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Optimism, interest and gender equality: comparing attitudes of university students in Latvia and Ukraine toward IT learning and work

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ABSTRACT

Global processes of digitalisation are transforming learning and work. University students in all nations are under pressure to develop positive and productive technology-related skills and dispositions. This study investigates the attitudes of 1,006 Latvian and Ukrainian university students towards information technology. Survey responses from the Attitudes towards Information Technology scale were collected, validated, analysed and interpreted. By generating group-response profiles and conducting multivariate analyses of variance, the attitudinal orientations of participants were compared, and significant differences between gender and nation subgroups identified. From a gender perspective, one noteworthy finding is that males in both countries expressed a significantly higher interest in learning about IT than females. From a national perspective, Ukrainians reported significantly higher optimism about IT in the workplace than Latvians. This study produces several novel findings addressing the attitudes of Eastern European university students towards information technology and their readiness for digitalised learning and work.

KEYWORDS

Information technology attitudes; technology readiness; digitalisation; higher education; Ukraine; Latvia

Introduction

Information technology (IT) continues to drive global transformations in education and work. Today, guided by programs such as Industry 4.0 (Xu, Xu, and Li 2018; Oztemel and Gursev 2018) and Society 5.0 (Fukuda 2019), businesses and organisations are entering a deeper phase of digitalisation, incorporating emerging technologies such as machine learning, Internet of Things, big data analytics, smart sensors, virtual/augmented reality, additive manufacturing and others (Atzori, Iera, and Morabito 2010; Rüssmann et al. 2015). These technologies are enabling objects, devices and human-machine systems with new physical, sensorial and cognitive capacities for addressing complex tasks (Romero et al. 2016). In digitalised environments, humans and machines will increasingly function together as ‘intelligent assemblages’ capable of producing knowledge and

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goods more efficiently, reliably and adaptively than when functioning alone. Increasing levels of human-machine intimacy will transform the technical requirements for learning and work activities, compelling university students in all fields to develop positive attitudes towards using and learning about technology (Adolph, Tisch, and Metternich 2014).

Much research has been conducted to conceptualise and measure the technology-related capacities of students around the world (van Deursen and van Diepen 2013; Calvani et al. 2008; Eshet-Alkalai and Amichai-Hamburger 2004; Blayone et al. 2018b). Digital skills and competencies have garnered tremendous attention, but numerous attitudinal complexes have also been investigated (Litt 2013). These include computer and Internet-related self-efficacy (Moos and Azevedo 2009) and motivations to use technology (Dwivedi et al. 2017). Indeed, attitudes, emotions and motivations are gaining status as predictors of technology acceptance along with rationale-choice factors (Dwivedi et al. 2017).

Given the variety of psychological dispositions influencing effective human-technology interaction, and the endless array of technology objects (e.g. computers, Internet, mobile devices, wearables, software applications, social media platforms and virtual reality gear), the research is fragmented. Available knowledge syntheses address technology attitudes related to teaching (Njiku, Maniraho, and Mutarutinya 2019), acceptance (Marangunić and Granić 2014), mathematics (Huscroft-D'Angelo, Higgins, and Crawford 2019), elderly populations (Mostaghel 2016), mobile applications (Malik, Suresh, and Sharma 2017) and more (Gerber, Gerber, and Volkamer 2018). However, these efforts address small portions of the research and combine different psychological tendencies, technological objects and contexts of use under a common theme. Some researchers have addressed this fragmentation by proposing standardised meta-theoretical frameworks for unifying research designs and comparing results (Tate, Evermann, and Gable 2015). Time will tell whether this type of coordinated planning will unite the diverse interests and theoretical perspectives of researchers.

