The MAPLE Project – Findings from Data Analysis

Introduction

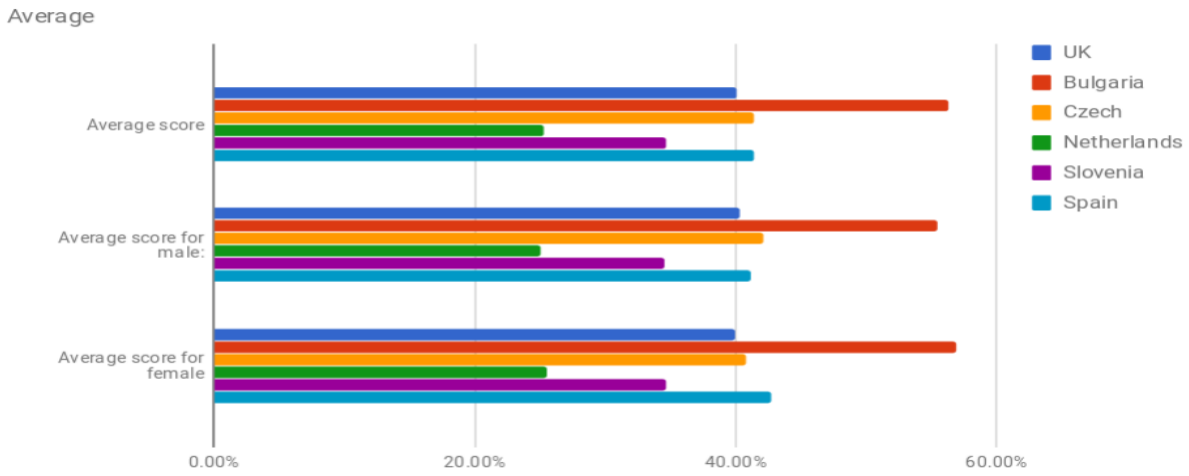
The MAPLE project was designed to discover the level of understanding of students at age 11 in computer science and to track them across three years of study to look for diferences in their understanding and ability. It was expected that they would make some progress, but the project was designed to see how much and what might be causing more or less progress. Would the progress be made regardless of teaching content or would specifc content be more important? Would boys progress more than girls and if so why? Would country specifc diferences be observable? The project hoped that some of the questions could be answered, or at least be better understood, and therefore lead to improvements in the way the subject was taught.

The design of the project allowed teachers to give their students a multiple choice test at age 11 and then re-test at a time to suit them. The tests would be developed and released every 6 months and be comparable in terms of content and difculty. This way, teachers could track what aspects of computer science their students were struggling with and hopefully adjust their teaching to fx the issues.

Findings

The following graphs are some of the basic fndings of the project and do not ofer a comprehensive dive into the data, but some high level observations of some trends and issues for further exploration.

The following graph shows all the results for all countries and all students, with averages for males and females.



