very important  
5 Faculty       Job                Very important  
6 Post-Doc      Research            Very important  
7 Post-Doc      Teaching            Moderately important  
8 Post-Doc      Learning            Important  
9 Post-Doc      Professional Development Important  
10 Post-Doc     Job                Non-applicable  
# i 1,460 more rows
```

Bar plots

Simple bar plot for teachers

Now let's start making some bar plots. Let's start by making a bar plot showing how teachers rate the importance of open source for their teaching. Since we didn't ask people "Do you teach?", and since there was a "Non-applicable" option, we will simply assume that if they gave an answer for the "Teaching" option, they must be a teacher.

```

teaching <- long_data %>%
  filter(
    importance_area == "Teaching"
  ) %>%
  filter(
    importance_level != "Non-applicable"
  )

# For our bar plot, we only care about how many times each 'importance level' was selected.
teaching_to_plot <- teaching %>% select(-c(job_category, importance_area))

teaching_to_plot <- teaching_to_plot %>%
  count(importance_level, name = "Counts")

# By sheer luck, the columns are already ordered by response rates.
teaching_to_plot

```

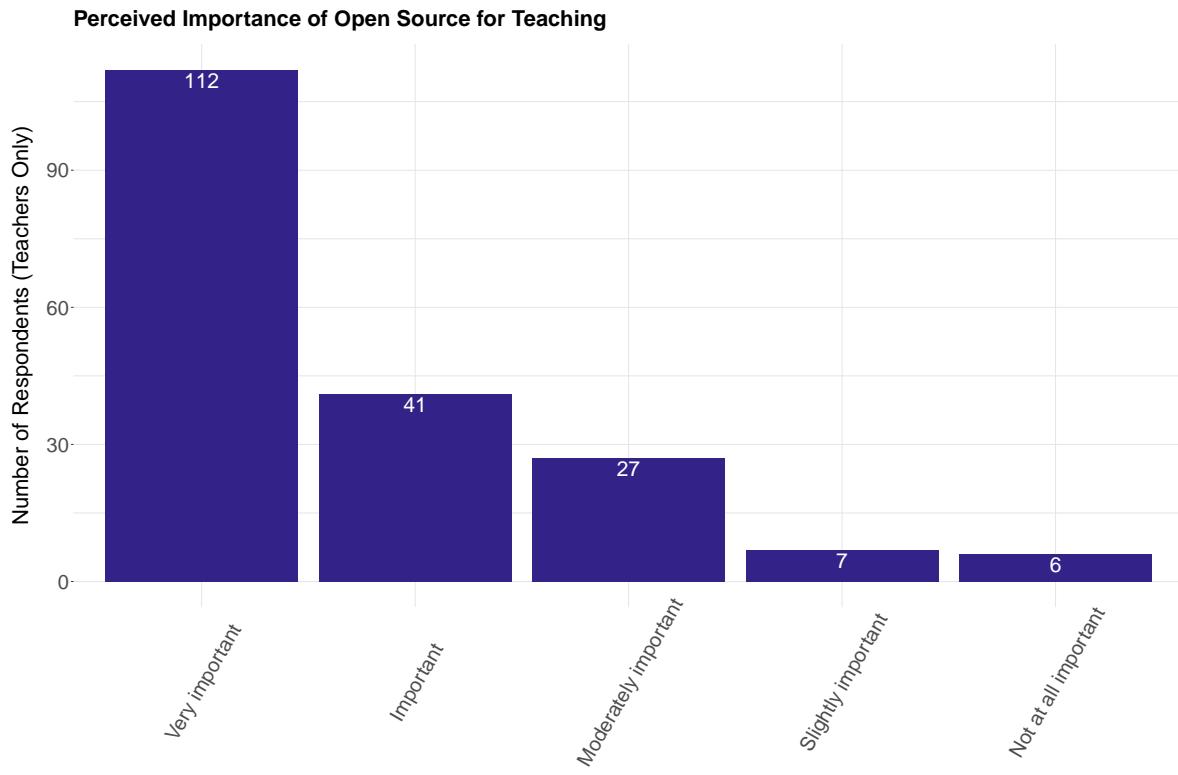
importance_level	Counts
Very important	112
Important	41
Moderately important	27
Slightly important	7
Not at all important	6

Now let's make that bar chart using a function that lives in my utilities script (`scripts/utils.R`).