One burgeoning research subdomain relevant to this study addresses *gender differences* in attitudes towards technological objects. A recent meta-analysis, updating two prior syntheses (Liao 1999; Whitley 1997), found that males still held more favourable beliefs about the usefulness of digital technology and their ability to learn technical skills, even though the gender gap in self-efficacy had closed (Cai, Fan, and Du 2017). A secondary finding was that gender-related attitudinal differences were not consistent across national and regional contexts, suggesting that cultural factors were influencing dispositions towards technology (Cai, Fan, and Du 2017). This insight aligns with the dominant situationist orientation of social psychology and highlights the need for cross-cultural studies to address the contexts of investigation as an integral part of the research design (DeLamater and Ward 2013).

Research addressing technology-related attitudes in Eastern Europe (the context of this study) comprise an eclectic literature. For example, the dispositional tendencies of Turkish students towards computer-supported education were measured with computer anxiety, self-efficacy and multi-dimensional attitudes scales (Celik and Yesilyurt 2013). Additionally, the experience and confidence of university students in Ukraine and Georgia towards using computers and mobile devices for technical, social, informational and computational interactions were measured and compared using the General

Technology Competency and Use framework (Blayone et al. 2018a). Several studies led by Scottish researchers addressed relationships between gender, nationality and the attitudes of Western and Eastern European academics towards computing, the Internet and engineering (Durndell and Haagb 2002; Durndell et al. 1997; Durndell, Haag, and Laithwaite 2000; Durndell and Thomson 1997). Notable findings from this research programme, conducted during an early period of post-communist transition, were twofold. Firstly, Eastern Europe was producing proportionally far more female technologists, engineers and physicists than Western Europe and the USA (Durndell and Haagb 2002). Secondly, despite this, gender variations, in which females reported higher levels of computer anxiety, less favourable attitudes towards technology and lower computer self-efficacy, mirrored many Western findings from the same period (Cai, Fan, and Du 2017). A fuller synthesis of the literature addressing technology attitudes in Eastern Europe since the dissolution of the Soviet Union is outstanding.

Two funded projects catalysed this cross-cultural study. The investigation began with research teams at selected universities in Latvia and Ukraine surveying the technology attitudes of university students at their institutions using the same self-report instrument. After the collection period, the authors reviewed the resulting data sets and analysed them from the perspective of student readiness for emerging forms of digital learning and IT work. This interpretive focus was strategic because the IT sectors in both Ukraine and Latvia have shown growth amidst struggling economies. Moreover, programs such as Industry 4.0 have recently entered the economic-development discourse in both countries as a catalyst for ongoing transformation.

The structure of this study is as follows. First, a foundational theoretical apparatus is established for analysing the data set. The Eastern European research contexts are then highlighted, and the research questions stated. Next, the data collection and analysis methodologies are described, and key findings presented. Finally, significant contributions to research and educational praxis are highlighted, and limitations addressed.

Theoretical apparatus

Empirical explorations of psychological tendencies towards target objects or activities can be based on first-order attitudinal models (Tate, Evermann, and Gable 2015) or second-order theories such as reasoned action, planned behaviour and self-efficacy (Gokhale et al. 2015). Researchers addressing *technology-related* objects and activities have even adapted second-order theories to produce specialised frameworks such as technology acceptance (TAM) (Marangunić and Granić 2014), computer self-efficacy (Moos and Azevedo 2009) and unified theory of acceptance and use of technology (UTAUT) (Williams, Rana, and Dwivedi 2015).

Following Gokhale, Brauchle, and Machina (2013), and consistent with the questionnaire deployed in this study, a theoretical apparatus was derived from a first-order social-psychological perspective beginning with Allport's well-established definition of attitudes.

An attitude is a mental and neural state of readiness, organised through experience, exerting a directive or dynamic influence upon the individual's response to all objects and situations with which it is related. (Allport 1935, 794–795)

This definition highlights the latent relational structure of attitudes, incorporating (a) an individual's 'state of readiness' triggered by an *object* (e.g. a mental representation of a thing, an abstract concept or activity); and (b) the *situation* as an interpretive frame for the state–object relationship. Significantly, this relational psychological structure is reinforced through experience, influencing subsequent perceptions, decisions and behaviours. Allport (1935) also emphasised that this structure generally expresses *directionality*, leading an individual to adopt a favourable or unfavourable posture to an object within a situational frame.