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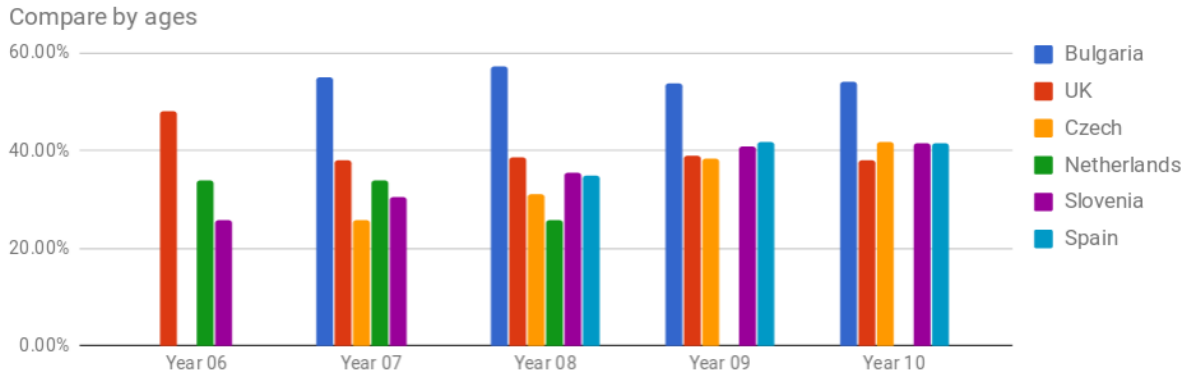
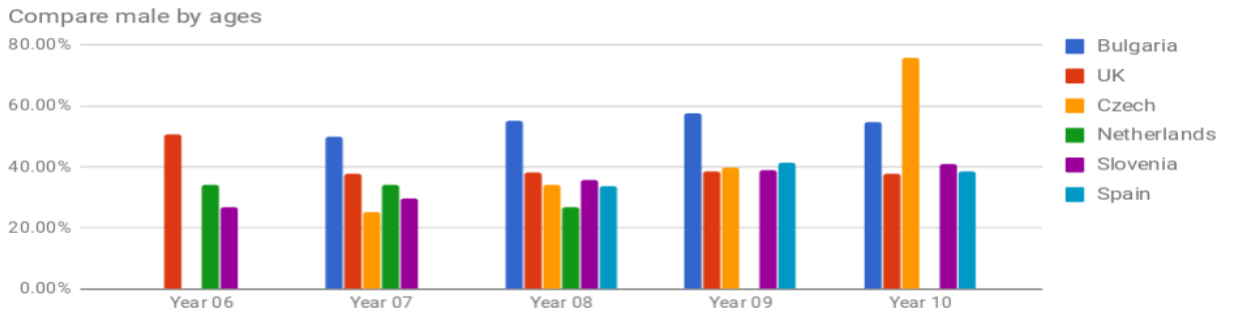
Most of the countries here have a similar average score. Bulgaria has a considerably higher score and the Netherlands is somewhat below, so we would need to look in more detail at the results from these countries to work out why there are these disparities. A simple conclusion here is that the teaching of computer science in Bulgaria is already very efective and the other countries could learn from the practice and their methods.

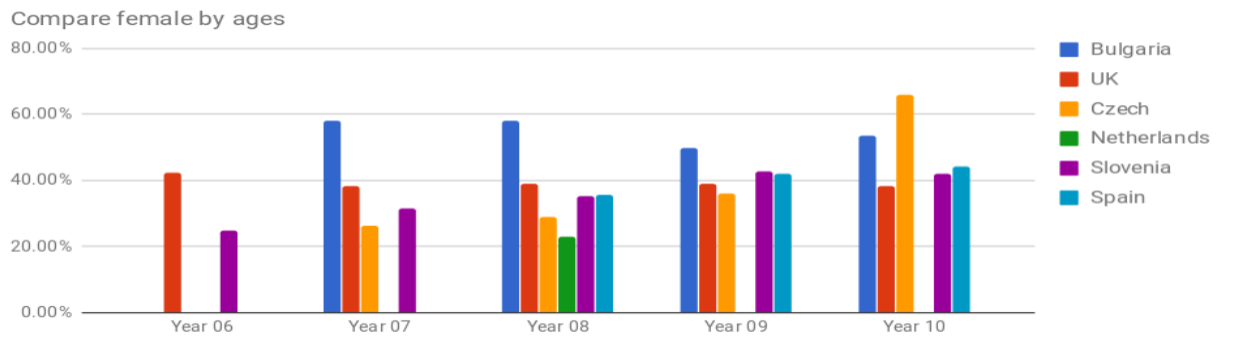
The graph below is a break down in terms of the age of the participants.



Some observations here for further work and study are that the students from the UK and the Netherlands appear to get worse from the age of 11 onwards. It is not so marked in the Netherlands, though still a downward trend, but in the UK students are dropping more than 10% in their score. Does this mean the teaching is inefective? In contrast, the Slovenian and Czech Republic students scores are improving over their age range which is what we would expect. The Bulgarian students may represent a smaller sample size, so again we would need to dive deeper into the data set.