```

basic_bar_chart(
  teaching_to_plot,
  x_var = "importance_level",
  y_var = "Counts",
  title = "Perceived Importance of Open Source for Teaching",
  ylabel = "Number of Respondents (Teachers Only)",
  show_bar_labels = TRUE
)

```



Save the plot using a function that lives in my utilities script (`scripts/utils.R`).

```
save_plot("importance_teachers.tiff", 8, 5)
```

Grouped bar plot for researchers

Now let's look at researchers, and the importance categories that apply to all researchers. The importance categories again are:

Research

Teaching -> Does not apply

Learning

Professional Development

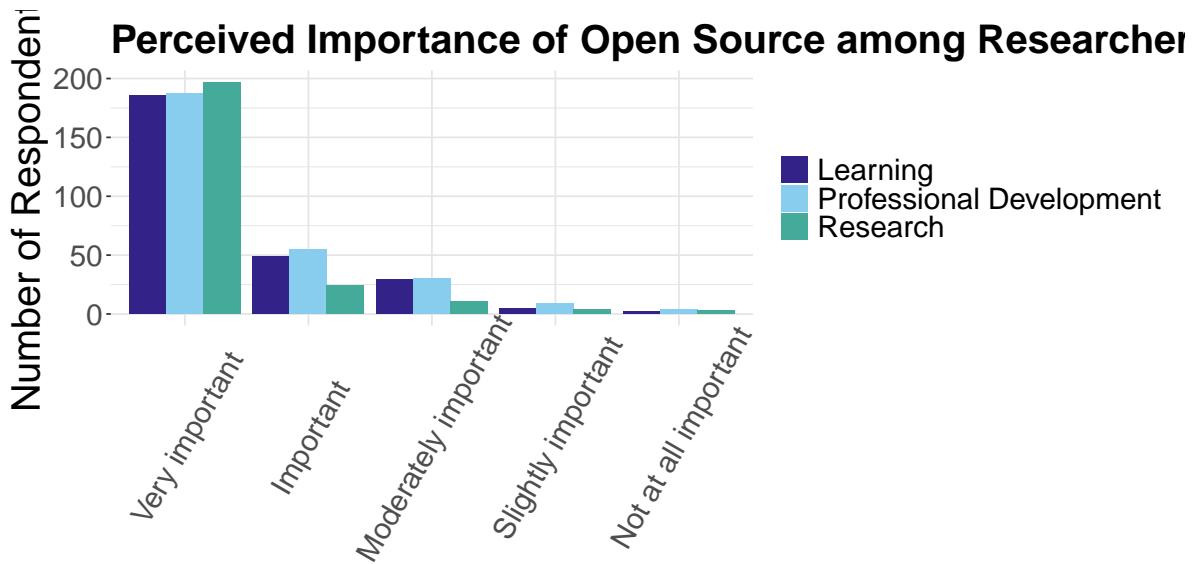
Job (For non-research staff) -> Does not apply

So we'll make a bar plot with just those three categories that apply to all researchers. As with teachers above, we will assume that if they didn't select "Non-applicable", they must be a researcher.

The grouped_bar_chart function, like the basic_bar_chart function, lives in my utility script.

```
research_learning_pd <- long_data %>%
  filter(
    importance_area == "Research" |
      importance_area == "Learning" |
      importance_area == "Professional Development"
  ) %>%
  filter(importance_level != "Non-applicable")

grouped_bar_chart(
  df = research_learning_pd,
  x_var = "importance_level",
  fill_var = "importance_area",
  title = "Perceived Importance of Open Source among Researchers"
)
```



