Visualising and Evaluating Spreadsheets

Chris Roast Roxanne Leitao (Sheffield Hallam University)

Why look at spreadsheets?

- Spreadsheets are a common general purpose tool
- Used for various purposes in STEM education
- Glorified calculators
- Modelling series and interrelationships

| С | D | E | F | G | Н | - I | J | K | L | M |
|------|----------|----------|----------|----|------|---------|----------|------|-------------|------|
| | | | | | | | | | | |
| | Cu | AI | SS | Tf | Г | | | | | |
| | 14.2 | 21.2 | 75.6 | | | 1.2 | | | | |
| 0 | 100 | 100 | 100 | 25 | | 1 | | | | |
| 0.01 | 90.07159 | 85.67235 | 60.21556 | 25 | | - | | | | |
| 0.02 | 81.4575 | 74.08179 | 41.53514 | 25 | | 0.8 | | | | |
| 0.03 | 73.98373 | 64.70544 | 32.76393 | 25 | | ÷. | | | | |
| 0.04 | 67.49932 | 57.1203 | 28.64548 | 25 | | 불 0.6 + | | | | |
| 0.05 | 61.87331 | 50.98419 | 26.7117 | 25 | | ā | | | | |
| 0.06 | 56.99207 | 46.02029 | 25.80371 | 25 | | 0.4 | | | | |
| 0.07 | 52.757 | 42.00467 | 25.37738 | 25 | | 0.2 | | | | |
| 0.08 | 49.08256 | 38.75618 | 25.17719 | 25 | | 0.2 | | | | |
| 0.09 | 45.89454 | 36.12826 | 25.0832 | 25 | | o 🖊 | , , | | | |
| 0.1 | 43.12855 | 34.00237 | 25.03907 | 25 | | 0 | 0.5 | 1 1 | .5 2 | |
| 0.11 | 40.72872 | 32.2826 | 25.01834 | 25 | | | | n | nL | |
| 0.12 | 38.64657 | 30.89137 | 25.00861 | 25 | | | | | | |
| 0.13 | 36.84005 | 29.76591 | 25.00404 | 25 | | | | | сс <u>т</u> | |
| 0.14 | 35.27268 | 28.85545 | 25.0019 | 25 | | | Cu | A | 55 11 | |
| 0.15 | 33.9128 | 28.11892 | 25.00089 | 25 | | 100 | | | | |
| 0.16 | 32.73293 | 27.5231 | 25.00042 | 25 | | 90 | | | | |
| 0.17 | 31.70926 | 27.0411 | 25.0002 | 25 | | 80 | | | | |
| 0.18 | 30.82109 | 26.65118 | 25.00009 | 25 | _ | 70 | | | | |
| 0.19 | 30.0505 | 26.33574 | 25.00004 | 25 | | 60 | | | | |
| 0.2 | 29.38192 | 26.08057 | 25.00002 | 25 | T(de | 50 | | | | |
| 0.21 | 28.80185 | 25.87414 | 25.00001 | 25 | | | | | | |
| 0.22 | 28.29857 | 25.70715 | 25 | 25 | | 40 | | | | |
| 0.23 | 27.86191 | 25.57206 | 25 | 25 | | 30 | | | | |
| 0.24 | 27.48305 | 25.46278 | 25 | 25 | | 20 | | | | |
| 0.25 | 27.15435 | 25.37437 | 25 | 25 | | 0 | 0.05 0.1 | 0.15 | 0.2 | 0.25 |
| 0.26 | 26.86916 | 25.30285 | 25 | 25 | | | | x(m) | | |
| 0.27 | 26.62172 | 25.245 | 25 | 25 | | | | | | |

Why look at spreadsheets?

- Easy and quick to create
- Easy to test out ideas great for experimenting
- Easily become complex



User behaviour

- Make it first
- Make it better (increments)
- Make it neat later (or never!)



