BqExAvI Survey Analysis (2017-2022)

Modesto

2023-03-01

Moodle survey

We are importing the data from the students answers in 5 years, between 2018-2022. The quiz consists on up to 77 questions, being 5 free-text questions (50, 51, 52, 75, 76 & 77), 7 three-options questions and the rest in Likert scale. The latter will be categorized as "Positive" or "Negative" if 5 ("Totally agree") means a "good" or "bad" feedback.

```r
#load questions
questions <- read.csv("questions.csv", head=TRUE, sep=";")
questions <- cbind(row.names(questions),questions[,c(3,1,2)])
#add type variable
questions$type <- "Pos."
questions$type[questions$Section=="Open"] <- ""
questions[c(4,10,56,63,63,64,65,66,67,72),5] <- "Neg."
questions$type[questions$Section=="Open"] <- "NA"
colnames(questions) <- c("No.","Since","Section","Question","Type")

kbl(questions, align = "cccl", caption = "Table 1. Students opinion quizz. The bulk of the questionaire
    kable_styling(bootstrap_options = "striped", full_width = F) %>%
    column_spec(1, italic = T)
```

Load data and pairwise t.test

Survey answers were downloaded from Moodle as txt/csv files. Moodle updates generated some format differences that could be bypassed after opening the files with Numbers and exporting as tables with ";" as column separator. We now show pairwise t.tests carried out to identify significant differences per year in the answers.

```r
#read the data in a list of dataframes
#didn't use the headers to avoid mistakes
quiz <- lapply(2017:2022, function(x) read.csv(paste0("survey",x,".csv"),header=FALSE,skip=1,sep=";"))
#add Year as the third variable (empty so far)
curso <- c("2017","2018","2019","2020","2021","2022")
for (i in 1:length(quiz)){
  quiz[[i]][,3] <- curso[i]
}

#adjust questions changes
#remove questions in colum 32 & 40 from 2017, because we removed it in the following years
quiz[[1]] <- quiz[[1]][,-c(32,40)]
quiz[[6]] <- quiz[[6]][,-10]
names(quiz[[6]]) <- names(quiz[[5]])
```

Table 1: Table 1. Students opinion quizz. The bulk of the questionaire was designed for the year 2017 and new questions were added as indicated in the rightmost column.

No.	Since	Section	Question
1	2017-2018	Equipment	We had sufficient amount of small lab equipment (e.g. pippettes, cuvettes,...)
2	2017-2018	Equipment	Access to general instruments/equipment (e.g. PCR, laminar flow hoods) was
3	2017-2018	Equipment	Lab equipment was well mantained/modern
4	2017-2018	Length and schedule	The course is too long
5	2017-2018	Length and schedule	The period allocated for the course within the term is appropriate
6	2017-2018	Length and schedule	On average, the number of hours per day is sufficient
7	2017-2018	General Methodology	Student engagement
8	2017-2018	General Methodology	Course interest
9	2017-2018	General Methodology	Course usefulness
10	2017-2018	General Methodology	Demand on student's part
11	2017-2018	General Methodology	Course difficulty
12	2017-2018	Method objectives	State a hypothesis
13	2017-2018	Method objectives	Design an experimental strategy to answer specific biological questions
14	2017-2018	Method objectives	Identify cost-effective (time and money-wise) practical techniques to answer a
15	2017-2018	Method objectives	Write an experimental protocol including all relevant controls
16	2017-2018	Method objectives	Execute an experimental protocol
17	2017-2018	Method objectives	Record, analyze and interpret experimental results
18	2017-2018	Method objectives	Integrate information from other researchers and discuss your results within a
19	2017-2018	Method objectives	Follow lab safety rules
20	2017-2018	Method objectives	Ability to work in a team
21	2017-2018	Activities interest	Introductory lecture (day 1)
22	2017-2018	Activities interest	Stats Intro (day 2)
23	2017-2018	Activities interest	Initial brainstorming session (day 2)
24	2017-2018	Activities interest	Group meetings (experiment planning and design)
25	2017-2018	Activities interest	Team feed-back session (propossal design)
26	2017-2018	Activities interest	Final group discussion session (day before the last)
27	2017-2018	Activities interest	Final class discussion session (last day)
28	2017-2018	Activities Length	Introductory lecture (day 1)
29	2017-2018	Activities Length	Stats Intro (day 2)
30	2017-2018	Activities Length	Initial brainstorming session (day 2)
31	2017-2018	Activities Length	Group meetings (experiment planning and design)
32	2017-2018	Activities Length	Team feed-back sessions
33	2017-2018	Activities Length	Final group discussion session (day before the last)
34	2017-2018	Activities Length	Final class discussion session (last day)
35	2017-2018	Assesment	Safety and clean-up weekly evaluation
36	2017-2018	Assesment	Individual lab notebook evaluation (design)
37	2017-2018	Assesment	Group lab notebook evaluation (design)
38	2017-2018	Assesment	Group lab notebook evaluation (results)
39	2017-2018	Assesment	Peer-evaluation (Team)
40	2017-2018	Assesment	Final exam
41	2017-2018	Learning Objectives	State a hypothesis
42	2017-2018	Learning Objectives	Design an experimental strategy to answer specific biological questions
43	2017-2018	Learning Objectives	Identify cost-effective (time and money-wise) practical techniques to answer a
44	2017-2018	Learning Objectives	Write an experimental protocol including all relevant controls
45	2017-2018	Learning Objectives	Execute an experimental protocol
46	2017-2018	Learning Objectives	Record, analyze and interpret experimental results
47	2017-2018	Learning Objectives	Integrate information from other researchers and discuss your results within a
48	2017-2018	Learning Objectives	Follow lab safety rules
49	2017-2018	Learning Objectives	Ability to work in a team
50	2017-2018	Open	Best
51	2017-2018	Open	Wors
52	2019-2020	Open	Open comments
53	2019-2020	ELN	I knew OneNote before the course.
54	2019-2020	ELN	I find OneNote a useful app for the elaboration of the course Notebook.