```
save_plot("importance_researchers.tiff", 10, 5)
```

Grouped bar plot for non-research staff

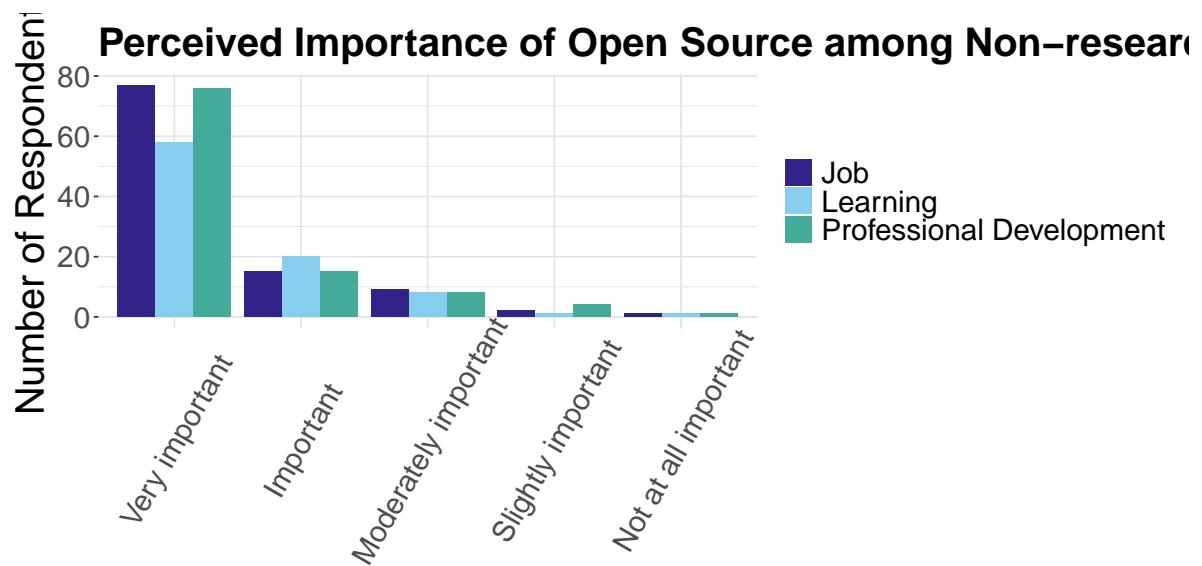
This is very similar to what I did above, except the three applicable categories have changed.

```

job_learning_pd <- long_data %>%
  filter(
    importance_area == "Job" |
    importance_area == "Learning" |
    importance_area == "Professional Development"
  ) %>%
  filter(job_category == "Non-research Staff") %>%
  filter(importance_level != "Non-applicable")

grouped_bar_chart(
  df = job_learning_pd,
  x_var = "importance_level",
  fill_var = "importance_area",
  title = "Perceived Importance of Open Source among Non-research Staff"
)

```



```
save_plot("importance_nrstaff.tiff", 10, 5)
```

Percent more than moderately important

Renata suggested I try to combine all these data into one figure that summarizes the question at a glance. Here's my attempt.

I think a useful “statistic” is the percent of a particular group that said OS is more than moderately important for a particular area of work. Let’s make a dataframe with those percentages. I’d ultimately like to turn this into a bar plot where the color or design of the bars corresponds to the five job categories, and the x-axis shows four groups that I think are most relevant: teachers, researchers, non-research staff, and students. However, not all these groups were explicit survey categories, and not all 5 importance areas apply to all groups, so we’ll need to do a fair amount of data wrangling.

To start, let’s get the percent of teachers who said teaching was more than moderately important.

```
teaching <- long_data %>%
  filter(
    importance_area == "Teaching"
  ) %>%
  filter(
    importance_level != "Non-applicable"
  )

# This will be useful later
res_teachers_teaching <- get_percent_more_than_moderate(teaching)

more_than_mod <- data.frame(
  job_category = "Teachers",
  importance_area = "Teaching",
  pct = res_teachers_teaching[3]
)

more_than_mod
```

job_category	importance_area	pct
Teachers	Teaching	79.27

The code is basically the same for researchers and researching: as with teaching, we will assume that anyone who gave an answer for research (i.e, didn’t select “N/A”) is a researcher.

```
research <- long_data %>%
  filter(
    importance_area == "Research"
  ) %>%
  filter(
    importance_level != "Non-applicable"
```

```

    )

res_researchers_research <- get_percent_more_than_moderate(research)

more_than_mod <- rbind(
  more_than_mod,
  list(
    "Researchers",
    "Research",
    res_researchers_research[3]
  )
)

```

The code for non-research staff and “Job” is slightly different. Our intention was that only non-research staff would answer this question, but there were some people who answered this but did not select “non-research staff” as their job category. So let’s just ensure that we’re only looking at responses from non-research staff by filtering for non-research staff using the job_category column.

```

nrstaff <- long_data %>%
  filter(
    job_category == "Non-research Staff"
  ) %>%
  filter(
    importance_area == "Job"
  ) %>%
  filter(
    importance_level != "Non-applicable"
  )

res_staff_job <- get_percent_more_than_moderate(nrstaff)

more_than_mod <- rbind(
  more_than_mod,
  list(
    "Non-research Staff",
    "Job",
    res_staff_job[3]
  )
)

```

Next, I want to look at two importance areas, Learning and Professional Development, for

all four job categories: Teachers, Researchers, Non-research staff, and Students. We'll have to determine teachers and researchers based on who answered the teaching question and who answered the research question, respectively. Meanwhile, for "Student", we'll have to combine grad students and undergrads into one group.

Let's keep rows from teachers, but keep columns for Learning and Professional Development. Then we change the job_category column to "Teacher".

