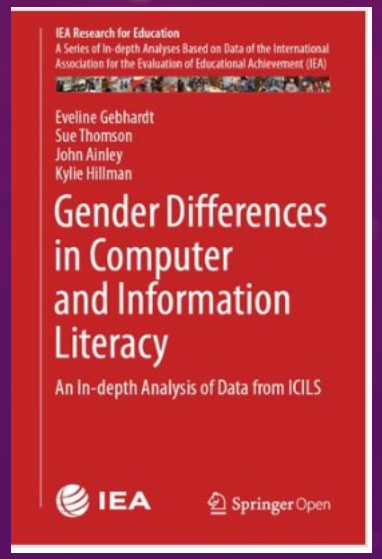


Gender differences in Computer and Information Literacy: An in-depth analysis of data from ICILS

Sue Thomson · Eveline Gebhardt · John Ainley · Kylie Hillman

Why this investigation?

- As educators, we understand the need for an individual in the 21st century to have the ability to "use computers to investigate, create and communicate in order to participate effectively at home, at school, in the workplace, and in society"

  (Fraillon et al., 2014)

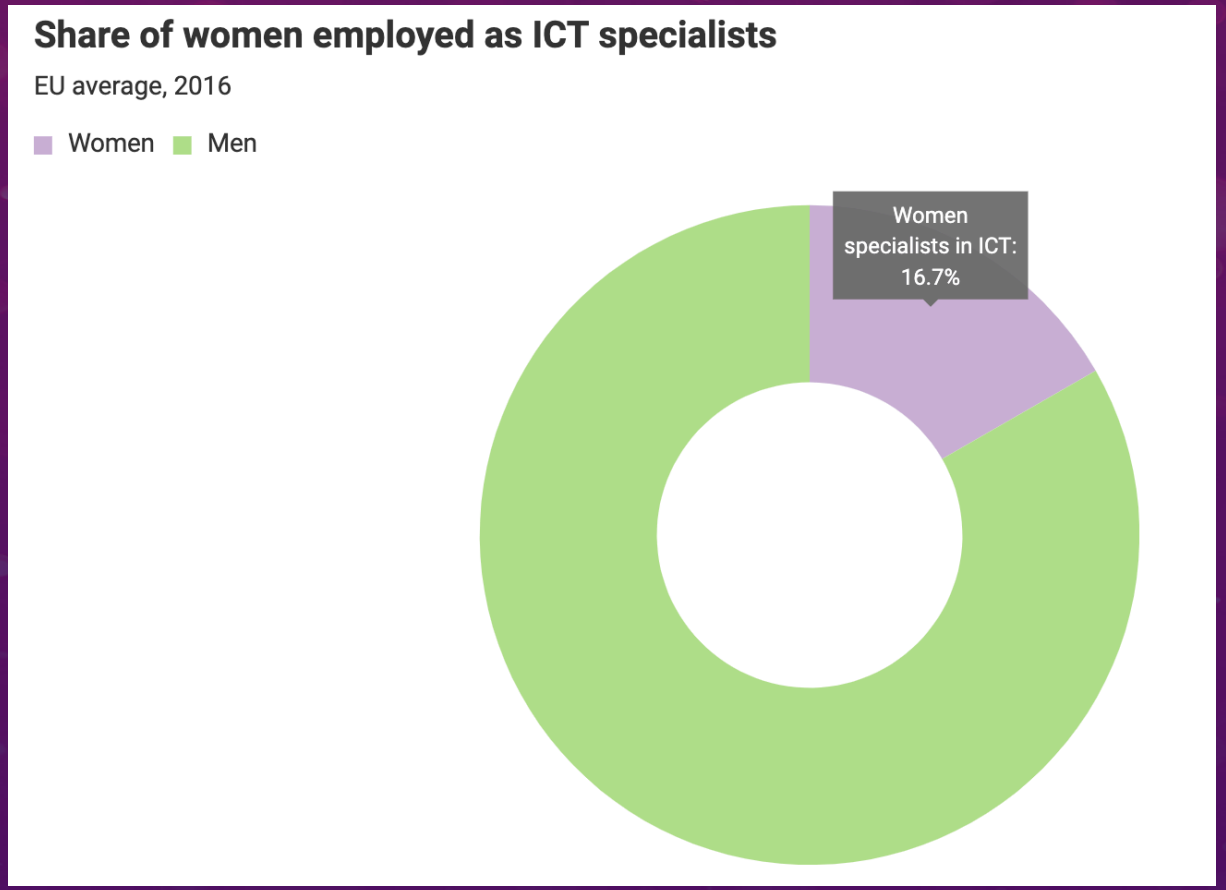
  We see technology sweeping throughout the world of work and reshaping it completely.

