Cross cultural social and psychological determinants of girls’ decisions to study information and communication technologies (ICT) at university

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Slovakia
Countries are significantly different in **Female percentage of students in Informatics Bachelor’s programs (first year)**

<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>Austria</td>
<td>22.0</td>
<td>0.8%</td>
<td>0.073</td>
<td>19.9</td>
<td>Catholic</td>
<td>Capitalist</td>
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<tr>
<td>Belgium</td>
<td>6.4</td>
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<td>0.045</td>
<td>5.8</td>
<td>Protestant</td>
<td>Capitalist</td>
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<tr>
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<td>14.1</td>
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<td>Post Communists</td>
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<tr>
<td>Czechia</td>
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<td>7.9%</td>
<td>0.137</td>
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<td>Post Communists</td>
</tr>
<tr>
<td>Denmark</td>
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<td>9.9%</td>
<td>0.04</td>
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<td>Capitalist</td>
</tr>
<tr>
<td>Estonia</td>
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<td>21.7</td>
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<td>Post Communists</td>
</tr>
<tr>
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<td>Capitalist</td>
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<tr>
<td>Germany</td>
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<td>Capitalist</td>
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<tr>
<td>Greece</td>
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<td>0.122</td>
<td>10.4</td>
<td>Orthodox</td>
<td>Capitalist</td>
</tr>
<tr>
<td>Ireland</td>
<td>16.0</td>
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<td>11.3</td>
<td>Catholic</td>
<td>Capitalist</td>
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<td>Italy</td>
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<td>Netherlands</td>
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<tr>
<td>Norway</td>
<td>15.6</td>
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<td>13.2</td>
<td>Protestant</td>
<td>Capitalist</td>
</tr>
<tr>
<td>Portugal</td>
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<td>0.081</td>
<td>10.6</td>
<td>Catholic</td>
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<tr>
<td>Romania</td>
<td>28.1</td>
<td>3.5%</td>
<td>0.316</td>
<td>3.3</td>
<td>Orthodox</td>
<td>Post Communists</td>
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<td>Switzerland</td>
<td>13.2</td>
<td>3.7%</td>
<td>0.037</td>
<td>18.3</td>
<td>Protestant</td>
<td>Capitalist</td>
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<td>UK</td>
<td>15.5</td>
<td>-0.6%</td>
<td>0.119</td>
<td>n.a.</td>
<td>Protestant</td>
<td>Capitalist</td>
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<tr>
<td>Total mean</td>
<td>18.8</td>
<td>0.0%</td>
<td>0.103</td>
<td>13.9</td>
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* Informatics Education in Europe, Key Data 2013 - 2018 Table 1bis. Female percentage of students in Informatics Bachelor’s programs (first year), p 40
In terms of cross cultural lens we can apply several different approaches

I. Correlation and explanation studies

Aim to identify statistically significant correlates of social/cultural/psychological constructs related to the percentage of girls studying IT.

If we assume that specific index (e.g. gender pay gap) is one small reflection of national culture from many available, therefore to get total cultural picture about men/women in IT we have to work with many of them.

After that we can apply complex regression/structural models.

II. Comparing national scores of various published social/psychological measurement tools. Mean score in attitudes toward IT or self-efficacy for e.g. Germany and Czechia.

III. New empirical research for the level of the variables such as gender role stereotypes, cultural stereotypes on occupational choices, gender roles, activity stereotypes in specific national context
I. Correlation and explanation studies

Historical factors + World values survey

- EU countries with communism period/without

- Former communist countries $M = 22.00; SD = 7.7$

- Capitalistic countries $M = 17.39; SD = 6.21$

- $t(17) = 1.4; p = .18$ with medium effect size Cohen’s $d = .69$

- Protestant vs Catholic vs Orthodox (World values survey)
  - $F(5.92) = 2.62; p = .15$, In post hoc test no significant differences

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Mean</th>
<th>SD</th>
<th>SE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protestant Europe</td>
<td>8</td>
<td>17.07</td>
<td>7.66</td>
<td>2.71</td>
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<tr>
<td>Catholic Europe</td>
<td>8</td>
<td>17.84</td>
<td>5</td>
<td>1.77</td>
</tr>
<tr>
<td>Orthodox Europe</td>
<td>3</td>
<td>26.25</td>
<td>5.67</td>
<td>3.27</td>
</tr>
</tbody>
</table>

- Linear regression Total mean (DV), communism vs no communism (IV1) + religion (IV2)
  - Adjusted $R^2 = 0.12$, $F (3,15) = 1.78; p = 0.2$, no predictor were significant
I. Correlation and explanation studies
Some another indicators

- Real practices in the countries measured by:
  - **Gender pay gap** (Eurostat 2019)
    - Linear regression Total mean (DV), gender pay gap (IV)
    - Adjusted R2 = -0.04; F (1,16) = .038; p = .54
  - **Gender Inequality Index** (2018)
    - Linear regression Total mean (DV), gender inequality index (IV)
    - Adjusted R2 = 0.14; F (1,17) = 3.83; p = .07

- Hierarchical regression modelling
Some results, more questions

• Cultural factors, measured on representative samples by various indexes or constructs, are related with % of girls studying IT at university.