In the following graph, there is more detail between the genders.



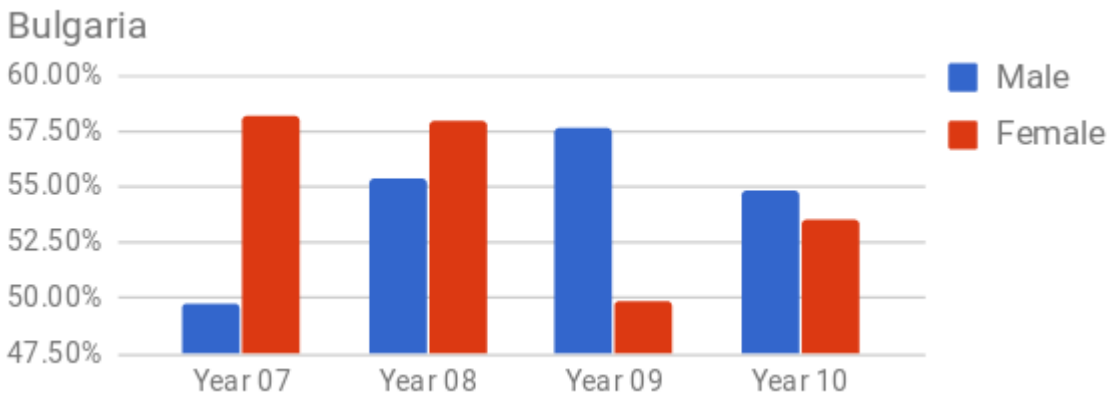


It appears that the UK boys' scores drop of as they get older, while the girls stay more or less the same, though perhaps slightly down. Both boys and girls in the Czech Republic seem to gain

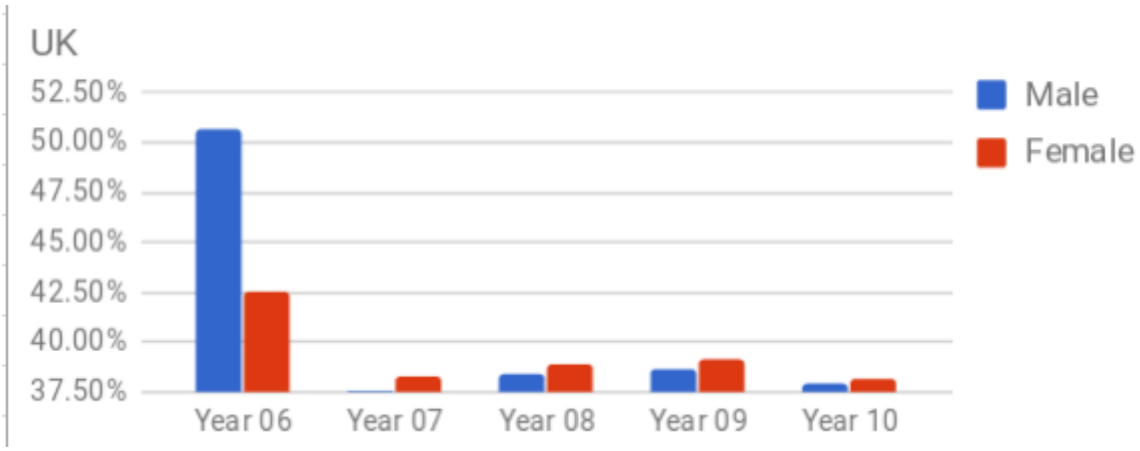
in understanding over time, so perhaps there are some good teaching techniques we can learn from teachers in this country.

Once again Bulgaria shows some high scores, though even here there is some drop over time, although not as pronounced as the UK.