2

```r
names(quiz[[1]]) <- names(quiz[[2]])
#merge all dataframes and name the columns
data <- Reduce(function(x, y) merge(x, y, all=TRUE), quiz)
#take the colnames from the last quiz that contains all the questions

colnames(data)[3] <- "Curso"


#statistics analysis
#subset questions 1: remove leftmost junk columns
subdata <- data[,c(3,11:87)]
names(subdata) <- c("Curso",paste0("Q",1:77))
#subset questions 2: remove open questions
open <- c(row.names(questions[questions$Section=="Open",]))
subdata <- subdata[,-(as.integer(open)+1)]
subdata <- sapply(subdata,as.numeric)
subdata <- as.data.frame(subdata)


tests <- list()
nombres <- c()

for (i in 2:ncol(subdata)){
  subdata[,i][!(subdata[,i] %in% c(1,2,3,4,5))] <- NA
  #subset for years with answers to avoid void groups
  kkk <- subset(subdata,!is.na(subdata[,i]))
  tests[[i-1]] <- pairwise.t.test(x=as.numeric(kkk[,i]),g=as.numeric(kkk[,1]),paired = F)
  nombres[i-1] <- questions[,4][(which(questions$No. %in% gsub("\\D", "",colnames(subdata[i]))))]
  names(tests) <- nombres
  print(names(tests[i-1]))
  print(tests[[i-1]]$p.value)
}
```

```
## [1] "We had sufficient amount of small lab equipment (e.g. pippettes, cuvettes,...)"
##                 2017         2018      2019        2020 2021
## 2018 4.835902e-05           NA        NA          NA   NA
## 2019 3.879170e-02   0.29237424        NA          NA   NA
## 2020 4.884986e-07   1.00000000 0.0419191          NA   NA
## 2021 2.620952e-01   0.05789424 1.0000000 0.003876997   NA
## 2022 4.191910e-02   0.45476018 1.0000000 0.092183903    1
## [1] "Access to general instruments/equipment (e.g. PCR, laminar flow hoods)  was limiting"
##            2017 2018 2019      2020 2021
## 2018 1.0000000   NA   NA        NA   NA
## 2019 1.0000000    1   NA        NA   NA
## 2020 0.8109768    1    1        NA   NA
## 2021 1.0000000    1    1 0.8344372   NA
## 2022 1.0000000    1    1 1.0000000    1
## [1] "Lab equipment was well mantained/modern"
##            2017 2018 2019 2020 2021
## 2018 0.4899485   NA   NA   NA   NA
## 2019 1.0000000    1   NA   NA   NA
## 2020 1.0000000    1    1   NA   NA
## 2021 1.0000000    1    1    1   NA
## 2022 0.6531043    1    1    1    1
```

```
## [1] "The course is too long"
##              2017 2018 2019 2020 2021
## 2018 0.0026643833   NA   NA   NA   NA
## 2019 0.0004996605    1   NA   NA   NA
## 2020 0.1019667926    1    1   NA   NA
## 2021 0.0868213996    1    1    1   NA
## 2022 0.1248722514    1    1    1    1
## [1] "The period allocated for the course within the term is appropriate"
##      2017 2018 2019 2020 2021
## 2018    1   NA   NA   NA   NA
## 2019    1    1   NA   NA   NA
## 2020    1    1    1   NA   NA
## 2021    1    1    1    1   NA
## 2022    1    1    1    1    1
## [1] "On average, the number of hours per day is sufficient"
##              2017         2018        2019         2020      2021
## 2018 0.0001740842           NA          NA           NA        NA
## 2019 0.7083631075 0.0082785316          NA           NA        NA
## 2020 1.0000000000 0.0000373255 0.557747775           NA        NA
## 2021 0.1093921851 0.2837206178 0.699933496 3.884956e-02        NA
## 2022 0.0002382551 1.0000000000 0.009910691 5.433618e-05 0.2837206
## [1] "Student engagement"
##      2017      2018      2019      2020 2021
## 2018    1        NA        NA        NA   NA
## 2019    1 1.0000000        NA        NA   NA
## 2020    1 0.2189352 0.3199053        NA   NA
## 2021    1 1.0000000 1.0000000 1.0000000   NA
## 2022    1 1.0000000 1.0000000 0.1269859    1
## [1] "Course interest"
##           2017 2018 2019      2020 2021
## 2018 1.0000000   NA   NA        NA   NA
## 2019 1.0000000    1   NA        NA   NA
## 2020 0.2988613    1    1        NA   NA
## 2021 1.0000000    1    1 0.1231708   NA
## 2022 1.0000000    1    1 0.3158588    1
## [1] "Course usefulness"
##      2017      2018     2019      2020 2021
## 2018    1        NA       NA        NA   NA
## 2019    1 1.0000000       NA        NA   NA
## 2020    1 0.3070813 0.401915        NA   NA
## 2021    1 1.0000000 1.000000 0.2706641   NA
## 2022    1 1.0000000 1.000000 1.0000000    1
## [1] "Demand on student's part"
##      2017 2018 2019 2020 2021
## 2018    1   NA   NA   NA   NA
## 2019    1    1   NA   NA   NA
## 2020    1    1    1   NA   NA
## 2021    1    1    1    1   NA
## 2022    1    1    1    1    1
## [1] "Course difficulty"
##           2017      2018     2019      2020 2021
## 2018 1.0000000        NA       NA        NA   NA
## 2019 1.0000000 1.0000000       NA        NA   NA
## 2020 0.5995961 0.2087174 0.752361        NA   NA
```

```
## 2021 1.0000000 1.0000000 1.000000 1.00000000    NA
## 2022 1.0000000 1.0000000 1.000000 0.09488378     1
## [1] "State a hypothesis"
##      2017 2018 2019      2020 2021
## 2018    1   NA   NA        NA   NA
## 2019    1    1   NA        NA   NA
## 2020    1    1    1        NA   NA
## 2021    1    1    1 0.5792492   NA
## 2022    1    1    1 1.0000000    1
## [1] "Design an experimental strategy to answer specific biological questions"
##           2017 2018 2019 2020 2021
## 2018 0.9819431   NA   NA   NA   NA
## 2019 1.0000000    1   NA   NA   NA
## 2020 1.0000000    1    1   NA   NA
## 2021 1.0000000    1    1    1   NA
## 2022 0.9819431    1    1    1    1
## [1] "Identify cost-effective (time and money-wise) practical techniques to answer a given question"
##      2017 2018 2019 2020 2021
## 2018    1   NA   NA   NA   NA
## 2019    1    1   NA   NA   NA
## 2020    1    1    1   NA   NA
## 2021    1    1    1    1   NA
## 2022    1    1    1    1    1
## [1] "Write an experimental protocol including all relevant controls"
##      2017 2018      2019 2020 2021
## 2018    1   NA        NA   NA   NA
## 2019    1    1        NA   NA   NA
## 2020    1    1 0.8385782   NA   NA
## 2021    1    1 0.9188235    1   NA
## 2022    1    1 1.0000000    1    1
## [1] "Execute an experimental protocol"
##      2017 2018 2019 2020 2021
## 2018    1   NA   NA   NA   NA
## 2019    1    1   NA   NA   NA
## 2020    1    1    1   NA   NA
## 2021    1    1    1    1   NA
## 2022    1    1    1    1    1
## [1] "Record, analyze and interpret experimental results"
##      2017      2018 2019       2020 2021
## 2018    1        NA   NA         NA   NA
## 2019    1 1.0000000   NA         NA   NA
## 2020    1 0.6303827    1         NA   NA
## 2021    1 1.0000000    1 0.67234486   NA
## 2022    1 1.0000000    1 0.07443221    1
## [1] "Integrate information from other researchers and discuss your results within a larger context"
##      2017 2018 2019 2020 2021
## 2018    1   NA   NA   NA   NA
## 2019    1    1   NA   NA   NA
## 2020    1    1    1   NA   NA
## 2021    1    1    1    1   NA
## 2022    1    1    1    1    1
## [1] "Follow lab safety rules"
##      2017      2018 2019 2020 2021
## 2018    1        NA   NA   NA   NA
```

```
## 2019    1 0.1591204    NA    NA    NA
## 2020    1 0.1062739    1    NA    NA
## 2021    1 1.0000000    1    1    NA
## 2022    1 1.0000000    1    1    1
## [1] "Ability to work in a team"
##           2017 2018      2019 2020 2021
## 2018 1.0000000    NA       NA   NA   NA
## 2019 0.1609205    1       NA   NA   NA
## 2020 1.0000000    1 0.7693568   NA   NA
## 2021 1.0000000    1 0.9866925    1   NA
## 2022 0.4842893    1 1.0000000    1    1
## [1] "Introductory lecture (day 1)"
##           2017      2018      2019 2020      2021
## 2018 1.0000000        NA       NA   NA       NA
## 2019 1.0000000 1.0000000       NA   NA       NA
## 2020 1.0000000 1.0000000 1.0000000   NA       NA
## 2021 1.0000000 1.0000000 1.0000000    1       NA
## 2022 0.1719199 0.2035414 0.2110407    1 0.4244263
## [1] "Stats Intro (day 2)"
##             2017      2018 2019 2020 2021
## 2018 9.016649e-02        NA   NA   NA   NA
## 2019 8.152269e-05 0.7431196   NA   NA   NA
## 2020 1.632072e-04 0.7465066    1   NA   NA
## 2021 8.674063e-05 0.7431196    1    1   NA
## 2022 8.588806e-04 1.0000000    1    1    1
## [1] "Initial brainstorming session (day 2)"
##           2017       2018      2019 2020 2021
## 2018 0.7350214        NA       NA   NA   NA
## 2019 1.0000000 1.00000000       NA   NA   NA
## 2020 1.0000000 0.54883014 1.0000000   NA   NA
## 2021 1.0000000 0.08910869 1.0000000    1   NA
## 2022 1.0000000 0.02113266 0.4213264    1    1
## [1] "Group meetings (experiment planning and design)"
##     2017 2018      2019      2020 2021
## 2018    1   NA       NA       NA   NA
## 2019    1    1       NA       NA   NA
## 2020    1    1 1.0000000       NA   NA
## 2021    1    1 1.0000000 1.0000000   NA
## 2022    1    1 0.4134602 0.4928046    1
## [1] "Team feed-back session (propossal design)"
##             2017         2018         2019      2020 2021
## 2018 1.000000e+00          NA          NA       NA   NA
## 2019 1.000000e+00 1.000000e+00          NA       NA   NA
## 2020 1.000000e+00 1.000000e+00 1.000000e+00       NA   NA
## 2021 5.122069e-05 9.484981e-08 1.323700e-06 9.133855e-08   NA
## 2022 1.580189e-03 9.221399e-06 8.708906e-05 9.221399e-06    1
## [1] "Final group discussion session (day before the last)"
##     2017      2018      2019 2020 2021
## 2018    1        NA       NA   NA   NA
## 2019    1 1.0000000       NA   NA   NA
## 2020    1 1.0000000 1.0000000   NA   NA
## 2021    1 0.8147184 0.8058628    1   NA
## 2022    1 1.0000000 1.0000000    1    1
## [1] "Final class discussion session (last day)"
```

```
##              2017 2018      2019 2020 2021
## 2018 1.00000000   NA        NA   NA   NA
## 2019 0.05752352    1        NA   NA   NA
## 2020 1.00000000    1 0.05752352  NA   NA
## 2021 1.00000000    1 0.19394869   1   NA
## 2022 1.00000000    1 0.13401895   1    1
## [1] "Introductory lecture (day 1)"
##      2017 2018 2019 2020 2021
## 2018    1   NA   NA   NA   NA
## 2019    1    1   NA   NA   NA
## 2020    1    1    1   NA   NA
## 2021    1    1    1    1   NA
## 2022    1    1    1    1    1
## [1] "Stats Intro (day 2)"
##               2017     2018      2019 2020      2021
## 2018 7.920217e-05       NA        NA   NA        NA
## 2019 1.121074e-02 0.923398        NA   NA        NA
## 2020 4.812777e-05 1.000000 0.9231893   NA        NA
## 2021 4.677896e-03 1.000000 1.0000000    1        NA
## 2022 5.872309e-06 1.000000 0.3164371    1 0.6849254
## [1] "Initial brainstorming session (day 2)"
##      2017      2018 2019 2020 2021
## 2018    1        NA   NA   NA   NA
## 2019    1 1.0000000   NA   NA   NA
## 2020    1 1.0000000    1   NA   NA
## 2021    1 0.9746626    1    1   NA
## 2022    1 0.4920238    1    1    1
## [1] "Group meetings (experiment planning and design)"
##      2017      2018 2019      2020      2021
## 2018    1        NA   NA        NA        NA
## 2019    1 0.5996380   NA        NA        NA
## 2020    1 1.0000000    1        NA        NA
## 2021    1 1.0000000    1 1.0000000        NA
## 2022    1 0.1165861    1 0.4314979 0.9808853
## [1] "Team feed-back sessions"
##               2017         2018         2019         2020      2021
## 2018 1.000000e+00          NA          NA          NA        NA
## 2019 1.000000e+00 1.000000e+00          NA          NA        NA
## 2020 1.000000e+00 1.000000e+00 1.000000e+00          NA        NA
## 2021 3.883002e-05 2.066388e-04 2.745649e-03 2.745649e-03        NA
## 2022 9.589759e-09 9.147903e-08 1.842478e-06 2.020658e-06 0.4156231
## [1] "Final group discussion session (day before the last)"
##           2017 2018      2019      2020 2021
## 2018 1.0000000   NA        NA        NA   NA
## 2019 1.0000000    1        NA        NA   NA
## 2020 1.0000000    1 1.0000000        NA   NA
## 2021 1.0000000    1 0.5053068 0.8400922   NA
## 2022 0.9660558    1 0.4379554 0.7278093    1
## [1] "Final class discussion session (last day)"
##            2017       2018       2019 2020 2021
## 2018 0.01265194         NA        NA   NA   NA
## 2019 0.12572353 1.00000000        NA   NA   NA
## 2020 1.00000000 0.00403720 0.04786672  NA   NA
## 2021 1.00000000 0.02036425 0.18483993   1   NA
```

```
## 2022 1.00000000 0.22708031 1.00000000     1     1
## [1] "Safety and clean-up weekly evaluation"
##      2017 2018 2019 2020 2021
## 2018    1   NA   NA   NA   NA
## 2019    1    1   NA   NA   NA
## 2020    1    1    1   NA   NA
## 2021    1    1    1    1   NA
## 2022    1    1    1    1    1
## [1] "Individual lab notebook evaluation (design)"
##               2017      2018 2019 2020 2021
## 2018 5.986044e-06        NA   NA   NA   NA
## 2019 3.624199e-02 0.1515468   NA   NA   NA
## 2020 3.708189e-03 0.9621303    1   NA   NA
## 2021 4.132923e-03 0.8032681    1    1   NA
## 2022 2.823163e-03 1.0000000    1    1    1
## [1] "Group lab notebook evaluation (design)"
##              2017      2018 2019 2020 2021
## 2018 0.009839814        NA   NA   NA   NA
## 2019 0.030480248 1.0000000   NA   NA   NA
## 2020 0.326865132 1.0000000    1   NA   NA
## 2021 0.862805649 0.8628056    1    1   NA
## 2022 1.000000000 0.5820280    1    1    1
## [1] "Group lab notebook evaluation (results)"
##           2017       2018      2019 2020 2021
## 2018 0.7761493         NA        NA   NA   NA
## 2019 1.0000000 0.85014326        NA   NA   NA
## 2020 1.0000000 0.08987183 1.0000000   NA   NA
## 2021 1.0000000 0.11606382 1.0000000    1   NA
## 2022 1.0000000 0.02078403 0.9301167    1    1
## [1] "Peer-evaluation (Team)"
##           2017      2018 2019 2020 2021
## 2018 0.2010087        NA   NA   NA   NA
## 2019 0.9374738 1.0000000   NA   NA   NA
## 2020 1.0000000 1.0000000    1   NA   NA
## 2021 1.0000000 0.4252861    1    1   NA
## 2022 1.0000000 1.0000000    1    1    1
## [1] "Final exam"
##            2017      2018        2019       2020         2021
## 2018 1.00000000        NA          NA         NA           NA
## 2019 1.00000000 1.0000000          NA         NA           NA
## 2020 1.00000000 1.0000000 1.000000000         NA           NA
## 2021 0.19443595 0.1119257 0.588829367 0.19443595           NA
## 2022 0.04751644 0.2425330 0.008068794 0.06184887 1.291026e-05
## [1] "State a hypothesis"
##            2017       2018      2019      2020 2021
## 2018 1.00000000         NA        NA        NA   NA
## 2019 0.04850727 0.04850727        NA        NA   NA
## 2020 1.00000000 1.00000000 0.2405459        NA   NA
## 2021 0.17406452 0.17406452 1.0000000 0.6417639   NA
## 2022 0.10429512 0.10429512 1.0000000 0.3946902    1
## [1] "Design an experimental strategy to answer specific biological questions"
##           2017       2018 2019 2020      2021
## 2018 0.2256925         NA   NA   NA        NA
## 2019 1.0000000 1.00000000   NA   NA        NA
```

```
## 2020 1.0000000 0.11316070    1    NA         NA
## 2021 1.0000000 0.05348894    1    1          NA
## 2022 1.0000000 1.00000000    1    1 0.6999663
## [1] "Identify cost-effective (time and money-wise) practical techniques to answer a given question"
##          2017       2018      2019 2020 2021
## 2018 0.8223218         NA        NA   NA   NA
## 2019 1.0000000 0.1174194        NA   NA   NA
## 2020 1.0000000 0.8007973 1.0000000   NA   NA
## 2021 1.0000000 1.0000000 0.8007973    1   NA
## 2022 1.0000000 1.0000000 1.0000000    1    1
## [1] "Write an experimental protocol including all relevant controls"
##           2017       2018 2019 2020 2021
## 2018 0.05017013         NA   NA   NA   NA
## 2019 1.00000000 0.11678843   NA   NA   NA
## 2020 1.00000000 0.03687698    1   NA   NA
## 2021 1.00000000 0.22014254    1    1   NA
## 2022 1.00000000 0.71000111    1    1    1
## [1] "Execute an experimental protocol"
##           2017      2018 2019 2020 2021
## 2018 0.06715688        NA   NA   NA   NA
## 2019 1.00000000 1.0000000   NA   NA   NA
## 2020 1.00000000 0.5912804    1   NA   NA
## 2021 1.00000000 0.2934492    1    1   NA
## 2022 1.00000000 0.5927727    1    1    1
## [1] "Record, analyze and interpret experimental results"
##           2017       2018 2019      2020 2021
## 2018 0.05965194         NA   NA        NA   NA
## 2019 1.00000000 0.17943892   NA        NA   NA
## 2020 1.00000000 0.08604197    1        NA   NA
## 2021 1.00000000 0.38331922    1 1.0000000   NA
## 2022 0.57856745 1.00000000    1 0.7137619    1
## [1] "Integrate information from other researchers and discuss your results within a larger context"
##      2017 2018 2019 2020 2021
## 2018    1   NA   NA   NA   NA
## 2019    1    1   NA   NA   NA
## 2020    1    1    1   NA   NA
## 2021    1    1    1    1   NA
## 2022    1    1    1    1    1
## [1] "Follow lab safety rules"
##      2017      2018 2019 2020 2021
## 2018    1        NA   NA   NA   NA
## 2019    1 0.3584685   NA   NA   NA
## 2020    1 1.0000000    1   NA   NA
## 2021    1 1.0000000    1    1   NA
## 2022    1 0.0763971    1    1    1
## [1] "Ability to work in a team"
##           2017      2018 2019 2020 2021
## 2018 0.5300693        NA   NA   NA   NA
## 2019 1.0000000 1.0000000   NA   NA   NA
## 2020 1.0000000 0.9486344    1   NA   NA
## 2021 1.0000000 1.0000000    1    1   NA
## 2022 1.0000000 1.0000000    1    1    1
## [1] "I knew OneNote before the course."
##            2019      2020      2021
```

```
## 2020 1.000000000          NA          NA
## 2021 1.000000000 1.00000000          NA
## 2022 0.001084163 0.01673493 0.01673493
## [1] "I find OneNote a useful app for the elaboration of the course Notebook."
##           2019         2020       2021
## 2020 0.0194452          NA         NA
## 2021 0.4290317 0.4290317085         NA
## 2022 0.4290317 0.0009279188 0.05334355
## [1] "I think we had enough previous information about the use of OneNote for the course laboratory n
##           2019         2020       2021
## 2020 0.9032147          NA         NA
## 2021 0.2647527 0.08479041         NA
## 2022 0.2647527 0.08179045 0.9032147
## [1] "I would prefer other applications like Evernote, Google Docs, or MS Word."
##            2019          2020         2021
## 2020 0.350094298           NA           NA
## 2021 0.285699438 7.806553e-01           NA
## 2022 0.000694997 7.056524e-06 1.613306e-06
## [1] "The structure of the Notebook in Sections, Pages, and Subpages was easy to understand and use."
##      2019      2020      2021
## 2020    1        NA        NA
## 2021    1 1.0000000        NA
## 2022    1 0.9442328 0.9442328
## [1] "I would recommend to use OneNote for the ELN next year."
##             2019         2020       2021
## 2020 0.002215487           NA         NA
## 2021 0.172920608 1.962236e-01         NA
## 2022 0.228618042 6.958609e-05 0.01373391
## [1] "It overall allowed us to save time through the whole course."
##           2019       2020      2021
## 2020 0.3052495         NA        NA
## 2021 0.7158066 0.54233771        NA
## 2022 0.5564205 0.03337407 0.5423377
## [1] "It helped us in the preparation of the final version to be presented."
##          2019      2020       2021
## 2020 0.1701509        NA         NA
## 2021 0.1701509 0.9558176         NA
## 2022 0.7062676 0.0374604 0.03256321
## [1] "It made it easier working in groups."
##            2019         2020       2021
## 2020 0.01181064           NA         NA
## 2021 0.50976729 5.372195e-02         NA
## 2022 0.10713885 2.366656e-05 0.04984517
## [1] "It could be useful for other practical courses."
##            2019         2020       2021
## 2020 0.09691404           NA         NA
## 2021 0.55929640 0.598200546         NA
## 2022 0.59820055 0.009901279 0.1035011
## [1] "Synchronization issues hindered our teamworking."
##            2019       2020       2021
## 2020 1.00000000         NA         NA
## 2021 1.00000000 1.0000000         NA
## 2022 0.06488059 0.2322175 0.06488059
## [1] "Conflicts of versions were very frequent."
```

```
##            2019      2020      2021
## 2020 0.74604855        NA        NA
## 2021 0.74604855 0.9710615        NA
## 2022 0.03894251 0.5201819 0.5201819
## [1] "Access to the ELN was slow."
##           2019       2020 2021
## 2020 0.2325937         NA   NA
## 2021 0.7892961 0.02082084   NA
## 2022 1.0000000 0.10289719    1
## [1] "We missed several wordprocessing features."
##      2019 2020 2021
## 2020    1   NA   NA
## 2021    1    1   NA
## 2022    1    1    1
## [1] "Some features of the application did not work properly."
##            2019      2020 2021
## 2020 1.00000000        NA   NA
## 2021 0.11460584 0.1956151   NA
## 2022 0.05474198 0.1146058    1
## [1] "The template helped us to prepare the final version of the notebook."
##              2019         2020       2021
## 2020 7.618311e-01           NA         NA
## 2021 1.688823e-05 0.0004018526         NA
## 2022 3.999242e-01 0.7618310929 0.01161285
## [1] "The structure of the template matches the evaluation rubric."
##              2019         2020        2021
## 2020 1.0000000000           NA          NA
## 2021 0.0001986663 0.0009679592          NA
## 2022 1.0000000000 1.0000000000 0.006709094
## [1] "The structure of 4 independent notes helped to understand each step of the work in a research la
##           2019      2020      2021
## 2020 0.7663575        NA        NA
## 2021 0.2501597 0.9376949        NA
## 2022 0.9376949 0.7663575 0.2501597
## [1] "The word limit in some sections of the template is appropriate (1"
##      2019 2020 2021
## 2020    1   NA   NA
## 2021    1    1   NA
## 2022    1    1    1
## [1] "We had to modify some sections of the template to suit our experimental work."
##              2019      2020      2021
## 2020 3.220546e-06        NA        NA
## 2021 1.115448e-06 0.8425691        NA
## 2022 1.868463e-03 0.3594123 0.3594123
## [1] "The template will facilitate an even evaluation."
##              2019        2020        2021
## 2020 9.979675e-01          NA          NA
## 2021 6.709339e-05 0.003506002          NA
## 2022 1.000000e+00 1.000000000 0.001176378
## [1] "The use of an ELN with OneNote in this course will help us in future laboratory work (TFG, TFM,
##           2019      2020      2021
## 2020 0.4321188        NA        NA
## 2021 0.4232123 1.0000000        NA
## 2022 1.0000000 0.4232123 0.3318217
```