• As individual predictors usually closely to statistical significance, but combined multivariable regression models usually explains a very high level of the variance in % of girls studying IT at university.

• Yes, the culture does matter.

• Question is: validity and methodological limitations. When we put everything in the model, of course it will have high adjusted R squared, but what about explanation power and practical usability?
II. Comparing national scores in more detailed and specific constructs

- I propose that we have to investigate specific psychological constructs related to the individual study/occupational decision.

- In my systematic review I identified about a 100 measurement tools related more or less with ICT study constructs such as attitudes toward ICT, or self-efficacy in ICT etc.
List of older measurement tools with limited psychometric characteristics
Most of them miss one or all methodological procedures: Factor analysis, reliability tests, validity confirmation, or are not based on established theory, no classical test theory or item response theory applied

Computer Attitude scale (Loyd and Gressard, 1984a), tested and updated by Bandalos and Benson (1990)
Attitudes about Computers (Zoltan and Chapanis, 1982),
Attitudes Toward Computers (Reece and Gable, 1982)
Beliefs About Computers (Ellsworth and Bowman, 1982)
Cybernetics Attitude Scale (Wagman, 1983)
Computer Attitude Scale - CAS (Loyd and Gressard, 1984), 8 - 12 grade students,
Computer Attitude Scale (Collis, 1984), secondary students
Attitude Towards MIS (ATMIS) (Kjerulf and Counte, 1984), students
Attitude Toward Computers in General - ACG (Kjerulf and Counte, 1984), students
Computer Attitude Scale - CATT (Dambrot, Watkins-Malek, Silling, Marshall, Garver, 1985), students
Cognitive & Affective computer attitudes (Bannon et al., 1985), students

Computer Attitude Scale -CAS (Nickell and Pinto, 1986)
Computer Attitude scale (Abdel-Gaid, Trueblood, and Shrigley 1986)
Bath County Computer Attitudes Inventory - BCCAS (Bear et al. 1987)
Attitudes Toward Computers Scale - ATCS (Rosen et al., (1987), 4 -12 grade students
Minnesota Computer Literacy & Awareness Assessment Instrument - MCLAA (Swadener and Hannafin, 1987), 6th grades
Computer Attitude Measure (CAM),
Computer Attitudes & Learning Performance (Gattiker and Hlavka, 1992), students
Attitude Toward Computer Scale - ATCS (Francis (1993)
Computer Attitude Survey (Klein, Knupfer, and Crooks, 1993)
Computer Attitude Scale for Secondary Students - CASS (Jones and Clarke, 1994)
Some selected measurement tools according the psychometric characteristics ICT

- **Attitudes:**
  - *Computer Science Attitudes Scale for middle school students (MG-CS attitudes)* (Rachmatullah et al, 2020)
  - *The Attitudes Toward Computer Usage Scale - ATCUS 2* (Morris et al, 2009)
  - *Attitude towards computers instrument - ATCI* (Shaft, Sharfman, Wu, 2004)
  - *Elementary Computer Science Attitudes - E-CSA* (Vandenberg et al., 2021)

- **Self-efficacy**
  - *Computational thinking scales – CTS* (Korkmaz, et al. 2017) has also strong cognitive component
  - *Computer programming self-efficacy scale* (Tsai et al, 2019)
  - *Computer user self-efficacy scale (CUSE)* (Cassidy, Eachus, 2002) – small sample

- These and other measurement tools allow us to compare countries in specific constructs such as attitudes, self-efficacy in usage/ in programming etc.
- Than we can create Mean for European countries and to place every country on the scale and to know where specifically country lags behind.
III. New empirical research

- Questionnaires measuring constructs (according to Eccles) related to the ICT study such as:
  - Gender role stereotypes
  - Specific country stereotypes of occupational/study characteristics
  - Gender roles
  - Activity stereotypes
  - Beliefs
More targeted approach
We need to know what is the problem/s and then apply proper policy to handle it.

In which factors country lags behind?
- Low levels of self-efficacy
- Negative attitudes toward computer programming
- Gender role stereotypes
- Negative/ambivalent attitudes toward ICT

Organize policies according to these factors

Apply targeted approach
To specific national problems apply relevant policies
Thank you for your time

Acknowledgement

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