```
teachers_learn_pd <- importance_and_job %>%
  filter(Teaching != "Non-applicable") %>%
  select(Learning, `Professional Development`, job_category)

teachers_learn_pd$job_category <- "Teacher"
head(teachers_learn_pd)
```

	Learning	Professional Development	job_category
1	Very important	Very important	Teacher
2	Important	Important	Teacher
3	Very important	Very important	Teacher
4	Important	Important	Teacher
5	Very important	Very important	Teacher
6	Moderately important	Moderately important	Teacher

Now we can add two more rows to `more_than_mod`.

```
teachers_learning <- teachers_learn_pd %>%
  select(Learning, job_category) %>%
  #unlikely but you never know
  filter(Learning != "Non-applicable") %>%
  # Change the column name because our function expects it
  rename(importance_level = Learning)

res_teachers_learning <- get_percent_more_than_moderate(teachers_learning)

more_than_mod <- rbind(
  more_than_mod,
  list(
    "Teachers",
    "Learning",
    res_teachers_learning[3]
  )
)
```

```

teachers_pd <- teachers_learn_pd %>%
  select(`Professional Development`, job_category) %>%
  #unlikely but you never know
  filter(`Professional Development` != "Non-applicable") %>%
  # Change the column name because our function expects it
  rename(importance_level = `Professional Development`)

res_teachers_pd <- get_percent_more_than_moderate(teachers_pd)

more_than_mod <- rbind(
  more_than_mod,
  list(
    "Teachers",
    "Professional Development",
    res_teachers_pd[3]
  )
)
more_than_mod

```

	job_category	importance_area	pct
1	Teachers	Teaching	79.27
2	Researchers	Research	92.47
3	Non-research Staff	Job	88.46
4	Teachers	Learning	84.29
5	Teachers	Professional Development	81.48

And let's do the same for researchers.

```

researchers_learn_pd <- importance_and_job %>%
  filter(Research != "Non-applicable") %>%
  select(Learning, `Professional Development`, job_category)

researchers_learn_pd$job_category <- "Researcher"

researchers_learning <- researchers_learn_pd %>%
  select(Learning, job_category) %>%
  #unlikely but you never know
  filter(Learning != "Non-applicable") %>%
  # Change the column name because our function expects it
  rename(importance_level = Learning)

```

```

res_researchers_learning <- get_percent_more_than_moderate(researchers_learning)

more_than_mod <- rbind(
  more_than_mod,
  list(
    "Researchers",
    "Learning",
    res_researchers_learning[3]
  )
)

researchers_pd <- researchers_learn_pd %>%
  select(`Professional Development`, job_category) %>%
  #unlikely but you never know
  filter(`Professional Development` != "Non-applicable") %>%
  # Change the column name because our function expects it
  rename(importance_level = `Professional Development`)

res_researchers_pd <- get_percent_more_than_moderate(researchers_pd)

more_than_mod <- rbind(
  more_than_mod,
  list(
    "Researchers",
    "Professional Development",
    res_researchers_pd[3]
  )
)
more_than_mod

```

	job_category	importance_area	pct
1	Teachers	Teaching	79.27
2	Researchers	Research	92.47
3	Non-research Staff	Job	88.46
4	Teachers	Learning	84.29
5	Teachers	Professional Development	81.48
6	Researchers	Learning	85.90
7	Researchers	Professional Development	83.98

Now get percentages for non-research staff. This is straightforward since it was a survey category.

```

nrstaff_learn_pd <- importance_and_job %>%
  filter(job_category == "Non-research Staff") %>%
  select(Learning, `Professional Development`, job_category)

nrstaff_learning <- nrstaff_learn_pd %>%
  select(Learning, job_category) %>%
  #unlikely but you never know
  filter(Learning != "Non-applicable") %>%
  # Change the column name because our function expects it
  rename(importance_level = Learning)

res_staff_learning <- get_percent_more_than_moderate(nrstaff_learning)

more_than_mod <- rbind(
  more_than_mod,
  list(
    "Non-research Staff",
    "Learning",
    res_staff_learning[3]
  )
)

nrstaff_pd <- nrstaff_learn_pd %>%
  select(`Professional Development`, job_category) %>%
  #unlikely but you never know
  filter(`Professional Development` != "Non-applicable") %>%
  # Change the column name because our function expects it
  rename(importance_level = `Professional Development`)

res_staff_pd <- get_percent_more_than_moderate(nrstaff_pd)

more_than_mod <- rbind(
  more_than_mod,
  list(
    "Non-research Staff",
    "Professional Development",
    res_staff_pd[3]
  )
)

```

Finally, let's get students.

