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

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

Country (RU and UAS mean)	Mean % from 2012/13 to 2017/18	Mean of growth in % from 2012/13 to 2017/19	Gender Inequality Index (2018)	Gender pay gap (Eurostat 2018/2019)	World values survey - Inglehart-Welzel World cultural Map (2020)	Capitalist/Post Communist
Austria	22.0	0.8%	0.073	19.9	Catholic	Capitalist
Belgium	6.4	6.8%	0.045	5.8	Protestant	Capitalist
Bulgaria	30.8	-0.9%	0.218	14.1	Orthodox	Post Communists
Czechia	17.7	7.9%	0.137	18.8	Catholic	Post Communists
Denmark	13.3	9.9%	0.04	14	Protestant	Capitalist
Estonia	27.1	3.8%	0.091	21.7	Catholic	Post Communists
Finland	17.6	2.3%	0.05	16.6	Protestant	Capitalist
Germany	22.7	1.4%	0.084	19.2	Protestant	Capitalist
Greece	19.9	0.9%	0.122	10.4	Orthodox	Capitalist
Ireland	16.0	0.7%	0.093	11.3	Catholic	Capitalist
Italy	18.7	0.1%	0.069	4.7	Catholic	Capitalist
Latvia	16.9	8.0%	0.169	21.2	Catholic	Post Communists
Lithuania	11.4	10.1%	0.124	13.3	Catholic	Post Communists
Netherlands	32.3	6.8%	0.041	14.6	Protestant	Capitalist
Norway	15.6	1.8%	0.044	13.2	Protestant	Capitalist
Portugal	12.9	1.7%	0.081	10.6	Catholic	Capitalist
Romania	28.1	3.5%	0.316	3.3	Orthodox	Post Communists
Switzerland	13.2	3.7%	0.037	18.3	Protestant	Capitalist
UK	15.5	-0.6%	0.119	n.a.	Protestant	Capitalist
Total mean	18.8	0.0	0.103	13.9		

* 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

Group WVS	N	Mean	SD	SE
Protestant Europe	8	17.07	7.66	2.71
Catholic Europe	8	17.84	5	1.77
Orthodox Europe	3	26.25	5.67	3.27

- Linear regression Total mean (DV), communism vs no communism (IV1) + religion (IV2)
- Adjusted R2 = 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) (Kjerulff and Counte, 1984), students

Attitude Toward Computers in General - ACG (Kjerulff 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 Attidues 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

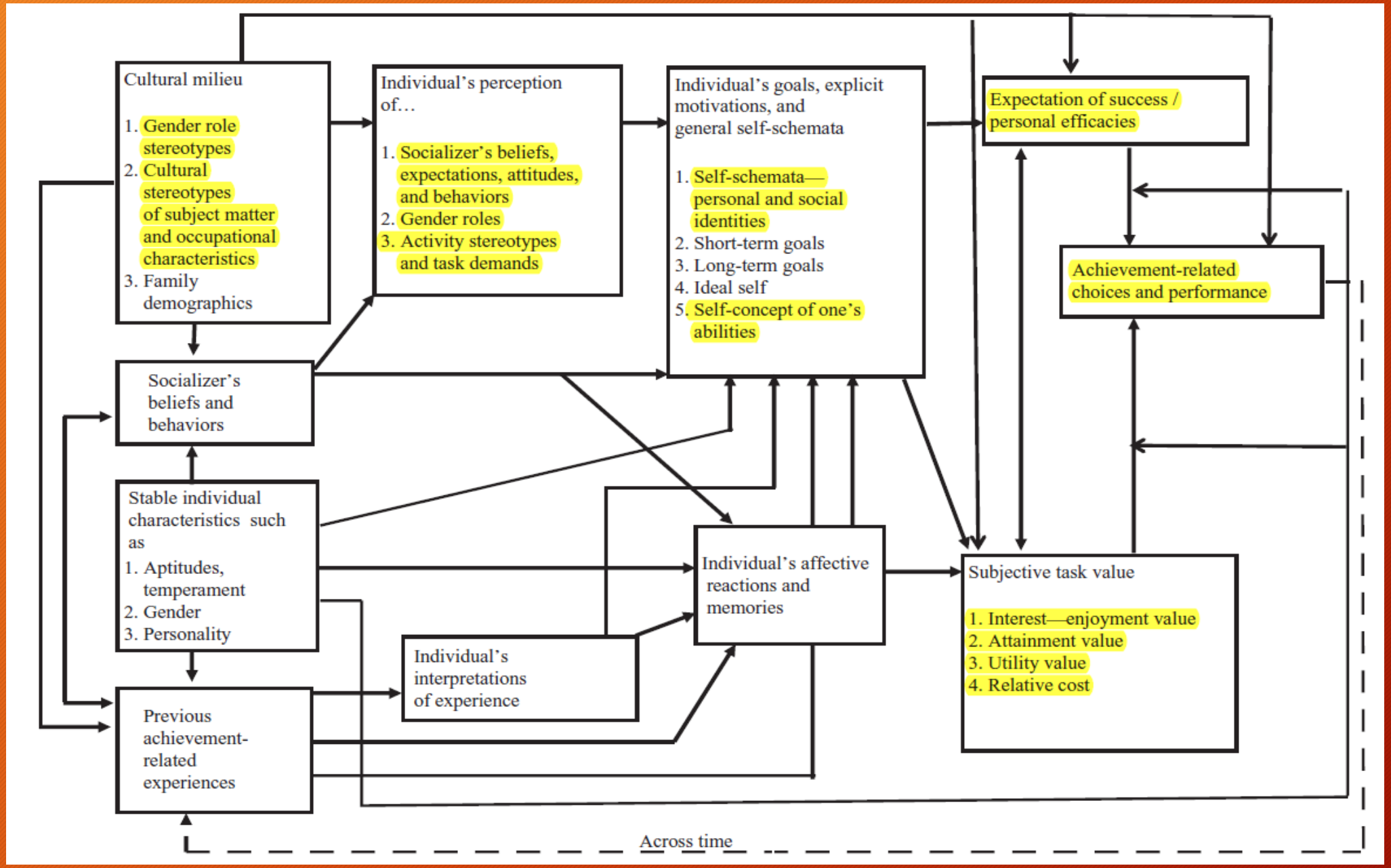
- Attitudes:
  - *Computer Science Attitudes Scale for middle school students (MG-CS attitudes)* (Rachmatullah et al, 2020)
  - *The Attitudes Toward Computer Usage Scale -ATCUS 2* (Morris et al, 2009)
  - *Attitude towards computers instrument -ATCI* (Shaft, Sharfman, Wu, 2004)
  - *Elementary Computer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



Eccles, J. (2011). Gendered educational and occupational choices: Applying the Eccles et al. model of achievement-related choices. *International Journal of Behavioral Development*, *35*(3), 195-201. page 196

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

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