Boxplots

Answers from each question are displayed in Boxplots by Year and significant differences from the overall answers are marked.

```r
#update question nubers
#stack table and add question type (except open)
subdata.stack <- cbind(subdata[,1],stack(subdata[,2:72]))
names(subdata.stack) <- c("Curso","value","question")
#add categories
for (i in 1:nrow(subdata.stack)){
  subdata.stack[i,4] <- questions$Section[subdata.stack[i,3]==paste0("Q",questions$No.)]
}
names(subdata.stack) <- c("Curso","value","question","section")

pp <- list()
plot <- list()

#plot in groups by section


for (i in 1:length(levels(as.factor(subdata.stack$section)))){
  kkk <- subdata.stack[subdata.stack$section==levels(as.factor(subdata.stack$section))[i],]
  pp[[i]] <- ggboxplot(kkk, x = "Curso", y = "value",
          color = "Curso", fill = "Curso",palette = "jco",
          add = "jitter",alpha = 0.3, ylim = c(0, 6),
          facet.by = "question")
  plot[[i]] <- pp[[i]] + ggtitle(levels(as.factor(subdata.stack$section))[i]) + theme(axis.text.x = elem
    stat_compare_means(label = "p.signif",method = "t.test", ref.group = ".all.", hide.ns = TRUE,label.y
}
```

```r
plot[[1]]
```