```

students_learn_pd <- importance_and_job %>%
  filter(job_category == "Undergraduate" | job_category == "Grad Student") %>%
  select(Learning, `Professional Development`, job_category)

students_learn_pd$job_category <- "Student"

students_learning <- students_learn_pd %>%
  select(Learning, job_category) %>%
  #unlikely but you never know
  filter(Learning != "Non-applicable") %>%
  # Change the column name because our function expects it
  rename(importance_level = Learning)

res_students_learning <- get_percent_more_than_moderate(students_learning)

more_than_mod <- rbind(
  more_than_mod,
  list(
    "Students",
    "Learning",
    res_students_learning[3]
  )
)

students_pd <- students_learn_pd %>%
  select(`Professional Development`, job_category) %>%
  #unlikely but you never know
  filter(`Professional Development` != "Non-applicable") %>%
  # Change the column name because our function expects it
  rename(importance_level = `Professional Development`)

res_students_pd <- get_percent_more_than_moderate(students_pd)

more_than_mod <- rbind(
  more_than_mod,
  list(
    "Students",
    "Professional Development",
    res_students_pd[3]
  )
)

```

```
more_than_mod
```

```
      job_category      importance_area   pct
1       Teachers           Teaching 79.27
2    Researchers          Research 92.47
3 Non-research Staff            Job 88.46
4       Teachers           Learning 84.29
5       Teachers Professional Development 81.48
6    Researchers           Learning 85.90
7    Researchers Professional Development 83.98
8 Non-research Staff           Learning 88.64
9 Non-research Staff Professional Development 87.50
10      Students           Learning 92.86
11      Students Professional Development 87.04
```

FINALLY, let's plot it!

Save the data to a file for fine-tuning of plot.

```
write_df_to_file(
  more_than_mod,
  file.path("data_for_plots/importance.tsv")
)
```

Reorder factor levels

```
more_than_mod$job_category <- gsub(
  "Non-research Staff",
  "Non-research\\nStaff",
  more_than_mod$job_category
)

more_than_mod$job_category <- factor(
  more_than_mod$job_category,
  levels = c(
    "Teachers",
    "Researchers",
    "Non-research\\nStaff",
    "Students"
  )
)
```

```

more_than_mod$importance_area <- factor(
  more_than_mod$importance_area,
  levels = c(
    "Learning",
    "Professional Development",
    "Teaching",
    "Research",
    "Job"
  )
)

```

I'm not using my `grouped_bar_chart` function in `scripts/utils.R` because I have pre-computed the bar heights, and that function counts rows. Since I'm currently only creating this kind of bar chart once, I'm not bothering to create a new function (or incorporate this option into the `grouped_bar_chart` function).

```

p <- ggplot(
  more_than_mod,
  aes(
    x = job_category,
    y = pct,
    fill = importance_area
  )
) +
  geom_col(position = position_dodge(width = 0.8), width = 0.7) +
  geom_hline(yintercept = 80, linetype = "dashed", color = "black") +
  ggtitle("Perceived Importance of Open Source\nfor Different Kinds of Work") +
  labs(
    y = "Percent of Respondents Who Said OS\\nIs above Moderate Importance"
  ) +
  scale_y_continuous(labels = function(x) paste0(x, "%")) +
  coord_cartesian(ylim = c(50, 100)) +
  theme(
    axis.title.x = element_blank(),
    axis.title.y = element_text(size = 24),
    axis.text.x = element_text(
      angle = 60,
      vjust = 1,
      hjust = 1,
      size = 22,
      margin = margin(t = 12)
  )
)

