Qualitative Methods for Research in Data Science Education

## The Block Model (Schulte 2008)

|  | Text Surface | Program Execution | Function |
| --- | --- | --- | --- |
| **Macrostructure** | Understanding the overall structure of the program | Understanding the “algorithm” of the program | Understanding the goal / purpose of the program (in its context) |
| **Relations** | References between blocks, e.g., method calls, object creation | Sequence of method calls, object sequence diagrams | Understanding how sub-goals are related to goals, how function is achieved by subfunctions |
| **Blocks** | Regions of interest (ROI) that syntactically or semantically build a unit | Operation of a block, a method, or a ROI (as a sequence of statements) | Function of a block, may be seen as a sub-goal |
| **Atoms** | Language elements | Operation of a statement | Function of a statement, only understandable in context |

## Student’s Coding Process

| Student A | Student B |
| --- | --- |
| plot(EarlyLengthAge$meanLE∼EarlyLengthAge$Age, las = 1, ylab = “Fork Length (mm)”, xlab = “Age”) | plot(x = predictionTimesD, y = prediction, type = “l, col = “blue”, xlab = “”, ylab = “”, ylim = c(0, 0.08), main = “Mesocosm D”, las = 1) |
| lines(EarlyLengthAge$meanLE∼EarlyLengthAge$Age) | points(timed, obsD, pch = 19) |
| points(MidLengthAge$meanLM∼MidLengthAge$Age, col = "red") | title(ylab = expression(paste("Tracer "^15, N[2], ":Ar")), line = 2.5, font.sub = 2) |
| lines(MidLengthAge$meanLM∼MidLengthAge$Age, col = "red") | title(xlab = "Time (days)", line = 2, font.sub = 2) |
| legend(15, 600, legend = c("1998-2003", "2006-2017"), col = c(“black”, “red”), lty = 1:1, cex = 0.8) | legend("bottomright", legend = c("Modeled", "Measured"), lty = c("solid", NA), col = c("blue", "black"), pch = c(NA, 19)) |

## **Excerpt 1: Uma & Sean**

|  |  |
| --- | --- |
| Sean | So I kinda ran out of room here, but I just went 1010, 109, 108 (*points to the different eras on his paper, turning towards Uma*) and then will fit those within there. |
| Uma | Oh, ok! And then we'll fit them. Yeah. |
| Sean | Yeah. |

*The two work independently on their own papers. Both students can be heard narrating their work (5 seconds).*

|  |  |
| --- | --- |
| Uma | (*turning to look at Sean's paper*) 106 |
| Sean | Yep, 105, and then I'm going to start my line over here, I'm actually going to extend it on– (*continuing to work on his own paper*) |
| Uma | *(After working independently for 9 seconds, learning towards Sean to see his paper*) and then you're adding a little bit more? (*returning to her own paper*) |
| Sean | Yeah (*continuing on his own paper*) |
| Uma | (*5 sec.*) Keeping the similar— |
| Sean | Mhm (*affirming, 7 sec.*) Well, and that's turning into a scale that I recognize (*bobbing, smiling slightly, looking over his glasses to Uma*). |
| Uma | Yeah, so then that's… it goes to 104 |
| Sean | Mhm |
| Uma | and then that's going to be 103, and then 102 (*turning to look at Sean*)? |
| Sean | Yep, and then I just went on out to– |
| Uma | 100, yeah to make it easier (*4 sec.*). So then "Now" falls in at the zero mark, right? Right? Would that be where we have now? |
| Sean | That's "Now", yep (*working on his own paper*) |
| Uma | *(5 sec.*) And then 102 is 100, right? |
| Sean | Yeah, so you want to kinda like— (*continuing to work on his own paper*) |
| Uma | so then you have— (*working on her own paper*) |
| Sean | (*4 sec*) so if you want to like— (*continuing to work on his one paper, 7 sec.*) so if we— the difference from here is actually 900 years, right. |
| Uma | Yeah, but then with each one the years are going to be more (*gesturing "expanding" with her hands*). |
| Sean | Yep, yep (*nodding*). |
| Uma | Yeah, that's what I was thinking. I was like— because 500 is going to be, because this is 1000, so your 500 is kinda going to be like half-way, right? |
| Sean | Y-e-a-h (*with hesitation, watching Uma work on her paper briefly before returning to his paper*) |
| Uma | It should be like here, 500, and then this will be 1000 (*working on her own paper, 6 sec., thinking aloud*) 104 right here. |

*The interaction ends with about 54 seconds of the two students working independently on their own papers. Uma occasionally narrates as she writes. Neither student acknowledges the other.*

## References

Schulte, Carsten. 2008. “Block Model.” *Proceedings of the Fourth International Workshop on Computing Education Research*, September. <https://doi.org/10.1145/1404520.1404535>.