Activities interest
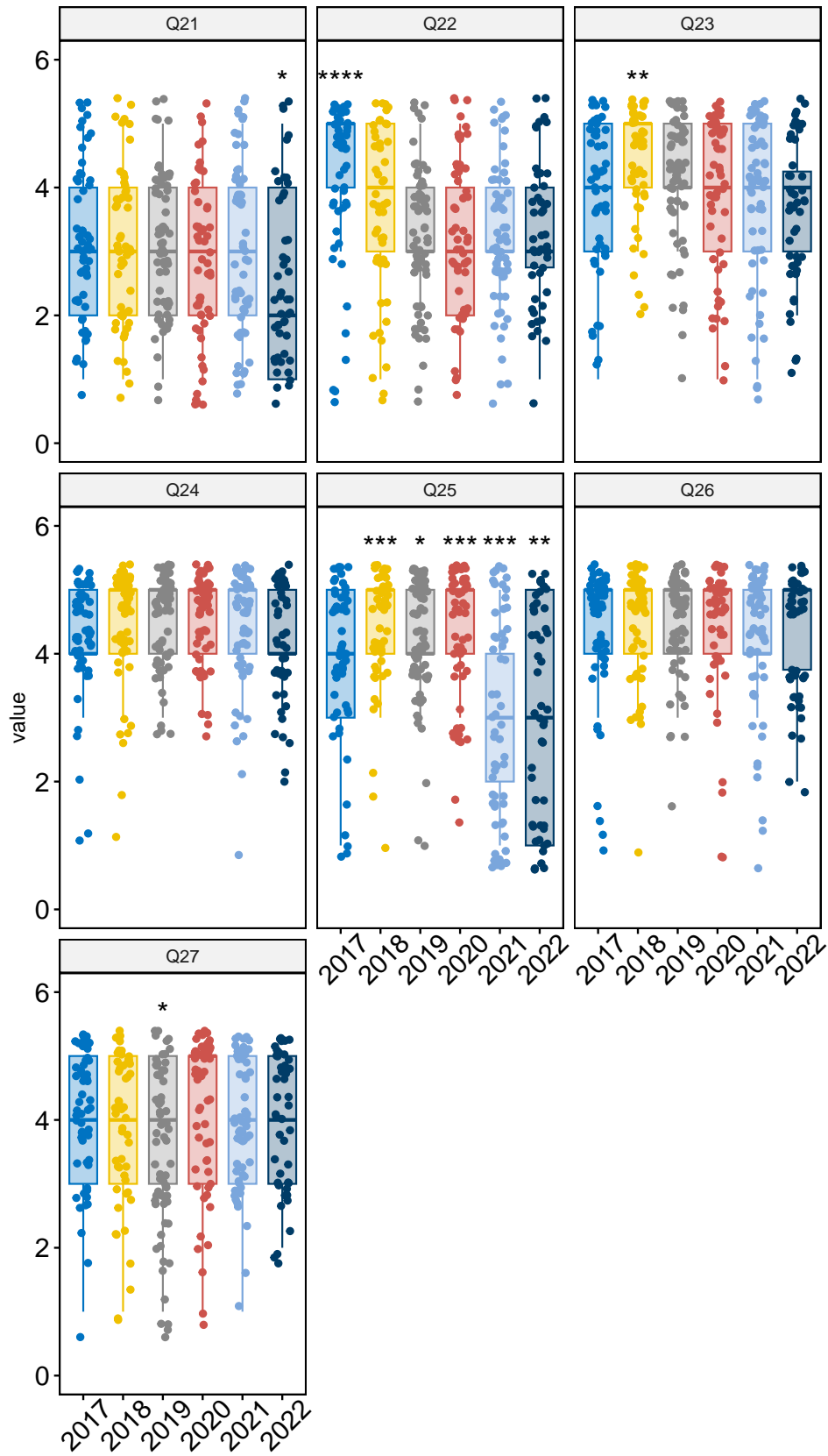
```
plot[[2]]
```

Activities Length

```
plot[[3]]
```

Assesment


```
plot[[4]]
```

ELN

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```
plot[[5]]
```


Equipment
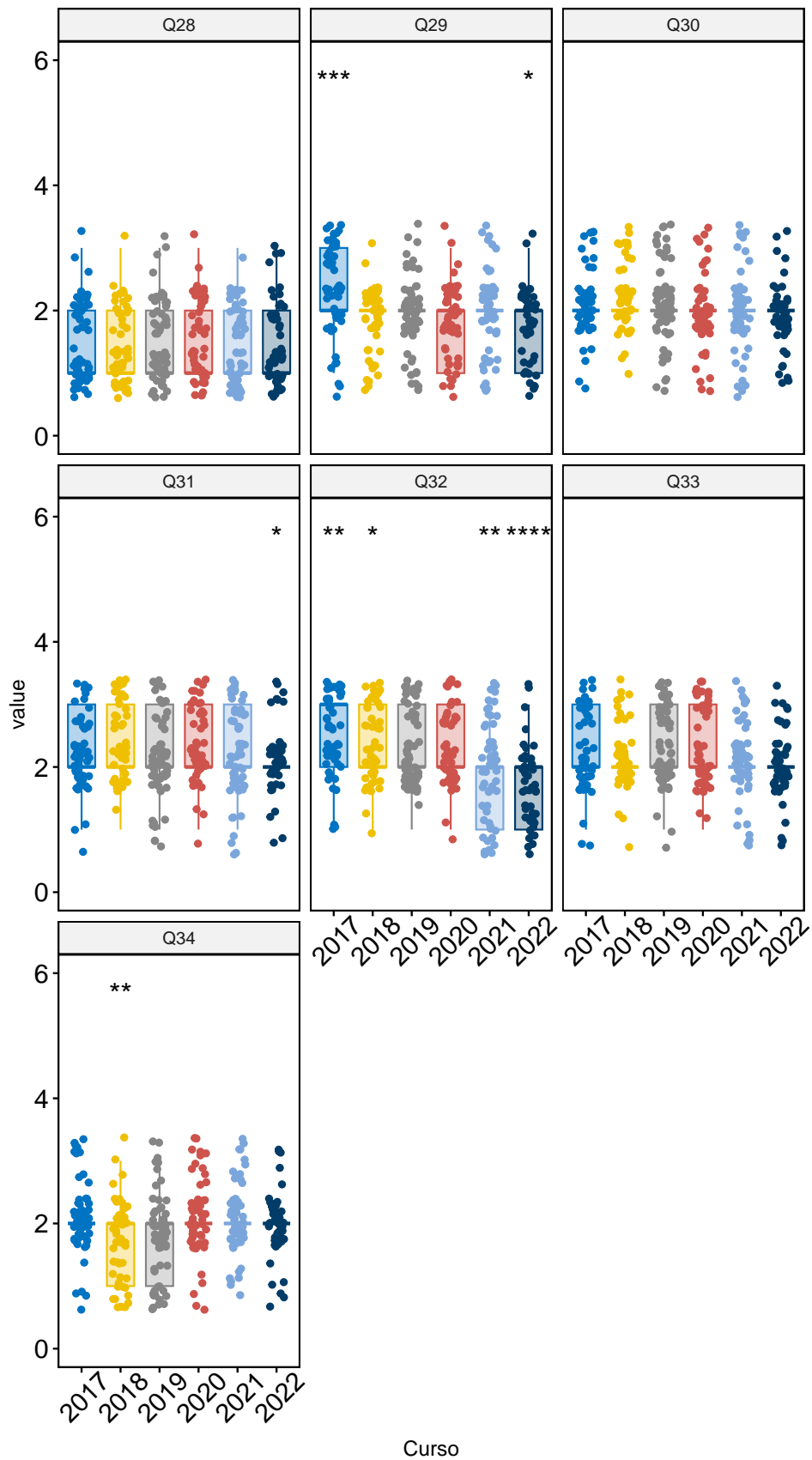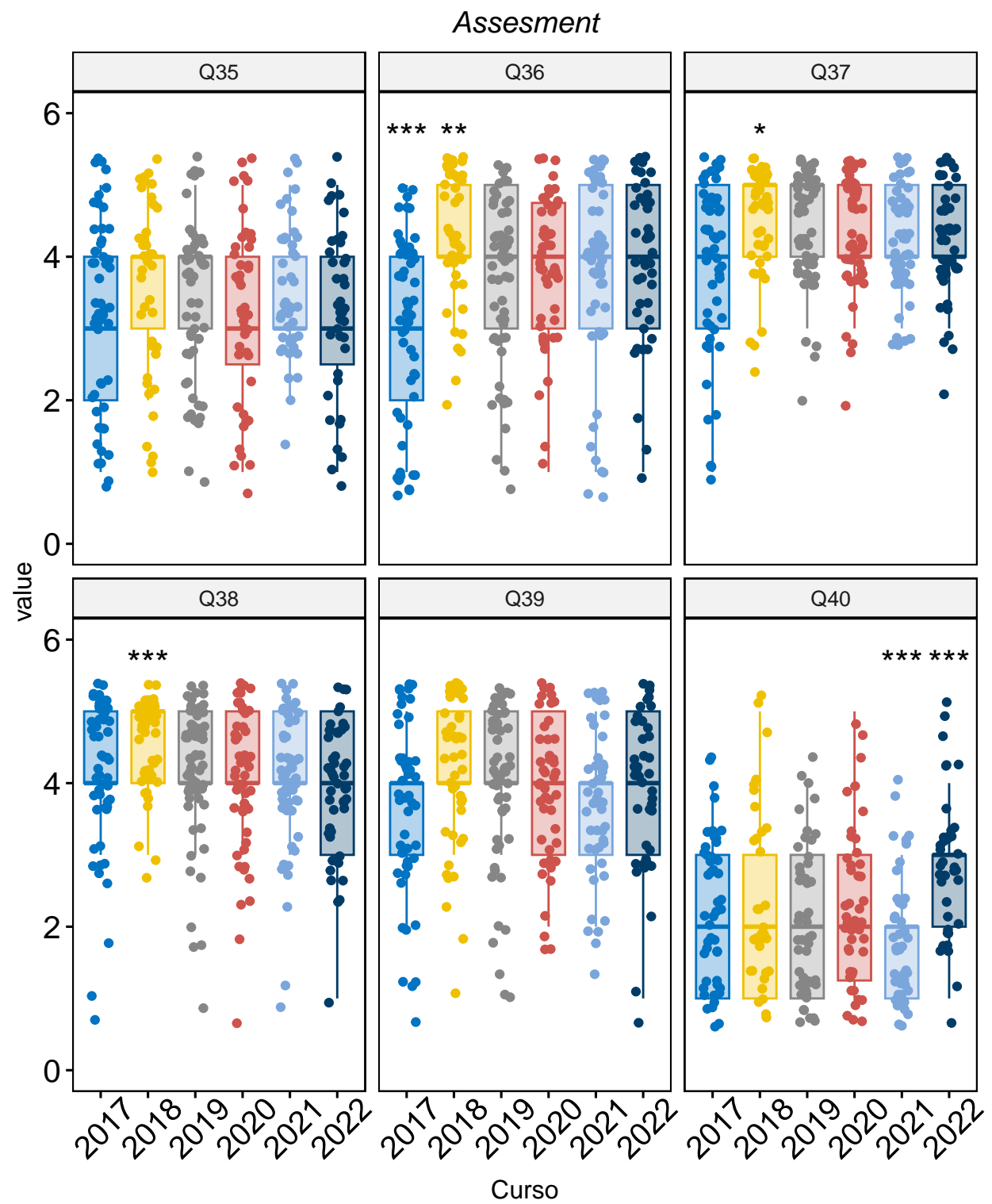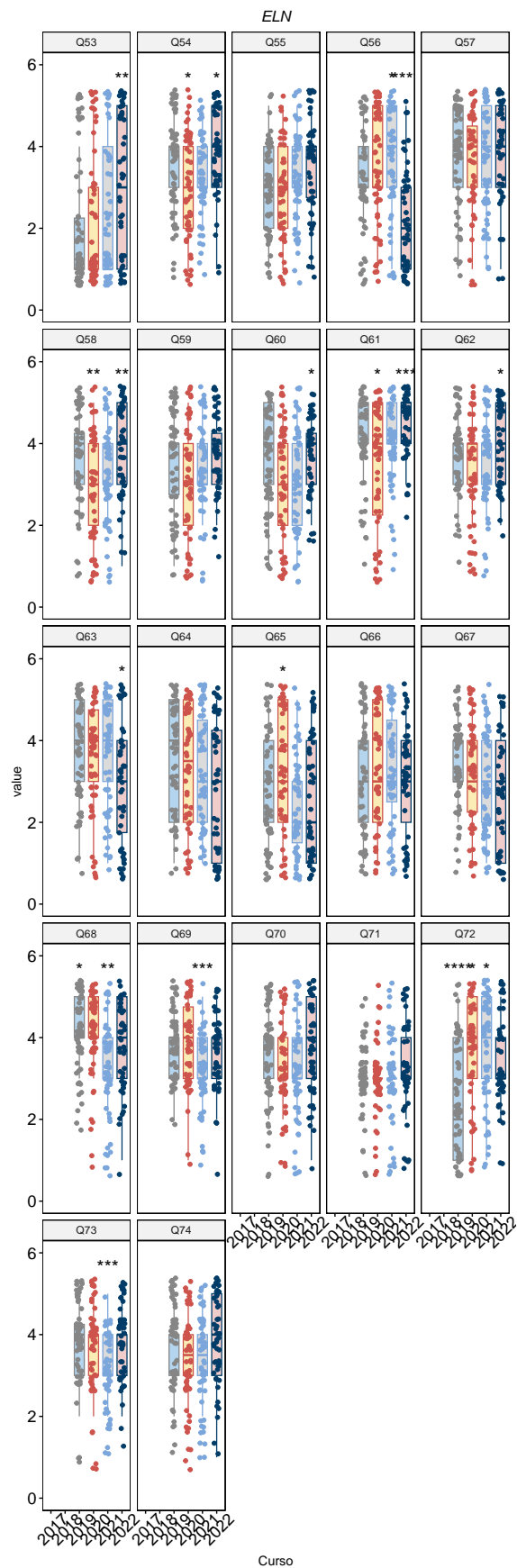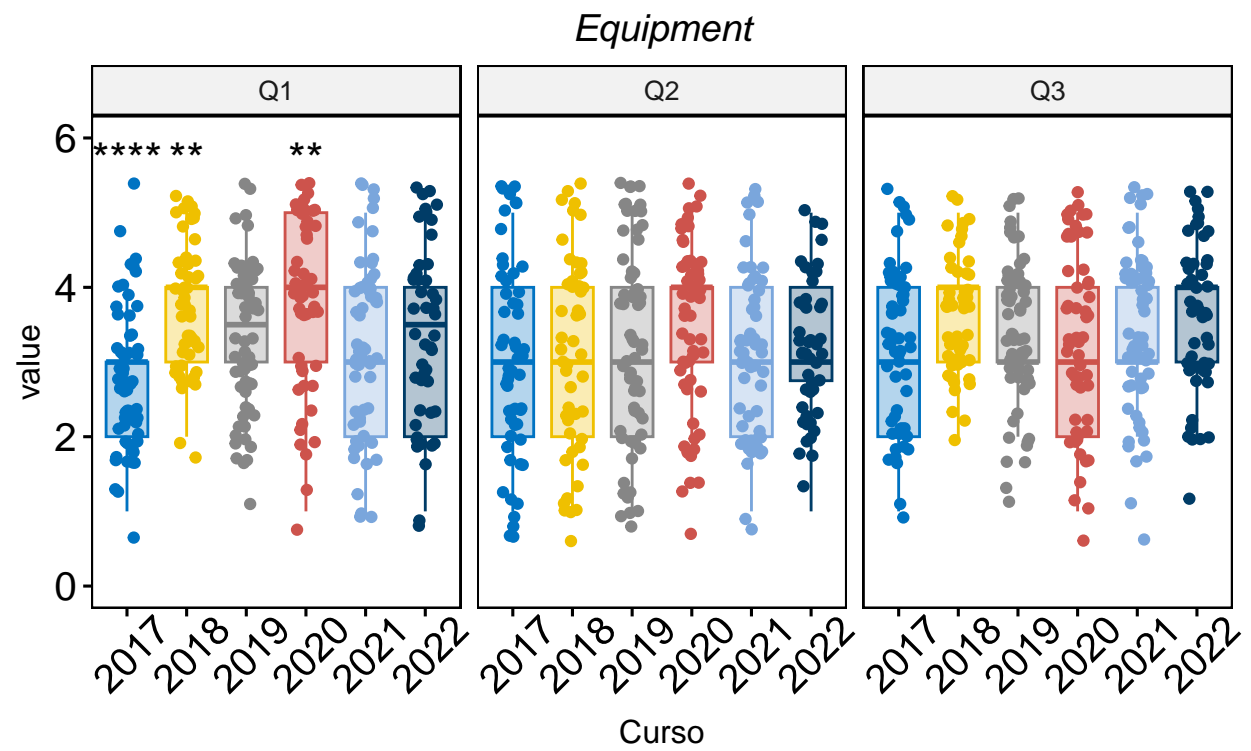
```
plot[[6]]
```

General Methodology
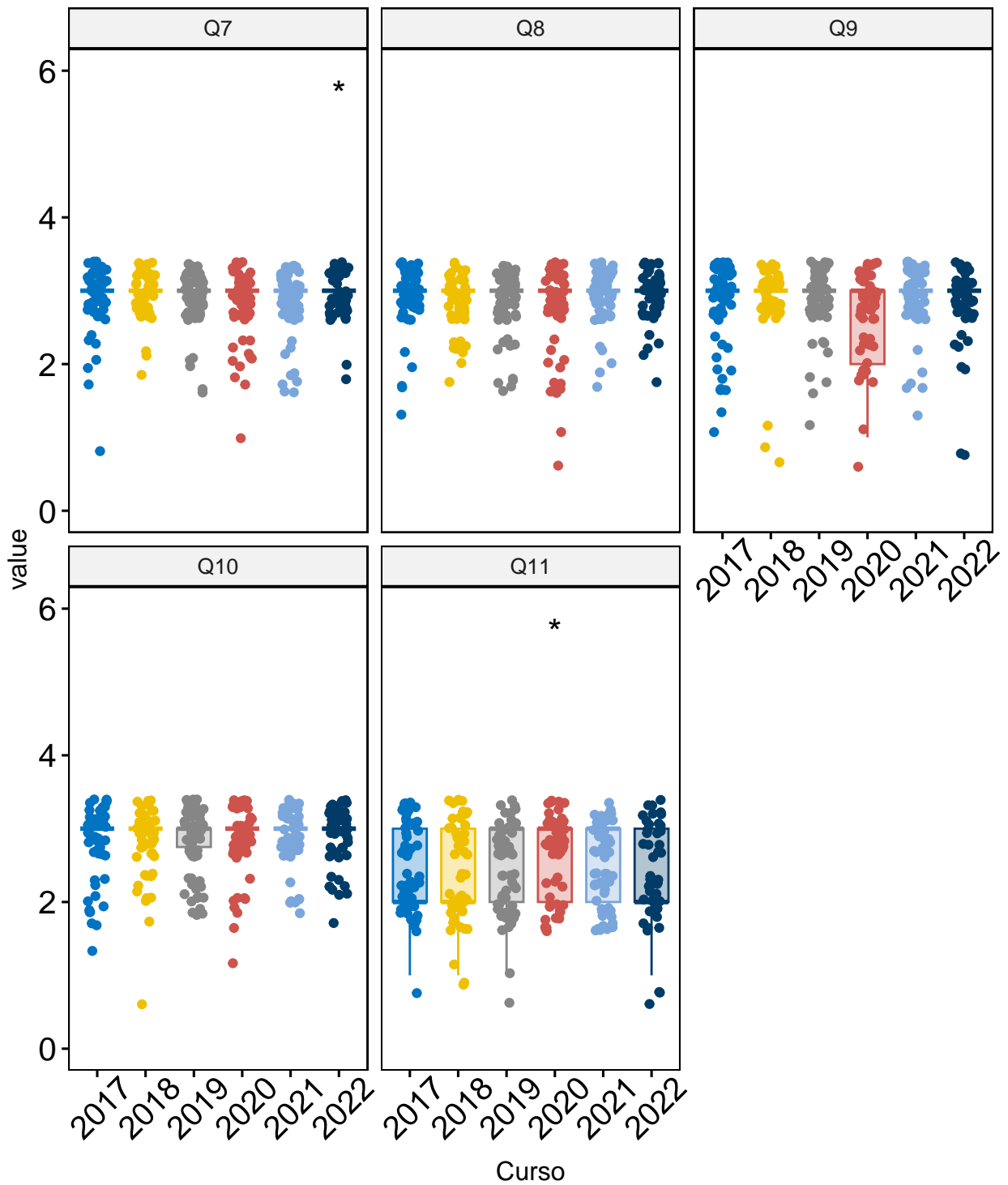
```
plot[[7]]
```

Learning Objectives