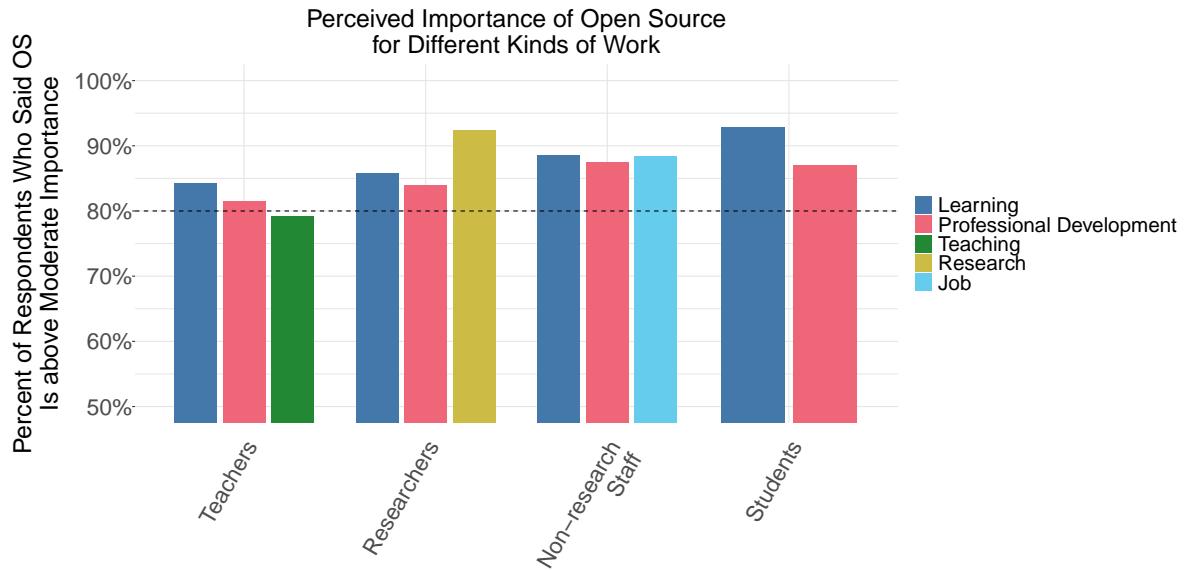
```

```

),
axis.text.y = element_text(
  size = 22,
  margin = margin(l = 8)
),
axis.ticks.x = element_blank(),
legend.title = element_blank(),
legend.text = element_text(size = 20),
panel.background = element_blank(),
plot.title = element_text(hjust = 0.5, size = 24),
plot.margin = unit(c(0.3, 0.3, 0.3, 0.3), "cm"),
panel.grid = element_line(linetype = "solid", color = "gray90")
) +
#https://sronpersonalpages.nl/~pault/
scale_fill_manual(
  values = c(
    '#4477AA',
    '#EE6677',
    '#228833',
    '#CCBB44',
    '#66CCEE'
  )
)

```

p



This is the version I've used for powerpoint presentations

```
save_plot("importance_all_pct.tiff", 12, 8, p=p)
```

This is the version for the journal, meeting their submission requirements.

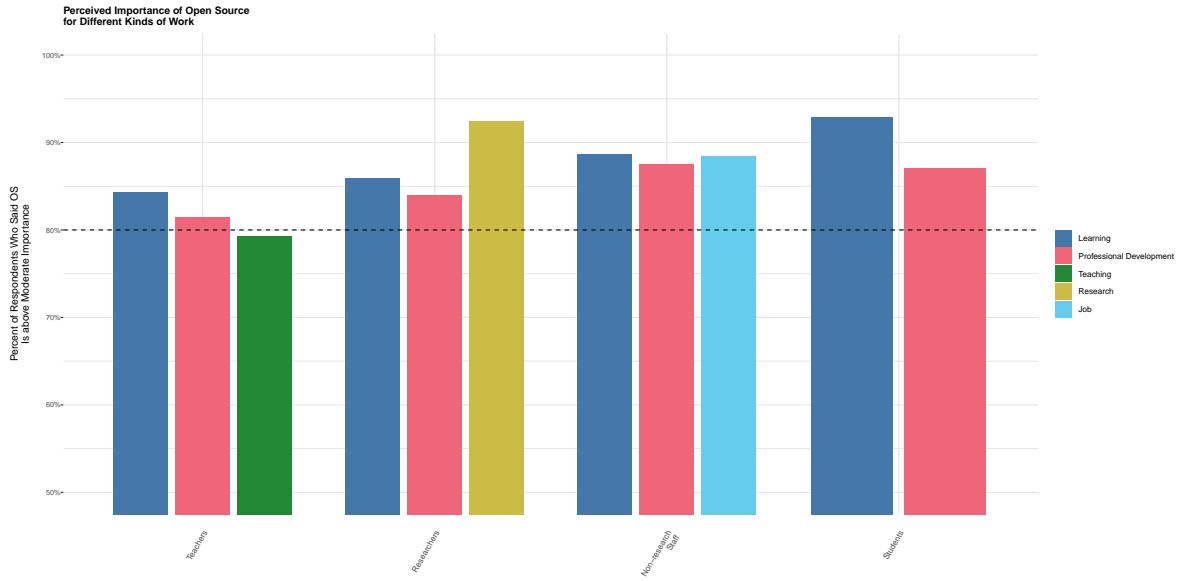
```
p2 <- ggplot(
  more_than_mod,
  aes(
    x = job_category,
    y = pct,
    fill = importance_area
  )
) +
  geom_col(position = position_dodge(width = 0.8), width = 0.7) +
  geom_hline(yintercept = 80, linetype = "dashed", color = "black") +
  ggtitle("Perceived Importance of Open Source\\nfor Different Kinds of Work") +
  labs(
    y = "Percent of Respondents Who Said OS\\nIs above Moderate Importance"
  ) +
  scale_y_continuous(labels = function(x) paste0(x, "%")) +
  coord_cartesian(ylim = c(50, 100)) +
  theme(
    axis.title.x = element_blank(),
    axis.title.y = element_text(size = 10),
```