  And we understand that this need is similar for both women and men, and therefore for female as well as male students. We also believe that this world needs diversity, particularly gender diversity, and that the ICT developments for the future need to be designed by men AND women.

  However …

Some sobering numbers…

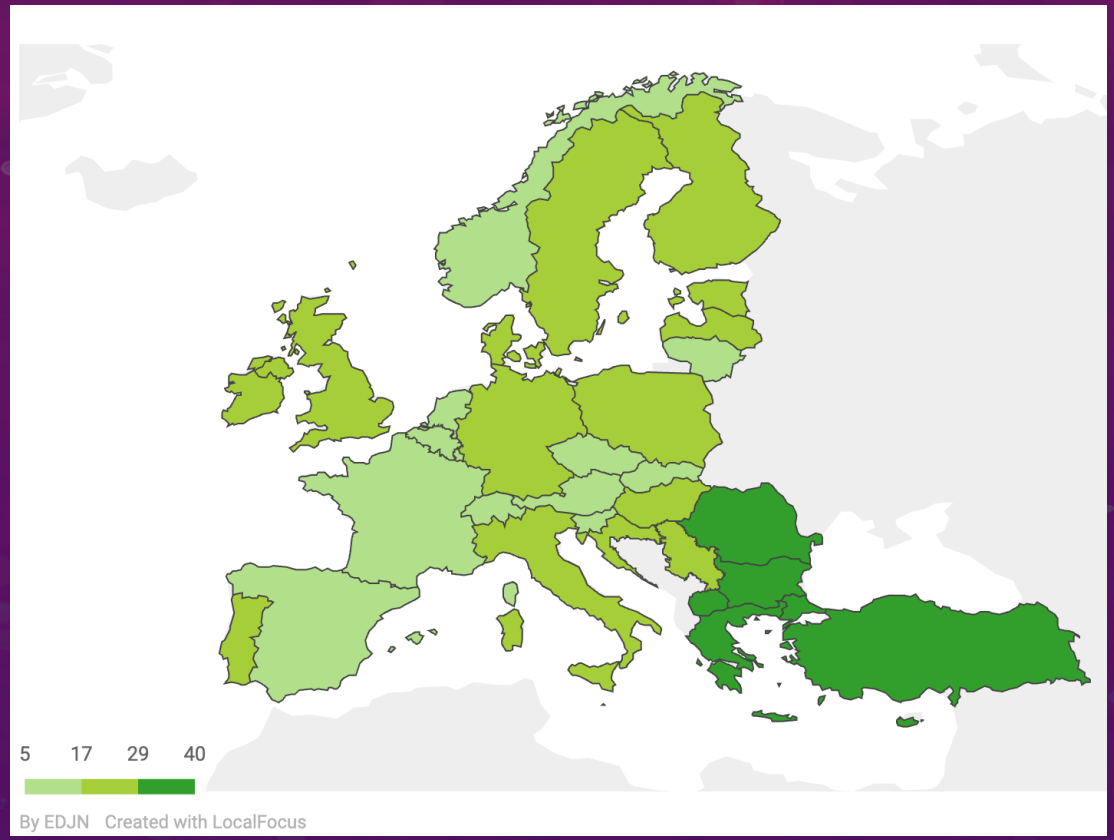
- While the number of persons employed as ICT specialists in the EU grew by 36 % during the period from 2007 to 2017, (this was more than 10 times as high as the corresponding increase (3.2 %) for total employment), the proportion of women employed in these fields has stagnated.



And the outlook is not rosy…

- This figure shows the proportion of women graduates in ICT tertiary education programmes in the EU according to the latest available data from Eurostat.
- The aspiration to work in a certain field starts forming at a very early age – "girls and boys being already exposed to the highly segregated world of work in terms of gender bias in school curriculum and a women-dominated educational workforce" argue the European Institute for Gender Equality
- Whatever is happening, whatever it is that is stopping girls wanting to pursue careers in ICT, it seems to be happening well before they finish school.

- Using the ICILS 2013 data, we wanted to have a systematic look at gender differences for students and their teachers.



Data

- Whilst 21 systems participated in ICILS 2013, data from only 14 countries were included in these analyses. It was decided to focus on data from entire counties, and only data from countries that fully achieved the response rates.