```
plot[[8]]
```

Length and schedule
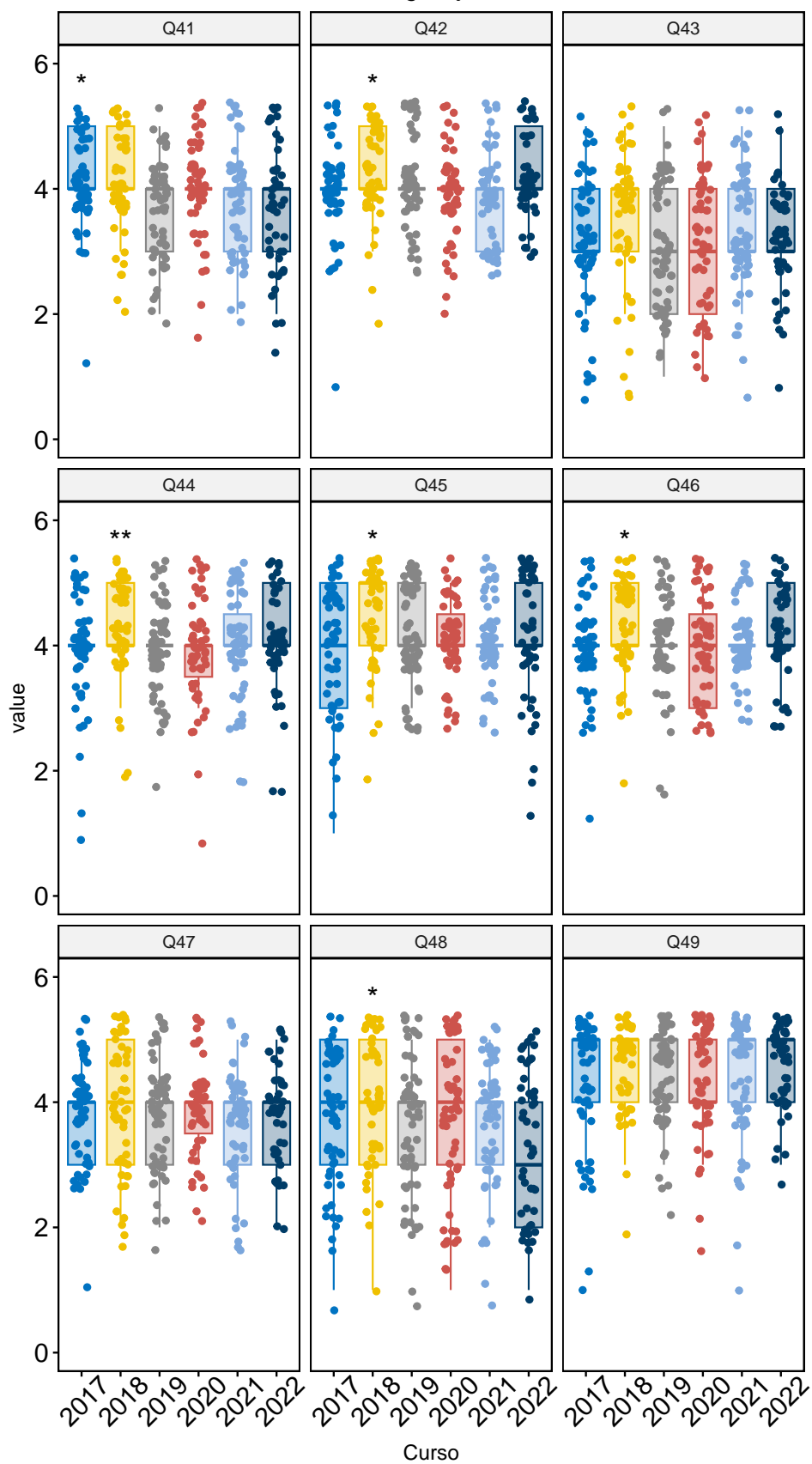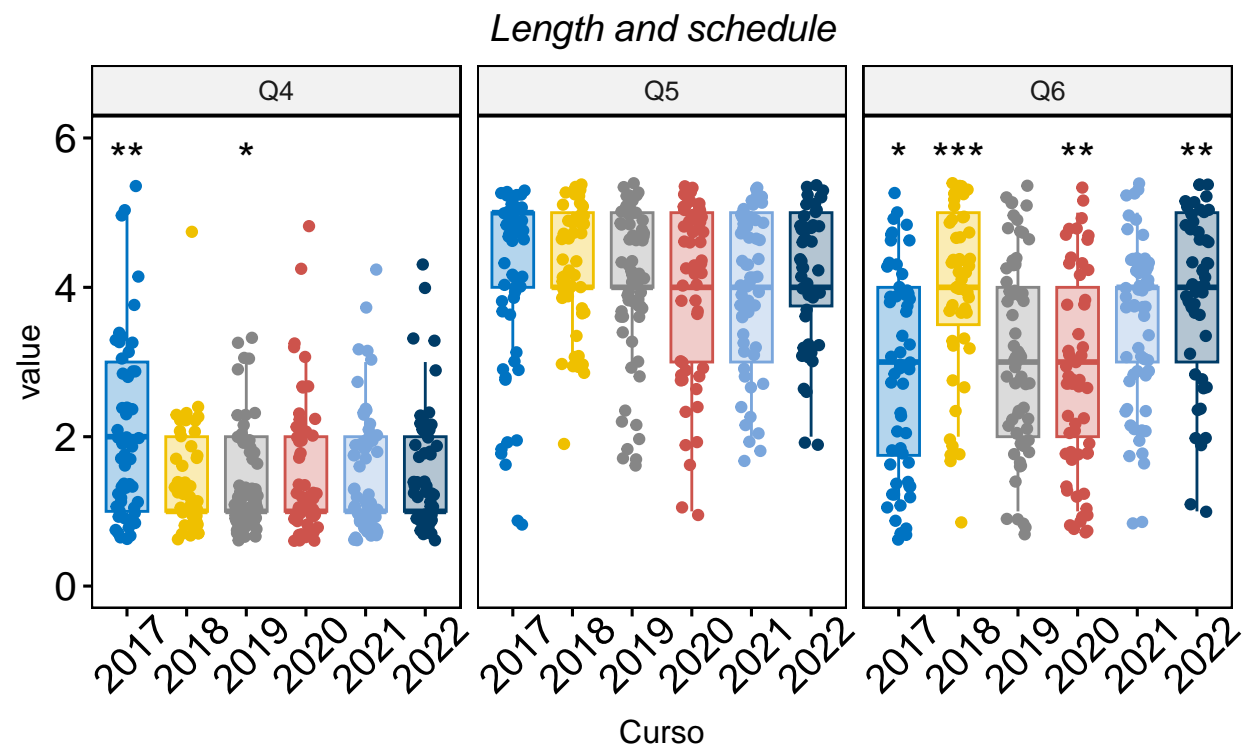

```
plot[[9]]
```

Method objectives
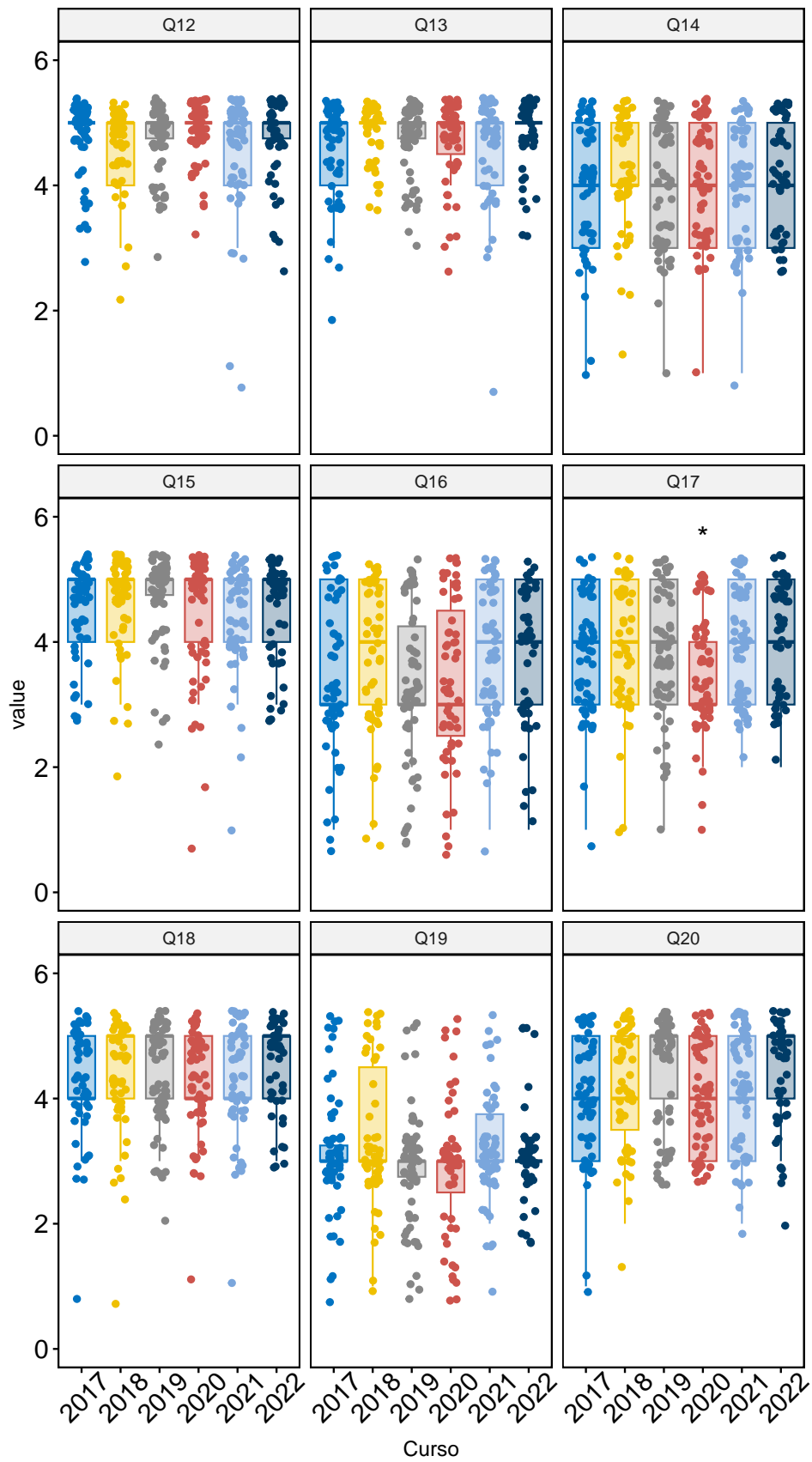
Likert scale plots

Answers in Likert scales are represented by sections in the quiz.

General Methodology

```r
#lickert
#change question names
tablita <- data.frame(matrix(NA,      # Create empty data frame
                             nrow = length(colnames(subdata)),
                             ncol = 2))
for (i in 2:length(colnames(subdata))){
  tablita[i-1,] <- cbind(colnames(subdata[i]),questions$Question[as.numeric(gsub("\\D", "",colnames(subda
  colnames(subdata)[i] <- tablita[i-1,2]
}

for (i in 2:72){
  subdata[,i] <- factor(subdata[,i])
}
#questions with 3 options
#General Methodology
subdata[,c(8:12)] <- lapply(subdata[,c(8:12)], function(x) factor(x,
      labels = c("Traditional","Same","Open Question"))
  )
xlikgroup3a = likert(subdata[,c(8:12)], grouping = subdata$Curso)
plot(xlikgroup3a, type = "bar", centered = T)
```

	Course difficulty		
2022	6%	50%	44%
2021	0%	49%	51%
2020	0%	33%	67%
2019	3%	45%	52%
2018	6%	47%	47%
2017	2%	50%	48%

	Course interest		
2022	0%	10%	90%
2021	0%	8%	92%
2020	4%	20%	76%
2019	0%	16%	84%
2018	0%	16%	84%
2017	2%	7%	91%

	Course usefulness		
2022	4%	12%	83%
2021	2%	8%	90%
2020	4%	25%	71%
2019	2%	11%	88%
2018	6%	0%	94%
2017	4%	18%	79%

	Demand on student's part		
2022	0%	17%	83%
2021	0%	12%	88%
2020	2%	15%	84%
2019	0%	25%	75%
2018	2%	20%	78%
2017	2%	20%	79%

	Student engagement		
2022	0%	4%	96%
2021	0%	15%	85%
2020	2%	18%	80%
2019	0%	8%	92%
2018	0%	6%	94%
2017	2%	11%	88%

Percentage

Response   Traditional   Same   Open Question

Activities Length

```
subdata[,c(29:35)] <- lapply(subdata[,c(29:35)], function(x) factor(x,
    labels = c("Less","Fine","More"))
  )

xlikgroup3b = likert(subdata[,c(29:35)], grouping = subdata$Curso)

plot(xlikgroup3b, type = "bar", centered = T)
```

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Final class discussion session (last day)

	Less	Fine	More
2022	12%	77%	10%
2021	12%	69%	19%
2020	9%	69%	22%
2019	30%	58%	12%
2018	35%	57%	8%
2017	9%	73%	18%

Final group discussion session (day before the last)

	Less	Fine	More
2022	10%	71%	19%
2021	12%	66%	22%
2020	4%	64%	33%
2019	5%	59%	36%
2018	6%	73%	22%
2017	5%	62%	32%

Group meetings (experiment planning and design)

	Less	Fine	More
2022	8%	77%	15%
2021	12%	50%	38%
2020	5%	58%	36%
2019	12%	59%	28%
2018	2%	59%	39%
2017	5%	66%	29%

Initial brainstorming session (day 2)

	Less	Fine	More
2022	17%	73%	10%
2021	17%	67%	16%
2020	15%	69%	16%
2019	14%	62%	23%
2018	6%	71%	24%
2017	9%	73%	18%

Introductory lecture (day 1)

	Less	Fine	More
2022	60%	31%	8%
2021	52%	47%	2%
2020	51%	45%	4%
2019	53%	41%	6%
2018	61%	37%	2%
2017	54%	41%	5%

Stats Intro (day 2)

	Less	Fine	More
2022	31%	65%	4%
2021	22%	62%	16%
2020	27%	65%	7%
2019	17%	69%	14%
2018	24%	73%	4%
2017	12%	43%	45%

Team feed-back sessions

	Less	Fine	More
2022	38%	54%	8%
2021	31%	45%	24%
2020	4%	58%	38%
2019	2%	64%	34%
2018	4%	49%	47%
2017	5%	43%	52%

Percentage

Response   Less   Fine   More

```
#title(main = "Activities Length", xlab = "X axis", ylab = "Y axis", cex.main = 4,    font.main = 3)
#legend("bottom",  c("Less","Fine","More"))
```

Equipment

```
subdata[,c(2:4)] <- lapply(subdata[,c(2:4)], function(x) factor(x,
     labels = c("Not at all","Disagree","OK","Agree","Completely Agree"))
  )

xlikgroup5a = likert(subdata[,c(2:4)], grouping = subdata$Curso)
plot(xlikgroup5a, type = "bar", centered = T)
```


Length and Schedule

```
subdata[,c(5:7)] <- lapply(subdata[,c(5:7)], function(x) factor(x,
     labels = c("Not at all","Disagree","OK","Agree","Completely Agree"))
  )
xlikgroup5b = likert(subdata[,c(5:7)], grouping = subdata$Curso)
plot(xlikgroup5b, type = "bar", centered = T)
```

On average, the number of hours per day is sufficient

Year	Not at all / Disagree	OK	Agree / Completely Agree
2022	15%	12%	73%
2021	22%	22%	56%
2020	44%	27%	29%
2019	36%	22%	42%
2018	14%	12%	75%
2017	41%	20%	39%

The course is too long

Year	Not at all / Disagree	OK	Agree / Completely Agree
2022	90%	6%	4%
2021	90%	7%	3%
2020	85%	11%	4%
2019	92%	8%	0%
2018	98%	0%	2%
2017	71%	20%	9%

The period allocated for the course within the term is appropriate

Year	Not at all / Disagree	OK	Agree / Completely Agree
2022	4%	21%	75%
2021	12%	15%	73%
2020	13%	16%	71%
2019	12%	8%	80%
2018	2%	18%	80%
2017	12%	11%	77%

Percentage

Response: Not at all | Disagree | OK | Agree | Completely Agree

Method Objectives