```

axis.text.x = element_text(
  angle = 60,
  vjust = 1,
  hjust = 1,
  size = 8,
  margin = margin(t = 12)
),
axis.text.y = element_text(
  size = 7,
  margin = margin(l = 8)
),
axis.ticks.x = element_blank(),
legend.title = element_blank(),
legend.text = element_text(size = 8),
panel.background = element_blank(),
plot.title = element_text(hjust = 0, size = 10, face = "bold"),
plot.margin = unit(c(0.3, 0.3, 0.3, 0.3), "cm"),
panel.grid = element_line(linetype = "solid", color = "gray90")
) +
#https://sronpersonalpages.nl/~pault/
scale_fill_manual(
  values = c(
    '#4477AA',
    '#EE6677',
    '#228833',
    '#CCBB44',
    '#66CCEE'
  )
)

```

p2



```
# FIGURE_PATH is in .Renvironment file
ggsave(
  file.path(FIGURE_PATH, "fig3.tif"), p2,
  width = 5.2,
  height = 5.2 * (8/12),    # = 3.4667 in
  units = "in",
  dpi = 600
)
```

Get numbers, not just %

A last-minute add-on for the manuscript: let's get the raw numbers, not just the percentages, for those categories we chose to highlight.

```
res_teachers_teaching2 <- c("Teachers", "Teaching", res_teachers_teaching)
res_teachers_learning2 <- c("Teachers", "Learning", res_teachers_learning)
res_teachers_pd2 <- c("Teachers", "Professional Development", res_teachers_pd)
res_researchers_research2 <- c("Researchers", "Research", res_researchers_research)
res_researchers_learning2 <- c("Researchers", "Learning", res_researchers_learning)
res_researchers_pd2 <- c("Researchers", "Professional Development", res_researchers_pd)
res_staff_job2 <- c("Non-research staff", "Job", res_staff_job)
res_staff_learning2 <- c("Non-research staff", "Learning", res_staff_learning)
res_staff_pd2 <- c("Non-research staff", "Professional Development", res_staff_pd)
```

```

res_students_learning2 <- c("Students", "Learning", res_students_learning)
res_students_pd2 <- c("Students", "Professional Development", res_students_pd)

more_than_mod2 <- as.data.frame(rbind(
  res_teachers_teaching2,
  res_teachers_learning2,
  res_teachers_pd2,
  res_researchers_research2,
  res_researchers_learning2,
  res_researchers_pd2,
  res_staff_job2,
  res_staff_learning2,
  res_staff_pd2,
  res_students_learning2,
  res_students_pd2
))
)

names(more_than_mod2) <- c("job_category", "importance_area", "more_than_mod", "total_participants")
rownames(more_than_mod2) <- NULL
more_than_mod2

```

	job_category	importance_area	more_than_mod	total_participants
1	Teachers	Teaching	153	193
2	Teachers	Learning	161	191
3	Teachers	Professional Development	154	189
4	Researchers	Research	221	239
5	Researchers	Learning	201	234
6	Researchers	Professional Development	194	231
7	Non-research staff	Job	92	104
8	Non-research staff	Learning	78	88
9	Non-research staff	Professional Development	91	104
10	Students	Learning	52	56
11	Students	Professional Development	47	54
	perc_more_than_mod			
1		79.27		
2		84.29		
3		81.48		
4		92.47		
5		85.9		
6		83.98		
7		88.46		