- We derived a set of research questions designed to systematically investigate the gender differences in computer literacy, computer usage and attitudes to computer technology in the ICILS 2013 data. These research questions can be divided into two groups. The first set of questions focus on students.

Research questions regarding students

- RQ1 *What is the magnitude of the difference between female and male students in measured computer literacy overall, and for particular types of items?*
- RQ2 *To what extent do female and male students differ in computer self-efficacy overall, and in particular aspects of computing?*
- RQ3 *To what extent do female and male students differ in their patterns of computer use and in their attitudes to computer technology?*

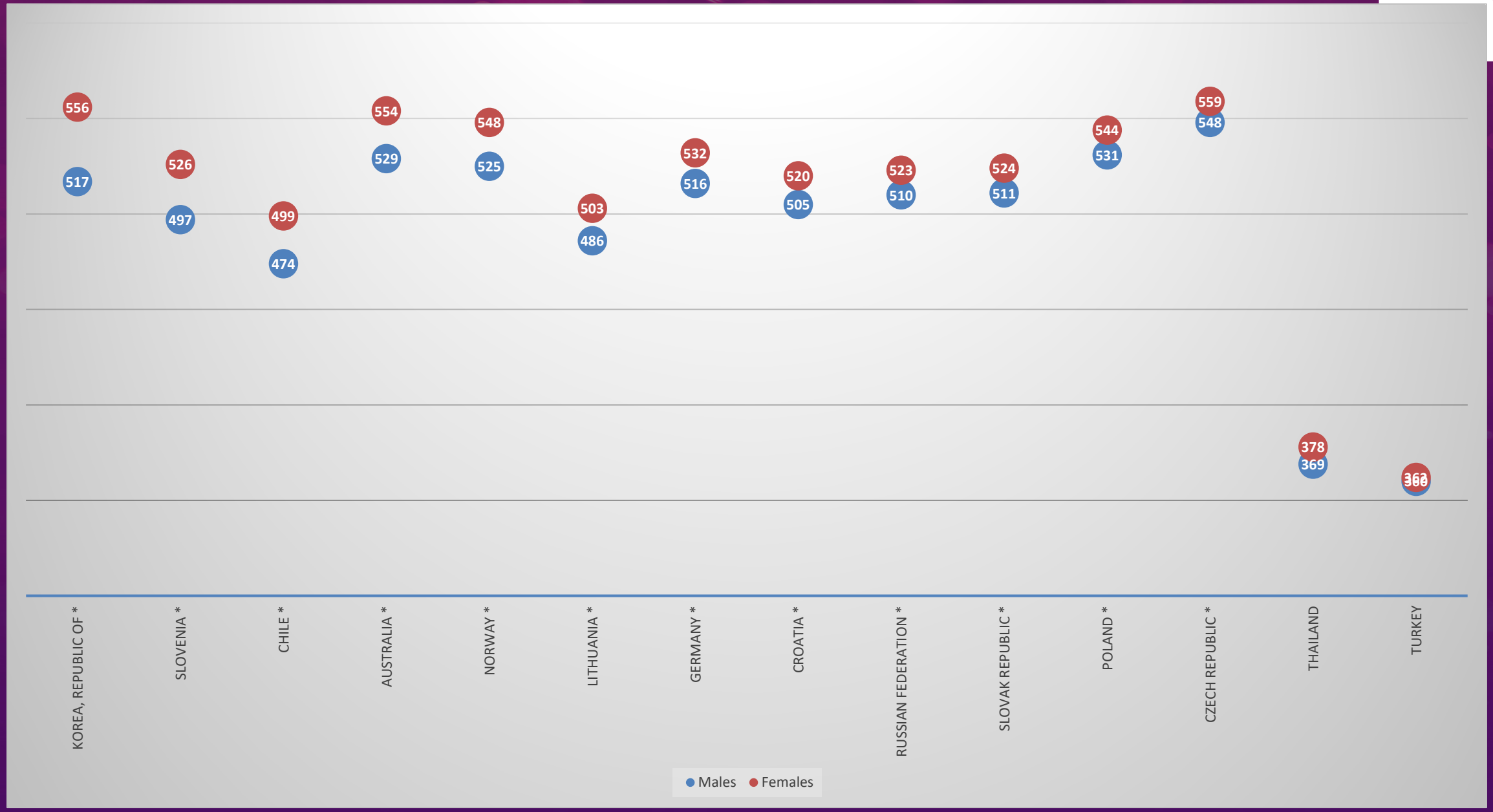
Research questions regarding teachers

- RQ4 *To what extent do female and male teachers differ in computer self-efficacy overall and in relation to particular aspects of computing?*
- RQ5 *To what extent do female and male teachers differ in their attitudes towards the use of computer technologies in school education?*
- RQ6 *To what extent do female and male teachers differ in the ways in which they use computer technologies in their teaching?*

RQ1 *What is the magnitude of the difference between female and male students in measured computer literacy overall, and for particular types of items?*

- As reported in the ICILS 2013 international report (Fraillon et al. 2014), the performance of female students was substantially higher than male students in 12 out of the 14 ICILS 2013 countries for which adequate data were collected.