```
subdata[,c(13:21)] <- lapply(subdata[,c(13:21)], function(x) factor(x,
    labels = c("Not at all","Disagree","OK","Agree","Completely Agree"))
  )
xlikgroup5c = likert(subdata[,c(13:21)], grouping = subdata$Curso)
plot(xlikgroup5c, type = "bar", centered = T)
```

Ability to work in a team

Year	Not at all / Disagree	OK	Agree / Completely Agree
2022	2%	15%	83%
2021	3%	26%	71%
2020	0%	29%	71%
2019	0%	23%	77%
2018	4%	22%	75%
2017	4%	27%	70%

Design an experimental strategy to answer specific biological questions

Year	Not at all / Disagree	OK	Agree / Completely Agree
2022	0%	4%	96%
2021	2%	5%	93%
2020	0%	7%	93%
2019	0%	3%	97%
2018	0%	0%	100%
2017	2%	5%	93%

Execute an experimental protocol

Year	Not at all / Disagree	OK	Agree / Completely Agree
2022	10%	31%	58%
2021	10%	34%	55%
2020	25%	29%	45%
2019	20%	39%	41%
2018	12%	31%	57%
2017	18%	41%	41%

Follow lab safety rules

Year	Not at all / Disagree	OK	Agree / Completely Agree
2022	15%	73%	12%
2021	14%	60%	26%
2020	25%	55%	20%
2019	25%	58%	17%
2018	14%	55%	31%
2017	16%	59%	25%

Identify cost–effective (time and money–wise) practical techniques to answer a given question

Year	Not at all / Disagree	OK	Agree / Completely Agree
2022	0%	31%	69%
2021	3%	26%	71%
2020	2%	31%	67%
2019	3%	33%	64%
2018	6%	14%	80%
2017	5%	29%	66%

Integrate information from other researchers and discuss your results within a larger context

Year	Not at all / Disagree	OK	Agree / Completely Agree
2022	0%	12%	88%
2021	2%	16%	83%
2020	2%	15%	84%
2019	2%	12%	86%
2018	4%	10%	86%
2017	2%	12%	86%

Record, analyze and interpret experimental results

Year	Not at all / Disagree	OK	Agree / Completely Agree
2022	2%	33%	65%
2021	2%	40%	59%
2020	7%	45%	47%
2019	11%	23%	66%
2018	6%	29%	65%
2017	4%	38%	59%

State a hypothesis

Year	Not at all / Disagree	OK	Agree / Completely Agree
2022	0%	8%	92%
2021	3%	5%	91%
2020	0%	2%	98%
2019	0%	2%	98%
2018	2%	4%	94%
2017	0%	7%	93%

Write an experimental protocol including all relevant controls

Year	Not at all / Disagree	OK	Agree / Completely Agree
2022	0%	17%	83%
2021	3%	5%	91%
2020	4%	15%	82%
2019	2%	5%	94%
2018	2%	8%	90%
2017	0%	12%	88%

Percentage

Response: Not at all · Disagree · OK · Agree · Completely Agree

Activities Interest

```r
subdata[,c(22:28)] <- lapply(subdata[,c(22:28)], function(x) factor(x,
      labels = c("Not at all","Disagree","OK","Agree","Completely Agree"))
  )


xlikgroup5d = likert(subdata[,c(22:28)], grouping = subdata$Curso)
plot(xlikgroup5d, type = "bar", centered = T)
```

Final class discussion session (last day)

Year	Not at all	Disagree	OK	Agree	Completely Agree
2022	8%		25%		67%
2021	5%		25%		69%
2020	11%		18%		71%
2019	20%		28%		52%
2018	14%		24%		63%
2017	5%		21%		73%

Final group discussion session (day before the last)

Year	Not at all	Disagree	OK	Agree	Completely Agree
2022	4%		21%		75%
2021	10%		10%		80%
2020	7%		5%		87%
2019	2%		11%		88%
2018	2%		12%		86%
2017	7%		5%		88%

Group meetings (experiment planning and design)

Year	Not at all	Disagree	OK	Agree	Completely Agree
2022	4%		17%		79%
2021	3%		10%		86%
2020	0%		7%		93%
2019	0%		9%		91%
2018	4%		10%		86%
2017	5%		5%		89%

Initial brainstorming session (day 2)

Year	Not at all	Disagree	OK	Agree	Completely Agree
2022	15%		25%		60%
2021	19%		12%		69%
2020	18%		11%		71%
2019	8%		12%		80%
2018	6%		10%		84%
2017	11%		16%		73%

Introductory lecture (day 1)

Year	Not at all	Disagree	OK	Agree	Completely Agree
2022	58%		15%		27%
2021	44%		14%		42%
2020	40%		31%		29%
2019	30%		36%		34%
2018	33%		25%		41%
2017	29%		39%		32%

Stats Intro (day 2)

Year	Not at all	Disagree	OK	Agree	Completely Agree
2022	25%		31%		44%
2021	22%		39%		39%
2020	27%		31%		42%
2019	23%		33%		44%
2018	20%		24%		57%
2017	11%		9%		80%

Team feed−back session (propossal design)

Year	Not at all	Disagree	OK	Agree	Completely Agree
2022	38%		17%		46%
2021	46%		15%		39%
2020	4%		16%		80%
2019	5%		17%		78%
2018	6%		6%		88%
2017	11%		16%		73%

Percentage

Response: Not at all | Disagree | OK | Agree | Completely Agree

Assessment

```r
subdata[,c(36:41)] <- lapply(subdata[,c(36:41)], function(x) factor(x,
      labels = c("Not at all","Disagree","OK","Agree","Completely Agree"))
  )


xlikgroup5e = likert(subdata[,c(36:41)], grouping = subdata$Curso)
plot(xlikgroup5e, type = "bar", centered = T)
```

Final exam

Year	Not at all / Disagree	OK	Agree / Completely Agree
2022	32%	50%	18%
2021	82%	13%	4%
2020	65%	22%	13%
2019	61%	29%	10%
2018	64%	15%	21%
2017	57%	35%	8%

Group lab notebook evaluation (design)

Year	Not at all / Disagree	OK	Agree / Completely Agree
2022	2%	13%	85%
2021	0%	12%	88%
2020	2%	8%	90%
2019	2%	5%	94%
2018	2%	6%	92%
2017	11%	18%	71%

Group lab notebook evaluation (results)

Year	Not at all / Disagree	OK	Agree / Completely Agree
2022	7%	22%	72%
2021	5%	12%	83%
2020	8%	15%	77%
2019	6%	10%	84%
2018	0%	7%	93%
2017	6%	13%	81%

Individual lab notebook evaluation (design)

Year	Not at all / Disagree	OK	Agree / Completely Agree
2022	7%	25%	68%
2021	15%	13%	72%
2020	8%	20%	72%
2019	17%	20%	63%
2018	4%	13%	83%
2017	31%	25%	44%

Peer−evaluation (Team)

Year	Not at all / Disagree	OK	Agree / Completely Agree
2022	7%	21%	72%
2021	13%	28%	60%
2020	9%	22%	69%
2019	11%	14%	75%
2018	7%	17%	76%
2017	14%	26%	60%

Safety and clean−up weekly evaluation

Year	Not at all / Disagree	OK	Agree / Completely Agree
2022	26%	31%	44%
2021	9%	50%	41%
2020	26%	28%	47%
2019	22%	24%	55%
2018	21%	19%	60%
2017	33%	24%	43%

Percentage

Response: Not at all, Disagree, OK, Agree, Completely Agree

Learning Objectives

```r
subdata[,c(43:50)] <- lapply(subdata[,c(42:50)], function(x) factor(x,
      labels = c("Not at all","Disagree","OK","Agree","Completely Agree"))
  )


xlikgroup5f = likert(subdata[,c(42:50)], grouping = subdata$Curso)
plot(xlikgroup5f, type = "bar", centered = T)
```

Ability to work in a team
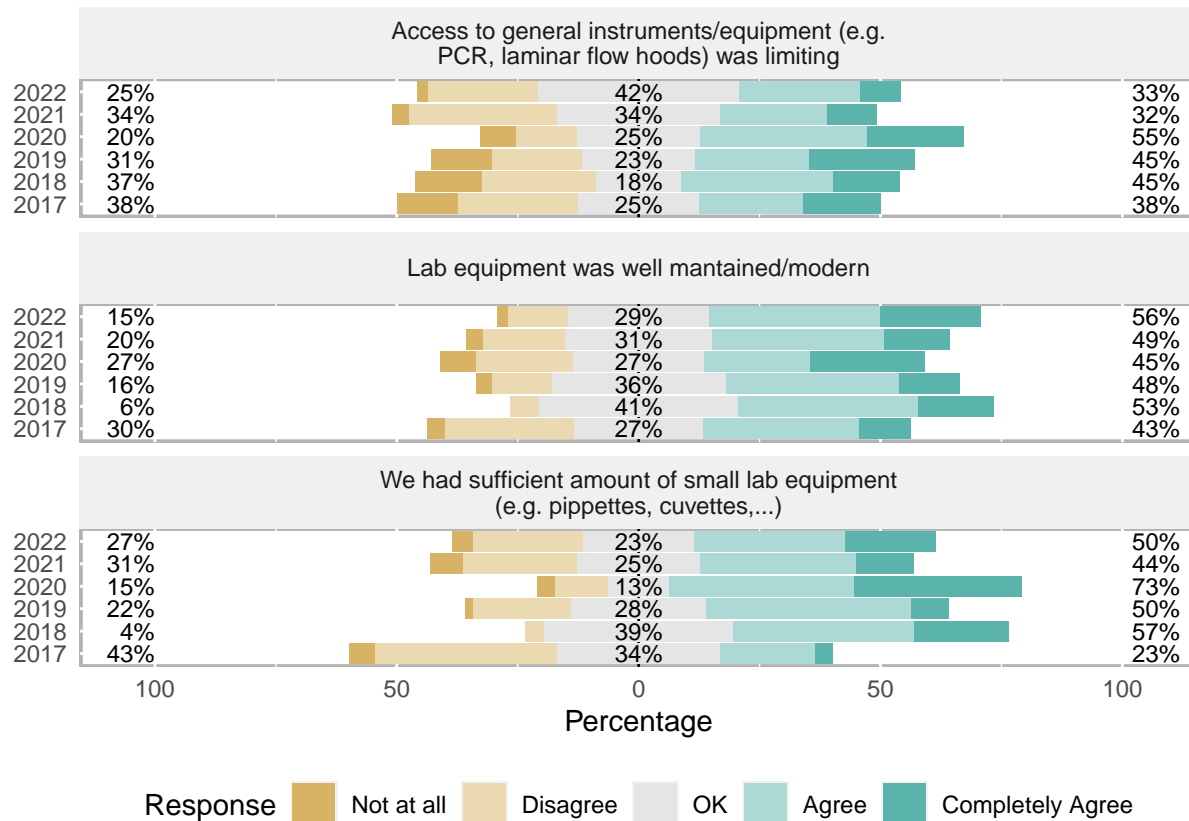
Year	Not at all / Disagree	OK	Agree / Completely Agree
2022	31%	21%	48%
2021	10%	27%	63%
2020	20%	18%	62%
2019	20%	27%	53%
2018	8%	24%	69%
2017	16%	25%	59%

Design an experimental strategy to answer specific biological questions

Year			
2022	10%	29%	60%
2021	5%	31%	64%
2020	4%	16%	80%
2019	8%	30%	62%
2018	4%	14%	82%
2017	2%	11%	88%

Execute an experimental protocol

Year			
2022	4%	12%	83%
2021	3%	19%	78%
2020	4%	22%	75%
2019	2%	22%	77%
2018	4%	4%	92%
2017	5%	16%	79%

Follow lab safety rules

Year			
2022	4%	27%	69%
2021	10%	20%	69%
2020	4%	22%	75%
2019	6%	30%	64%
2018	10%	22%	69%
2017	2%	29%	70%

Identify cost−effective (time and money−wise) practical techniques to answer a given question

Year			
2022	0%	12%	88%
2021	0%	27%	73%
2020	4%	16%	80%
2019	0%	17%	83%
2018	4%	6%	90%
2017	2%	12%	86%

Integrate information from other researchers and discuss your results within a larger context

Year			
2022	0%	15%	85%
2021	0%	12%	88%
2020	0%	27%	73%
2019	3%	12%	84%
2018	2%	10%	88%
2017	2%	18%	80%

Record, analyze and interpret experimental results

Year			
2022	6%	15%	79%
2021	0%	15%	85%
2020	0%	15%	85%
2019	0%	16%	84%
2018	2%	8%	90%
2017	7%	23%	70%

State a hypothesis

Year			
2022	10%	29%	60%
2021	5%	31%	64%
2020	4%	16%	80%
2019	8%	30%	62%
2018	4%	14%	82%
2017	2%	11%	88%

Write an experimental protocol including all relevant controls

Year			
2022	17%	42%	42%
2021	14%	44%	42%
2020	27%	31%	42%
2019	31%	36%	33%
2018	18%	20%	63%
2017	20%	43%	38%

Percentage

Response: Not at all · Disagree · OK · Agree · Completely Agree

ELN