```
8          88.64
9          87.5
10         92.86
11         87.04
```

```
write_df_to_file(more_than_mod2, "supplementary_tables/importance.tsv")
```

Session Info

```
sessionInfo()
```

```
R version 4.4.2 (2024-10-31)
Platform: aarch64-apple-darwin20
Running under: macOS 26.1
```

```
Matrix products: default
BLAS:      /Library/Frameworks/R.framework/Versions/4.4-arm64/Resources/lib/libRblas.0.dylib
LAPACK:    /Library/Frameworks/R.framework/Versions/4.4-arm64/Resources/lib/libRlapack.dylib

locale:
[1] C.UTF-8/C.UTF-8/C.UTF-8/C/C.UTF-8/C.UTF-8

time zone: America/Los_Angeles
tzcode source: internal

attached base packages:
[1] tools      grid       stats      graphics   grDevices datasets  utils
[8] methods     base

other attached packages:
[1] treemapify_2.5.6      tidyverse_1.3.1        svglite_2.2.1
[4] stringr_1.5.1         scales_1.4.0          readr_2.1.5
[7] pwr_1.3-0              patchwork_1.3.2       ordinal_2023.12-4.1
[10] lme4_1.1-37            Matrix_1.7-1          languageserver_0.3.16
[13] here_1.0.1             gtools_3.9.5          ggforce_0.5.0
[16] FSA_0.10.0              fpc_2.2-13          forcats_1.0.0
[19] factoextra_1.0.7      ggplot2_3.5.2         emmeans_1.11.2
[22] dplyr_1.1.4             corrplot_0.95        ComplexHeatmap_2.22.0
[25] cluster_2.1.8.1        BiocManager_1.30.26
```

```

loaded via a namespace (and not attached):
[1] Rdpack_2.6.4           rlang_1.1.6          magrittr_2.0.3
[4] clue_0.3-66            GetoptLong_1.0.5    matrixStats_1.5.0
[7] compiler_4.4.2         flexmix_2.3-20     systemfonts_1.2.3
[10] png_0.1-8             callr_3.7.6        vctrs_0.6.5
[13] pkgconfig_2.0.3       shape_1.4.6.1      crayon_1.5.3
[16] fastmap_1.2.0         labeling_0.4.3     utf8_1.2.6
[19] rmarkdown_2.29         ggfitttext_0.10.2 tzdb_0.5.0
[22] ps_1.9.1              nloptr_2.2.1      purrr_1.1.0
[25] xfun_0.53             modeltools_0.2-24 jsonlite_2.0.0
[28] tweenr_2.0.3          parallel_4.4.2    prabclus_2.3-4
[31] R6_2.6.1               stringi_1.8.7     RColorBrewer_1.1-3
[34] boot_1.3-31           diptest_0.77-2    numDeriv_2016.8-1.1
[37] estimability_1.5.1    Rcpp_1.1.0        iterators_1.0.14
[40] knitr_1.50             IRanges_2.40.1     splines_4.4.2
[43] nnet_7.3-19            tidyselect_1.2.1   yaml_2.3.10
[46] doParallel_1.0.17      codetools_0.2-20  processx_3.8.6
[49] lattice_0.22-6         tibble_3.3.0      withr_3.0.2
[52] evaluate_1.0.4         polyclip_1.10-7   xml2_1.4.0
[55] circlize_0.4.16        mclust_6.1.1      kernlab_0.9-33
[58] pillar_1.11.0          renv_1.1.5        foreach_1.5.2
[61] stats4_4.4.2           reformulas_0.4.1  generics_0.1.4
[64] rprojroot_2.1.1        S4Vectors_0.44.0  hms_1.1.3
[67] minqa_1.2.8            xtable_1.8-4      class_7.3-22
[70] glue_1.8.0              robustbase_0.99-4-1 mvtnorm_1.3-3
[73] rbibutils_2.3           colorspace_2.1-1   nlme_3.1-166
[76] cli_3.6.5               textshaping_1.0.1  gtable_0.3.6
[79] DEoptimR_1.1-4          digest_0.6.37     BiocGenerics_0.52.0
[82] ucminf_1.2.2            ggrepel_0.9.6      rjson_0.2.23
[85] farver_2.1.2            htmltools_0.5.8.1 lifecycle_1.0.4
[88] GlobalOptions_0.1.2     MASS_7.3-61

```