- The size of the difference ranged from small in the Czech Republic (12 scale points) to moderate in the Republic of Korea (38 scale points). In the remaining two countries (Thailand and Turkey; in both these countries achievement levels were very low), the differences were negligible.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TURKEY
Males
Females

Item DIF

- We examined item DIF, and found that overall there was no gender bias in questions – some favoured males and some favoured females.
- On average, female students performed better than male students of the same ability when asked to create information and, to a lesser extent, when asked to transform information.
- Male students outperformed female students of the same ability on items that required knowledge about and understanding computer use, and on items about using information safely and securely

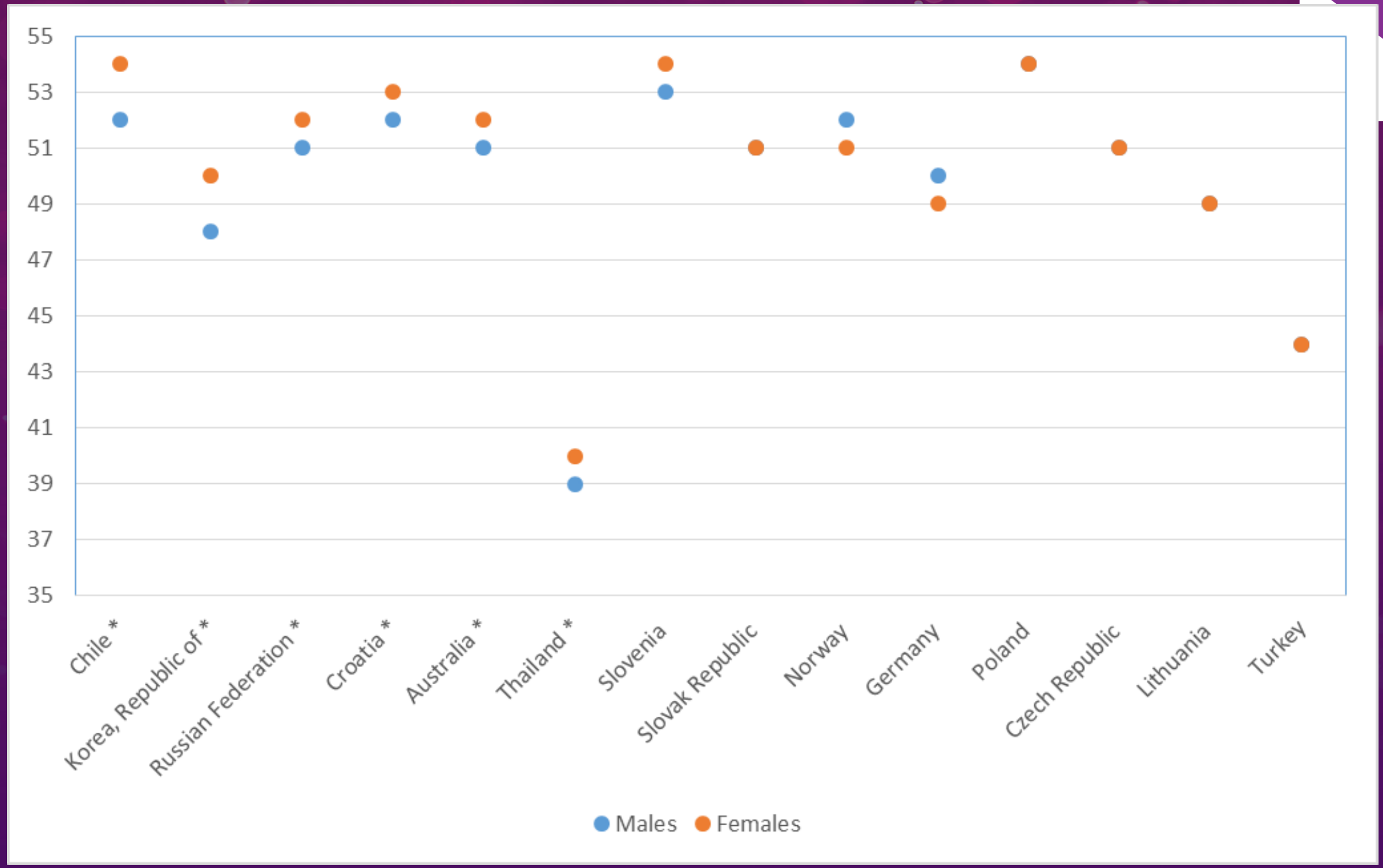
Time taken to respond

- A consistent finding in ICILS 2013 across all 14 countries was that male students spent less time responding to the test items, on average, than female students. On average, female students spent one to four seconds longer on each item than male students.
- These results suggest that response times for items may be a factor in the stronger average performance of female students on the ICILS 2013 CIL assessment.