```r
#subset to remove empty years
subdata[,c(51:72)] <- lapply(subdata[,c(51:72)], function(x) factor(x,
     labels = c("Not at all","Disagree","OK","Agree","Completely Agree"))
  )
eln <- subset(subdata[,c(1,51:72)][subdata$Curso==2019|subdata$Curso==2020|subdata$Curso==2021|subdata$C


xlikgroup5g = likert(eln[2:23], grouping = eln$Curso)
plot(xlikgroup5g, type = "bar", centered = T, title="ELN")
```
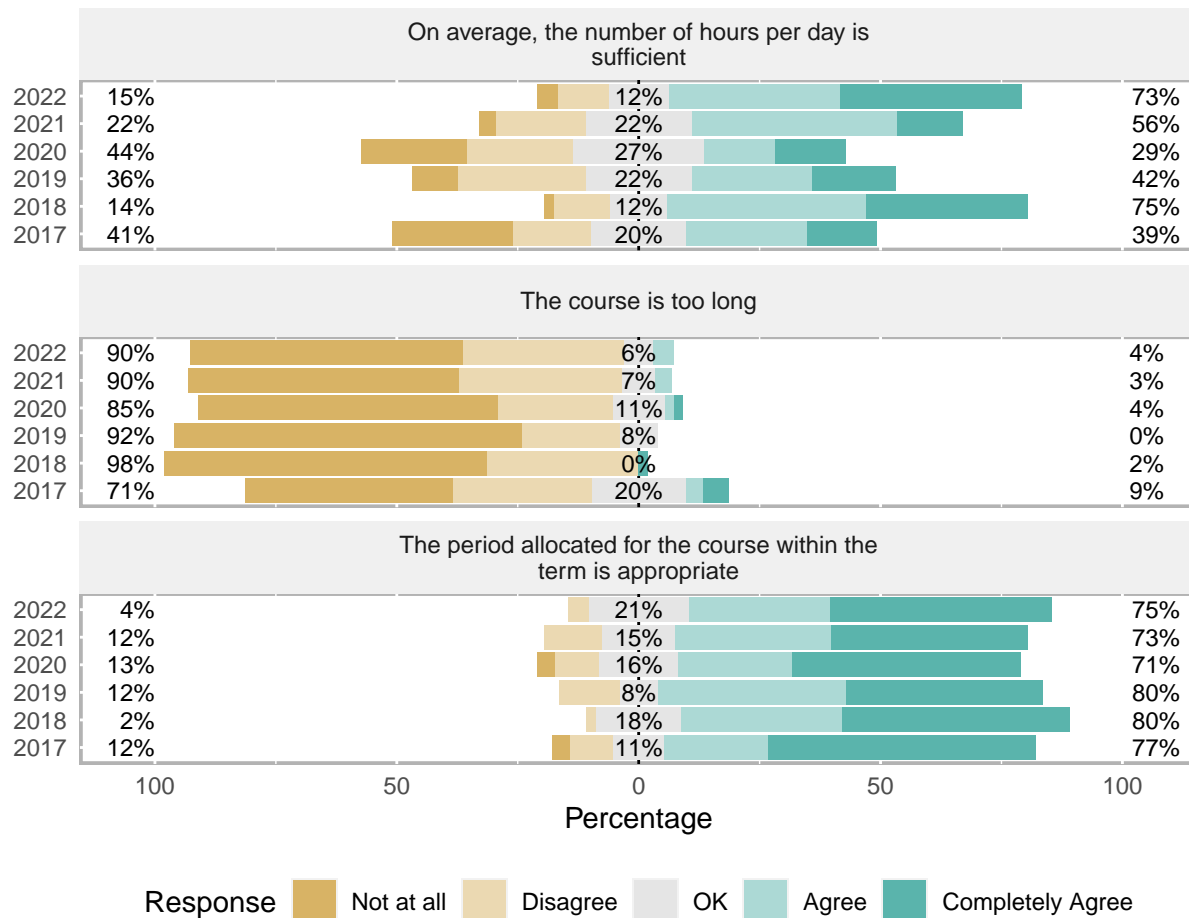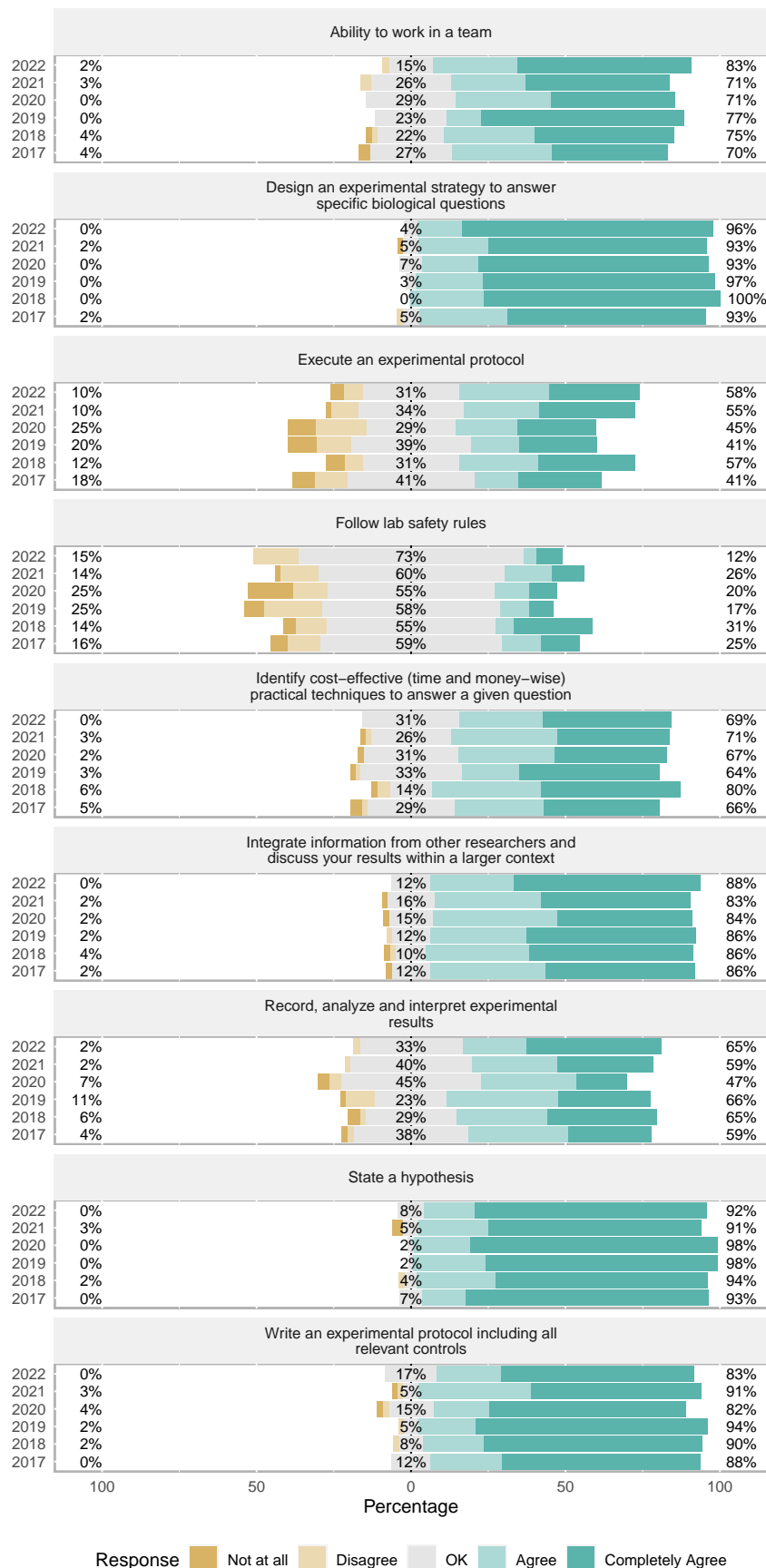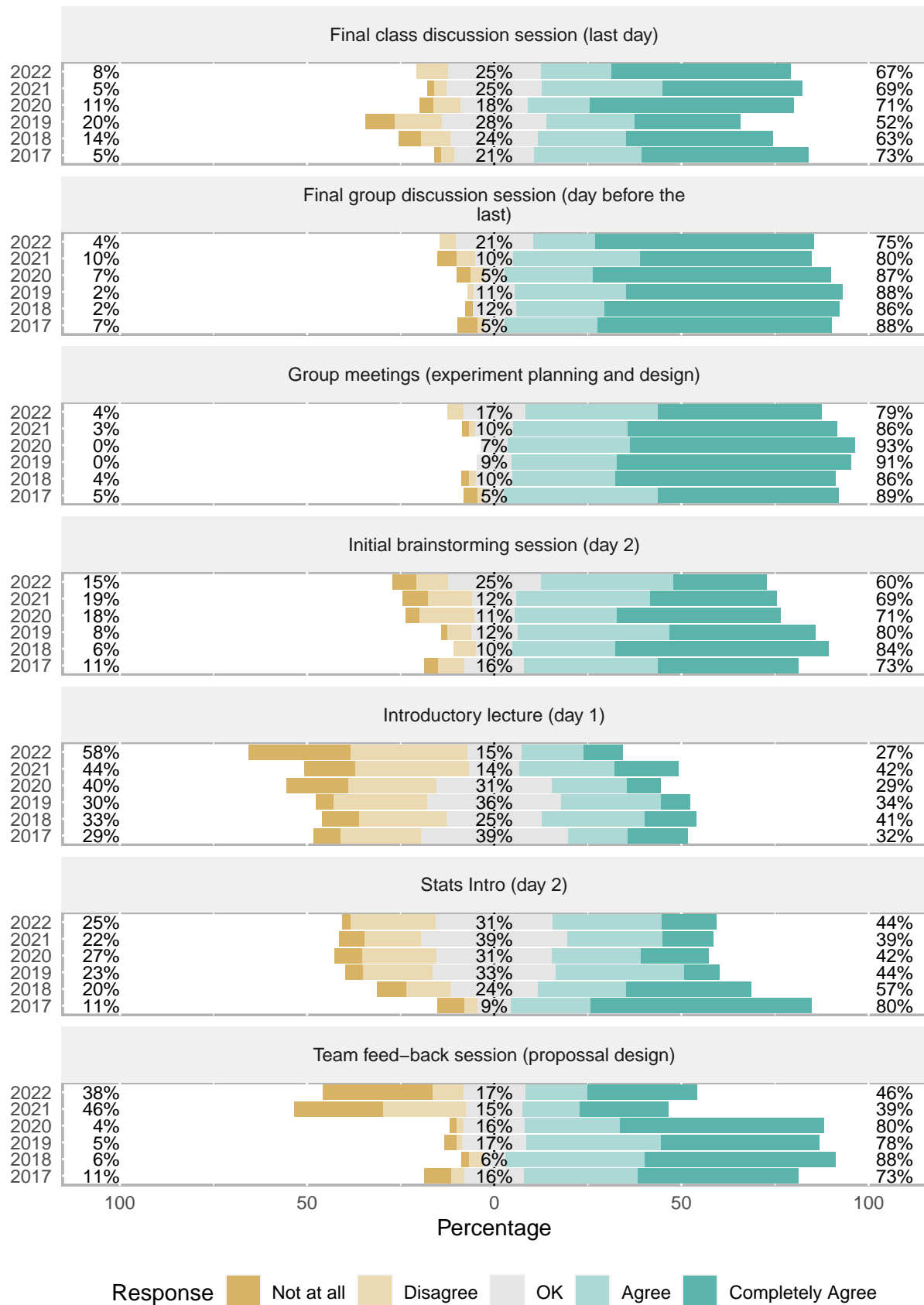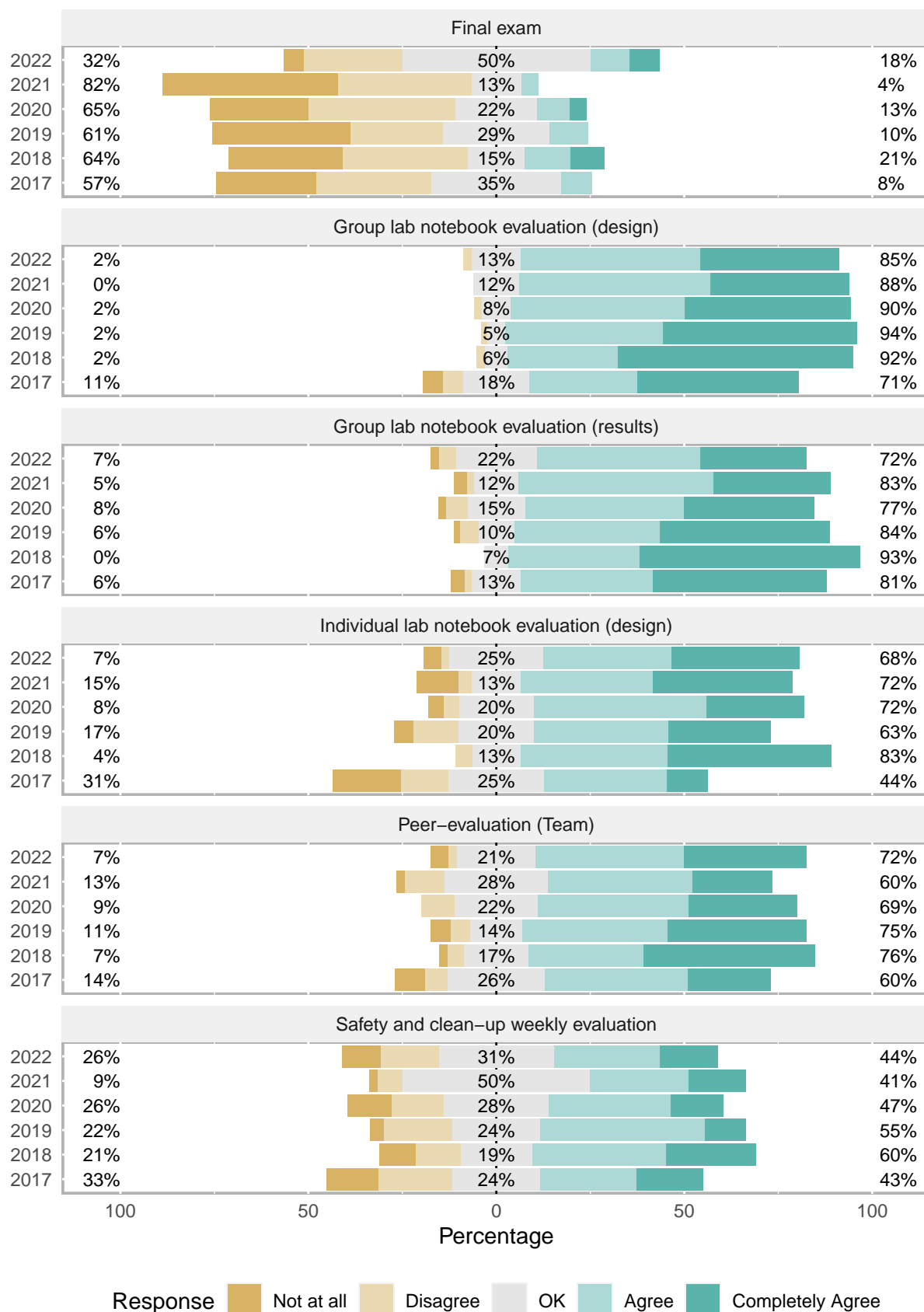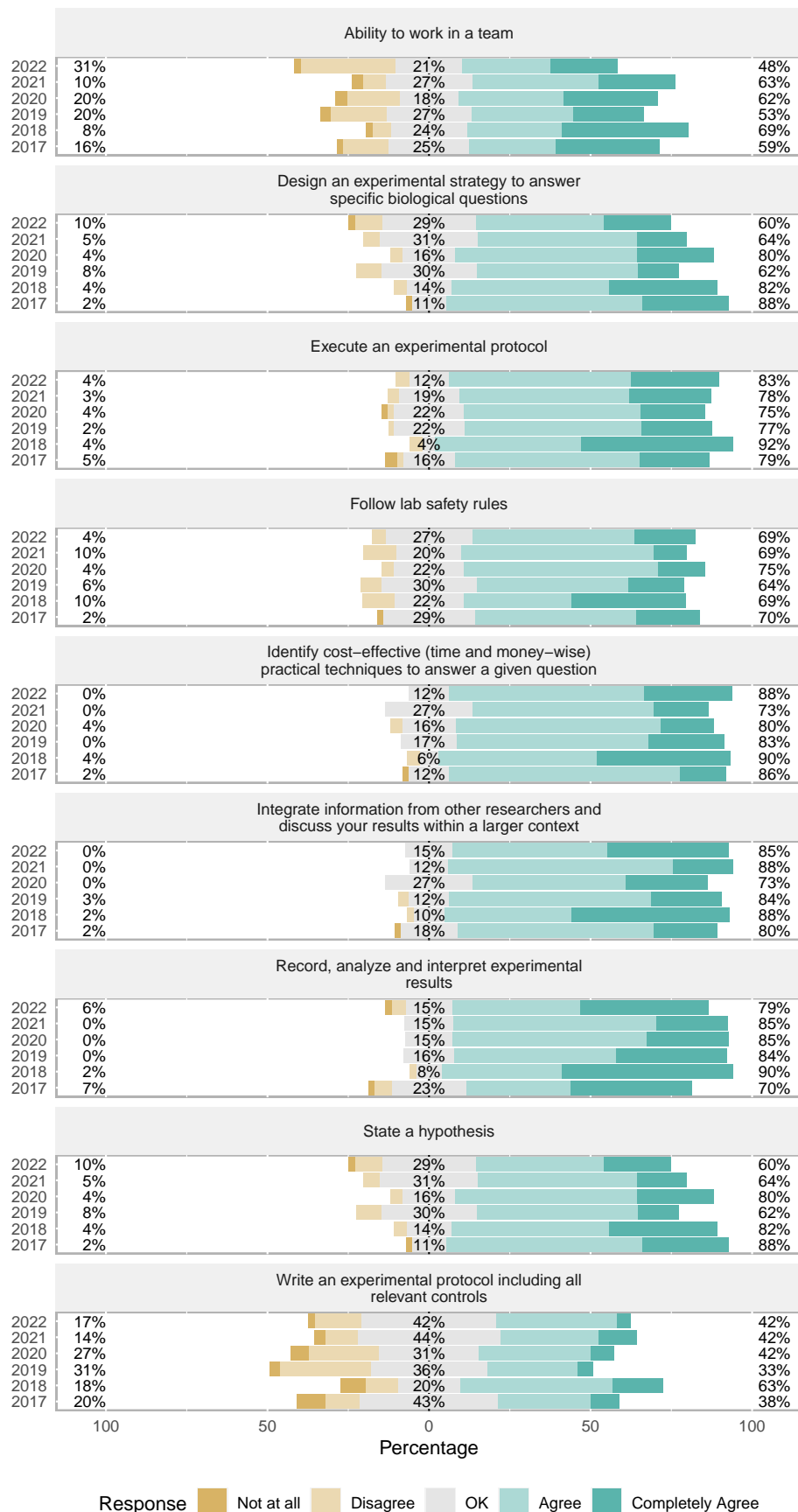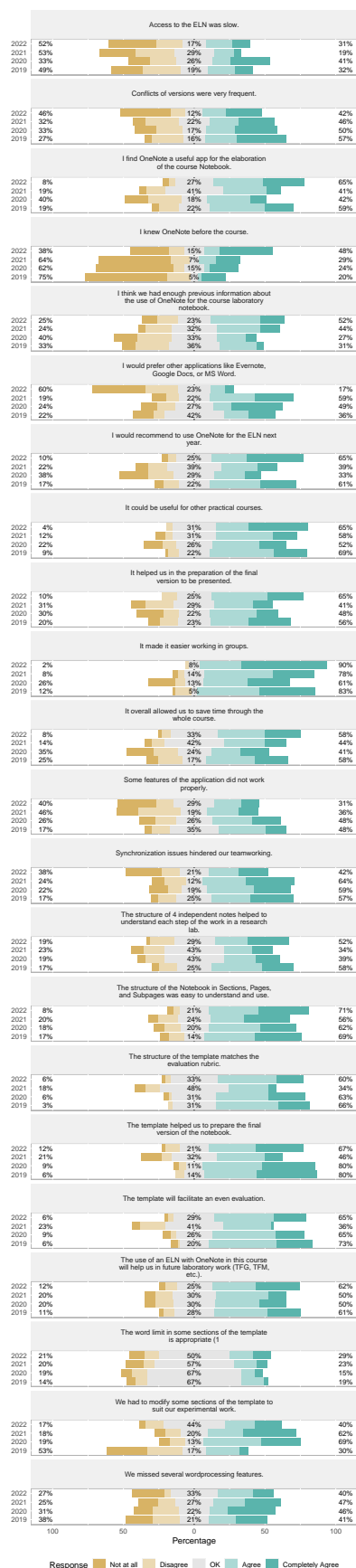
Access to the ELN was slow.

Year	Left %	Middle %	Right %
2022	52%	17%	31%
2021	53%	29%	19%
2020	33%	26%	41%
2019	49%	19%	32%

Conflicts of versions were very frequent.

Year	Left %	Middle %	Right %
2022	46%	12%	42%
2021	32%	22%	46%
2020	33%	17%	50%
2019	27%	16%	57%

I find OneNote a useful app for the elaboration of the course Notebook.

Year	Left %	Middle %	Right %
2022	8%	27%	65%
2021	19%	41%	41%
2020	40%	18%	42%
2019	19%	22%	59%

I knew OneNote before the course.

Year	Left %	Middle %	Right %
2022	38%	15%	48%
2021	64%	7%	29%
2020	62%	15%	24%
2019	75%	5%	20%

I think we had enough previous information about the use of OneNote for the course laboratory notebook.

Year	Left %	Middle %	Right %
2022	25%	23%	52%
2021	24%	32%	44%
2020	40%	33%	27%
2019	33%	36%	31%

I would prefer other applications like Evernote, Google Docs, or MS Word.

Year	Left %	Middle %	Right %
2022	60%	23%	17%
2021	19%	22%	59%
2020	24%	27%	49%
2019	22%	42%	36%

I would recommend to use OneNote for the ELN next year.

Year	Left %	Middle %	Right %
2022	10%	25%	65%
2021	22%	39%	39%
2020	38%	29%	33%
2019	17%	22%	61%

It could be useful for other practical courses.

Year	Left %	Middle %	Right %
2022	4%	31%	65%
2021	12%	31%	58%
2020	22%	26%	52%
2019	9%	22%	69%

It helped us in the preparation of the final version to be presented.

Year	Left %	Middle %	Right %
2022	10%	25%	65%
2021	31%	29%	41%
2020	30%	22%	48%
2019	20%	23%	56%

It made it easier working in groups.

Year	Left %	Middle %	Right %
2022	2%	8%	90%
2021	8%	14%	78%
2020	26%	13%	61%
2019	12%	5%	83%

It overall allowed us to save time through the whole course.

Year	Left %	Middle %	Right %
2022	8%	33%	58%
2021	14%	42%	44%
2020	35%	24%	41%
2019	25%	17%	58%

Some features of the application did not work properly.

Year	Left %	Middle %	Right %
2022	40%	29%	31%
2021	46%	19%	36%
2020	26%	26%	48%
2019	17%	35%	48%

Synchronization issues hindered our teamworking.

Year	Left %	Middle %	Right %
2022	38%	21%	42%
2021	24%	12%	64%
2020	22%	19%	59%
2019	17%	25%	57%

The structure of 4 independent notes helped to understand each step of the work in a research lab.

Year	Left %	Middle %	Right %
2022	19%	29%	52%
2021	23%	43%	34%
2020	19%	43%	39%
2019	17%	25%	58%

The structure of the Notebook in Sections, Pages, and Subpages was easy to understand and use.

Year	Left %	Middle %	Right %
2022	8%	21%	71%
2021	20%	24%	56%
2020	18%	20%	62%
2019	17%	14%	69%

The structure of the template matches the evaluation rubric.

Year	Left %	Middle %	Right %
2022	6%	33%	60%
2021	18%	48%	34%
2020	6%	31%	63%
2019	3%	31%	66%

The template helped us to prepare the final version of the notebook.

Year	Left %	Middle %	Right %
2022	12%	21%	67%
2021	21%	32%	46%
2020	9%	11%	80%
2019	6%	14%	80%

The template will facilitate an even evaluation.

Year	Left %	Middle %	Right %
2022	6%	29%	65%
2021	23%	41%	36%
2020	9%	26%	65%
2019	6%	20%	73%

The use of an ELN with OneNote in this course will help us in future laboratory work (TFG, TFM, etc.).

Year	Left %	Middle %	Right %
2022	12%	25%	62%
2021	20%	30%	50%
2020	20%	30%	50%
2019	11%	28%	61%

The word limit in some sections of the template is appropriate (1

Year	Left %	Middle %	Right %
2022	21%	50%	29%
2021	20%	57%	23%
2020	19%	67%	15%
2019	14%	67%	19%

We had to modify some sections of the template to suit our experimental work.

Year	Left %	Middle %	Right %
2022	17%	44%	40%
2021	18%	20%	62%
2020	19%	13%	69%
2019	53%	17%	30%

We missed several wordprocessing features.

Year	Left %	Middle %	Right %
2022	27%	33%	40%
2021	25%	27%	47%
2020	31%	22%	46%
2019	38%	21%	41%

Percentage
100 50 0 50 100

Response — Not at all — Disagree — OK — Agree — Completely Agree

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Session Info