Country Results – Detailed View

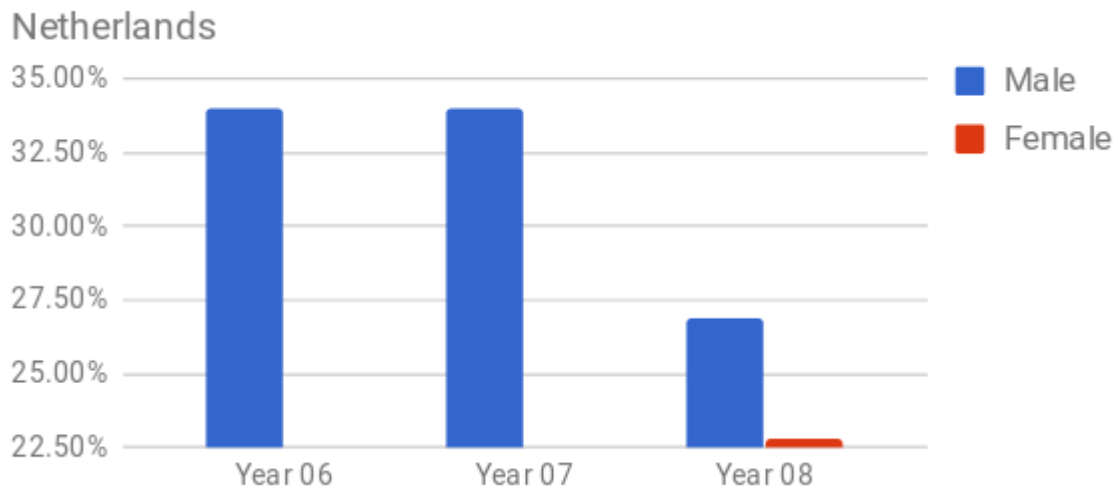


Some very interesting results in the above graph where it appears that in Year 7 the girls are signifcantly better than the boys, but this is completely reversed by Year 10. This could be an anomaly of the sample size, but does beg some further investigations. The Year 10 results are broadly in-line with expectations.

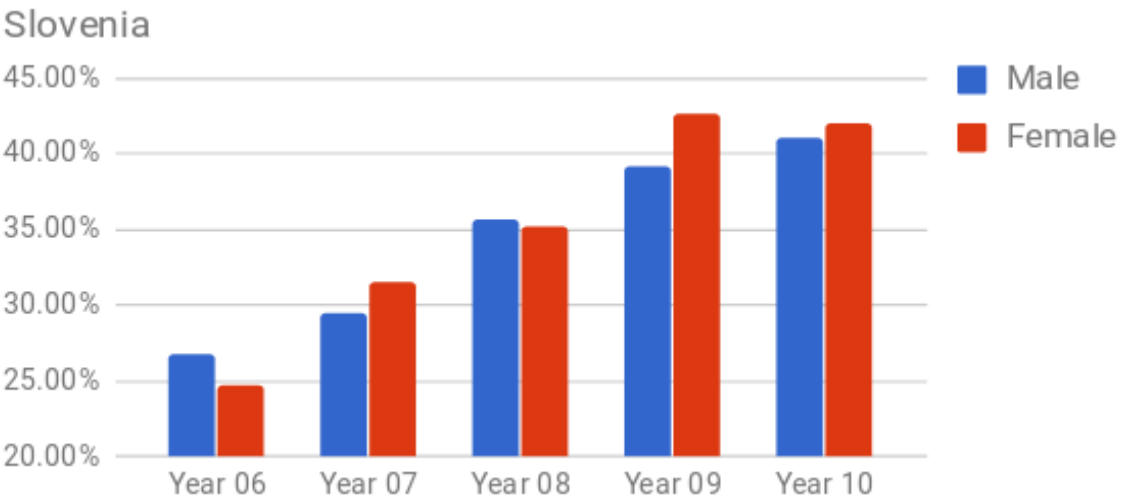


The UK results are very interesting. It is hard to say exactly why there is such a spike in Year 6, but it may be because primary schools in the UK have more time to engage students in the interesting aspects of computer science. In the UK there are projects such as Barefoot Computing[1] which do more kinaesthetic activities with students and most schools now use Scratch[2] to teach programming skills. It is an easy and fun program to use so perhaps gets students more engaged. This aside, the other interesting aspect here is that girls outperform boys across the age range, and yet very few girls take up computer science after Year 10. This should be something that the government needs to look into and clearly the girls are able, but are not being engaged beyond age 15. This will clearly afect the market when the majority of talented girls are not entering a profession related to computer science.