  Taking more time to respond to these CIL items may be reflective of more careful and thoughtful responses, rather than being less familiar or less confident in their responses, or needing more time to identify the correct response, as is often the case in other assessments.

RQ2 *To what extent do female and male students differ in computer self-efficacy overall, and in particular aspects of computing?*

Gender differences in self-efficacy for *basic* CIL skills

- To examine self-efficacy in basic CIL skills, students were asked to report how well they could do each of the following:
  - Search for and find a file on a computer;
  - Edit digital photographs or other graphic images;
  - Create or edit documents (for example assignments for school);
  - Search for and find information needed on the internet;
  - Create a multimedia presentation (with sound, pictures, or video); and
  - Upload text, images or video to an online profile.
- student responses to this set of items were combined into a self-efficacy scale for basic CIL skills. The scale was constructed to have a mean of 50 and a standard deviation of 10.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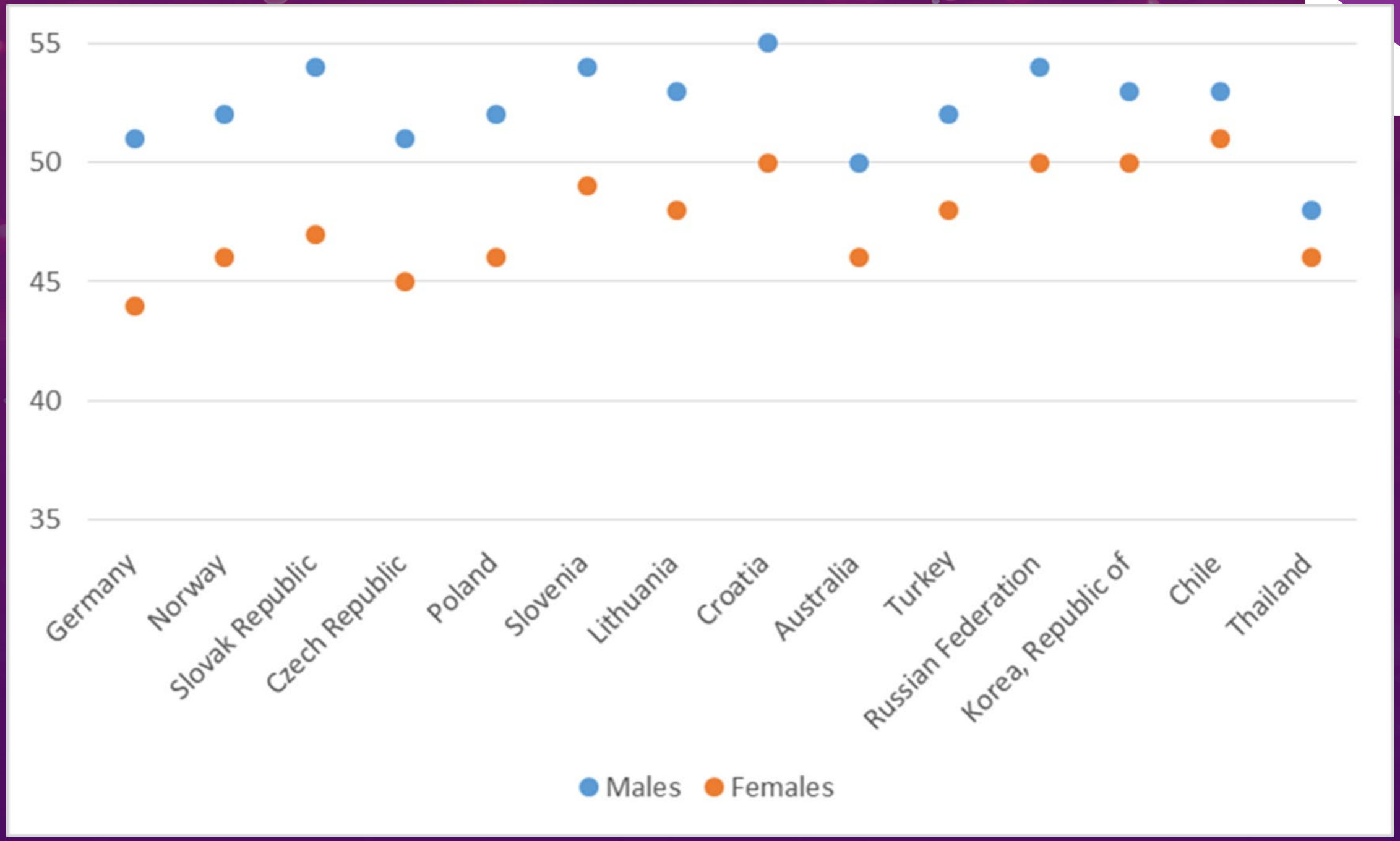
Males
Females