Support

- Understanding the complexity
- Dependency tools exist
- Little support for understanding 'the equation'



E nhancing the Quality and Usability of S preadsheets







- Better understanding
- Help fix issues / errors
- Within a common and widely used tool

- Better understanding
- Help fix issues / errors
- Within a common and widely used tool

$$= 3 + 2 * 4$$

3 + 2 × 4

- Better understanding
- Help fix issues / errors
- Within a common and widely used tool



- Better understanding
- Help fix issues / errors
- Within a common and widely used tool



Proof of Concept

- The EQUS concept offers a visualisation for increasing learner confidence and competence with spreadsheets
- Reducing the complexity of single line of text
 - structure
 - order
 - intermediate values

Proof of Concept

- Iteratively experimenting with:
 - Visualisation approaches
 - Interaction styles
 - Exceptional examples
- Responding to
 - Expert feedback
 - User feedback



Some of our feedback ...



"The problems are hard ... [the visualisation] helps when it is really hard, I wouldn't do it otherwise. Seeing it spread-out helps a lot" (11 years old)

"You can see the values and how they are worked out, that's great." "It was helpful, like a flowchart, it separates out things"

"Definitely good to see it in shapes and graphics, a lot easier to use."



"Seeing the spreadsheet visualisation prototype **made it clearer** to understand the formulas and feel that if I had chance to use a programme of that kind I would have a **greater understanding** and be able to **pick up the skills** I require much quicker. I feel that this product could help people like myself that struggle with spreadsheets."





"It will be **very useful** to many students to have a product that enables a **better conceptual understanding** of the equation format in Excel. There is a clear need for such a tool to be suitable for the many students who do not have high levels of mathematical skills and yet use mathematical symbolism every day in their studies. EQUS does this and, when fine-tuned, will provide the student with a **user-friendly and very useful tool**. The visual representation of the equation is given and this provides **a valuable aid**, particularly for those students who are visual learners, most notably dyslexics.

Do you think the visualisations made it easier or more difficult to do your work? Why?

| Ē | (Link | it m | 405 | it | cosier | 10 | 500 |
|----|-------|-------|------|----|--------|------|-----|
| iF | hab | inps; | Here | 64 | hatian | Vian | 5 |
| | 100 | | 1.96 | 1 | | | |

Tutor: During sessions the visualisation helps (I'd not draw it, I might get it wrong)





- In general highly positive about the visualisation being easy to read and interpret
- Harder to "measure" confidence
- Positive feedback in response to...
 - "Would you use it again?"
 - "Could you explain it to others?"

"I believe this has the most potential to help those able students who lack confidence in their own ability, to confirm that they can understand the process flow and that they can correctly apply the rules to any given formula. By utilising this with excel it gives the student the ability to practise with many different formulas as quickly or slowly as is needed by the student whilst allowing them to change input parameters to ensure the output change is as expected. Not only is it an excellent tool to help them with their mathematics but it also gives them a great introduction to spreadsheets which must be one of the most common applications used in businesses today."

Trading Director in Financial services

• Spreadsheets or maths?



POWER(X1,3)

- All "pure" single result spreadsheet functions
- However

is different!

• IF always does not evaluate one of its arguments

- All "pure" single result spreadsheet functions
- A desire for

RAND()

- All "pure" single result spreadsheet functions
- With ...

#DIV/0!

Errors

Prototype & Demo

• Like a 'plug-in' to a normal spreadsheet

Help!

- We more feedback from learners
 - Apprentices, NVQ Levels 2, 3 and above
 - Almost anyone using spreadsheets in education
 - Anyone where learners are let loose with spreadsheets
- Get in touch if you want to try EQUS
- Chris Roast (c.r.roast@shu.ac.uk, 0114 225 6845)
 See the EQUS blog: https://blogs.shu.ac.uk/equs/

Thank you



"All I'm saying is we plug these into Excel, let it do its thing, and then we can all play until lunch!"

Any questions?

EXCEL DOES NOT NEED MORE THAN 256 COLUMNS EXCEL DOES NOT NEED MORE THAN 256