```
sessionInfo()
```

```
## R version 4.2.2 (2022-10-31)
## Platform: x86_64-apple-darwin17.0 (64-bit)
## Running under: macOS Big Sur ... 10.16
##
## Matrix products: default
## BLAS:    /Library/Frameworks/R.framework/Versions/4.2/Resources/lib/libRblas.0.dylib
## LAPACK: /Library/Frameworks/R.framework/Versions/4.2/Resources/lib/libRlapack.dylib
##
## locale:
## [1] en_US.UTF-8/en_US.UTF-8/en_US.UTF-8/C/en_US.UTF-8/en_US.UTF-8
##
## attached base packages:
## [1] stats     graphics  grDevices utils     datasets  methods   base
##
## other attached packages:
##  [1] dplyr_1.1.0        reshape2_1.4.4    heatmaply_1.4.2   viridis_0.6.2
##  [5] viridisLite_0.4.1 plotly_4.10.1     ggpubr_0.5.0      likert_1.3.5
##  [9] xtable_1.8-4       corrplot_0.92     kableExtra_1.3.4  data.table_1.14.6
## [13] ggplot2_3.4.0
##
## loaded via a namespace (and not attached):
##  [1] httr_1.4.4         tidyr_1.3.0       jsonlite_1.8.4    foreach_1.5.2
##  [5] carData_3.0-5      assertthat_0.2.1  highr_0.10        yaml_2.3.7
##  [9] pillar_1.8.1       backports_1.4.1   lattice_0.20-45   glue_1.6.2
## [13] digest_0.6.31      RColorBrewer_1.1-3 ggsignif_0.6.4    rvest_1.0.3
## [17] colorspace_2.1-0  htmltools_0.5.4   plyr_1.8.8        psych_2.2.9
## [21] pkgconfig_2.0.3   broom_1.0.3       purrr_1.0.1       scales_1.2.1
## [25] webshot_0.5.4     svglite_2.1.1     tibble_3.1.8      farver_2.1.1
## [29] generics_0.1.3    car_3.1-1         withr_2.5.0       lazyeval_0.2.2
## [33] cli_3.6.0         mnormt_2.1.1      magrittr_2.0.3    evaluate_0.20
## [37] fansi_1.0.4       nlme_3.1-161      rstatix_0.7.2     xml2_1.3.3
## [41] tools_4.2.2       registry_0.5-1    lifecycle_1.0.3   stringr_1.5.0
## [45] munsell_0.5.0     ggsci_2.9         compiler_4.2.2    ca_0.71.1
## [49] systemfonts_1.0.4 rlang_1.0.6       grid_4.2.2        iterators_1.0.14
## [53] rstudioapi_0.14   htmlwidgets_1.6.1 labeling_0.4.2    rmarkdown_2.20
## [57] gtable_0.3.1      codetools_0.2-18  abind_1.4-5       TSP_1.2-2
## [61] R6_2.5.1          seriation_1.4.1   gridExtra_2.3     knitr_1.42
## [65] fastmap_1.1.0     utf8_1.2.2        dendextend_1.16.0 stringi_1.7.12
## [69] parallel_4.2.2    Rcpp_1.0.10       vctrs_0.5.2       tidyselect_1.2.0
## [73] xfun_0.36
```