Gender differences in self-efficacy for *specialised* CIL skills

- Students were also asked to rate the level of their skills for a set of specialized CIL skills :
  - Use software to find and get rid of viruses;
  - Create a database (for example, using [Microsoft Access ®]);
  - Build or edit a webpage;
  - Change the settings on the computer to improve the way it operates or to fix problems;
  - Use a spreadsheet to do calculations, store data or plot a graph;
  - Create a computer program or macro (for example, in [Basic, Visual Basic]); and
  - Set up a computer network.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Russian Federation
Korea, Republic of
Chile
Thailand
Males
Females

RQ3 *To what extent do female and male students differ in their patterns of computer use and in their attitudes to computer technology?*

Finding – no strong patterns…

- While there may be some gendered patterns of use of ICT that reflect different interests (females using ICT more for social communication and males using ICT more for recreation) these differences do not uniformly result in advantages or disadvantages for male or female students in terms of CIL achievement.
- For the most part, where correlations reached significance, they were significant among both male and female students and did not differ in magnitude.

Interest -enjoyment

- Male students reported significantly higher levels of interest in, and enjoyment of, ICT than their female peers in 12 of 14 ICILS countries, although these differences were usually small in magnitude. Interest and enjoyment, as measured in ICILS 2013, also appeared to have a stronger relationship with male student achievement in CIL than female student achievement

So what drives girls' achievement?

- The general assumption in educational research is that higher levels of interest and enjoyment are associated with higher achievement. Yet the findings for female students do not seem to follow this pattern. Although female students outperformed males in CIL, their interest - enjoyment in ICT was lower, on average, than that of male students, and did not appear to be as strongly related to their CIL ability as these factors were for male students. These findings raise an interesting question.

- *What drives the higher performance of female students if not higher interest and enjoyment of the subject area?*

RQ4 *To what extent do female and male teachers differ in computer self-efficacy overall and in relation to particular aspects of computing?*

RQ4

- There were several countries in which male teachers expressed slightly more positive views regarding the use of ICT in education than their female colleagues.
- There were differences between female and male teachers in their confidence in using computer technology. On average, male teachers reported higher ICT self-efficacy scores than did female teachers, with a magnitude of a little less than one-fifth of a standard deviation.
- However, there were differences among countries in the magnitude of these differences and, in the Russian Federation, female teachers reported higher self-efficacy than male teachers.

RQ5 *To what extent do female and male teachers differ in their attitudes towards the use of computer technologies in school education?*

RQ5

- There were only small differences in a few countries regarding the emphasis placed on teaching ICT-based capabilities
- The differing emphases that male and female teachers placed on developing ICT skills in students were positively associated with a teacher's years of experience in using ICT in the classroom, teacher self-efficacy, and positive views on using ICT in learning and teaching. Teachers' years of experience in using ICT in the classroom also appears to have a stronger relationship with female teachers' emphasis on such skill development than this factor does for male teachers. Other factors showed similar effects for both male and female teachers.

Conclusions re teachers

- The most pervasive conclusion from the analyses of female and male teachers' experience, dispositions toward, and use of ICT is that any differences are small and/or inconsistent across countries. These results should go some way towards dispelling any beliefs that female and male teachers in secondary schools differ in the extent of their pedagogical use of ICT.