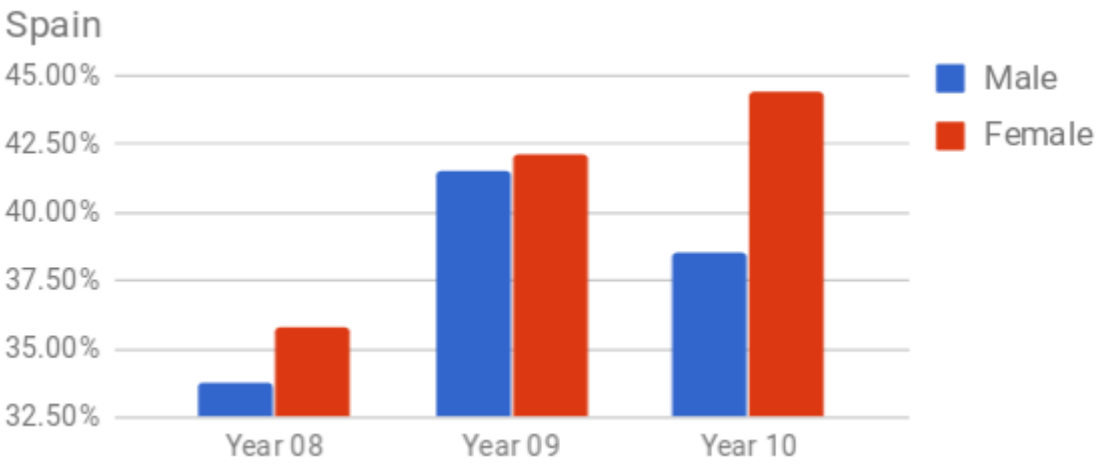
1 https://barefootcas.org.uk/
2 https://scratch.mit.edu/



The Netherlands clearly shows quite a small sample size so it is hard to draw any formal conclusions. Hopefully with more testing we can get a clearer picture over time. The disparity between boys and girls in the Year 8 sample is somewhat worrying and would need further investigation.



The results here are almost perfect as students are improving their understanding over time. As mentioned earlier, this would be a good place to look for best practice in teaching methods to see why the learning is so efective compared to other countries. As with other data here, the girls seem to be doing slightly better than the boys at the higher age ranges. It would be interesting to compare this to actual uptake of computer science courses at university or in employment.



The results for Spain also show some good forward development of skills and understanding and once again an increase in the scores for girls over boys.

Conclusion

The project results here, though admittedly quite basic, do show some interesting trends and areas for further study and investigation. As the study was over a relatively short time span, it would be difcult to draw any strong conclusions, but it is interesting that in most countries here the girls do get better scores than the boys. This could be a literacy issue as the questions clearly need to be read and understood to get the answers, but could also point to the fact that girls have a slightly better grasp of computational thinking. This contrasts strongly, at least in the UK, with an overall bias towards men in terms of the teaching of the subject and the careers shown in public. Perhaps this is more refective of the bias towards men in most occupations, rather than computer science specifcally. The data does at least give an opportunity to have some data to look into these fndings in more depth in the future and prompt more study and discussion.

It may be possible in future projects to create tests that are written in such a way that we can test for gender bias to see what impact this might have on overall scores. It does however show the importance of the project in fnding out answers to questions posed in the beginning of this report. For example, we can now look at these results in more detail and see what questions across all countries were not well understood and try to work out why. We can look at questions that have a more mathematical versus a linguistic focus and use these to inform our classroom teaching in these areas. We can look in more detail at the teaching methods and syllabi used in countries like the Czech Republic or Bulgaria, who got high scores, to see if we can learn from their examples. We can share this best practice across countries to make sure that all students achieve their maximum potential regardless of where they live or their background or gender.