Structural definitions of attitudes since Allport have further emphasised this directional or evaluative aspect. For example, Eagly and Chaikin (2007), regard attitudes as psychological tendencies, developed by evaluating particular entities *with some degree of favour or disfavour*. Although 'neutral' attitudes may find a place in the structure and discourse of attitudinal measurement (particularly when a 5-point Likert scale is deployed), it remains an open question to what degree a mid-point value indicates genuine indifference or masks latent directionality (e.g. represents a reserved or socially acceptable response that is not intra-personally authentic).

An essential distinction in the social-psychological research is made between explicit (conscious) attitudes, typically measured directly via self-reports, and implicit (unconscious) attitudes, measured indirectly via computer-based procedures such as the Implicit Association Test (IAT) (Hitlin and Pinkston 2013). The decision to measure explicit or implicit attitudes as predictors of behavioural outcomes largely depends on contextual dynamics. For example, measurements of explicit attitudes often have good predictive value when the object-circumstances frame is not socially sensitive, and a mental state is characterised by strong directionality (e.g. attraction or repulsion, favour or disfavour) (Hitlin and Pinkston 2013). Technological objects and activities (unlike those associated with race or sexuality, for example) are most often not socially sensitive, and therefore, are generally measured adequately with self-report instruments (Gokhale, Brauchle, and Machina 2013; Gokhale et al. 2015).

Based on these social-psychological first principles, Figure 1 presents the relational structure grounding this empirical investigation of technology-related attitudes. This entire relational structure, comprised of mental tendencies, a target object and

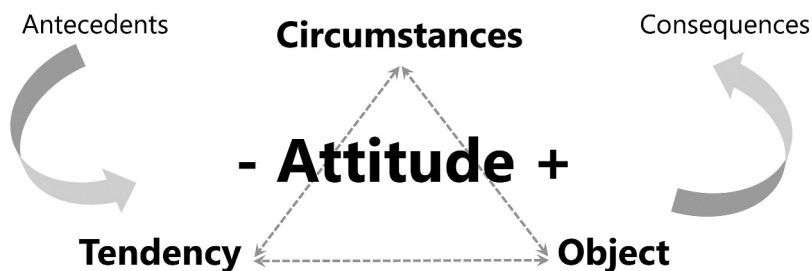


Figure 1. The three-facet foundational model of attitudes.

circumstances, is a *psychological* construct. Characteristics of the individual (positioned as antecedents) and associated responses (positioned as consequences), however, often have more objective qualities.

Application of the foundational model to this study

Deploying the Attitudes towards Information Technology (A-IT) questionnaire (Gokhale, Brauchle, and Machina 2013) for data collection in Ukraine and Latvia, this study applied an accompanying foundational model as shown in Figure 2. The two antecedents of interest were identified as student nationality and reported gender. Four discrete mental tendencies towards IT (the attitudinal object) measured by the A-IT instrument were selected for analysis. These are technology-related optimism and anxiety, an interest in learning about IT, and perceptions of gender equality in IT workplaces. Each of these attitudinal tendencies was positioned as influencing the overall quality of the target outcome, defined as successfully engaging with informational technology at school and work. Before articulating the guiding research questions and methodological procedures, the contexts of study are highlighted focusing on core themes of technology, attitudes and gender.

Geographical contexts of study

Ukraine, a nation of over 40 million people, was a Soviet republic for about 70 years (Central Intelligence Agency 2020b). It has produced two transformative peoples' revolutions – the Orange Revolution in 2004 and the Revolution of Dignity in 2014 – each accelerating systemic reform. Latvia, a Baltic nation of about 2 million people, was a Soviet republic for 45 years (Central Intelligence Agency 2020a). In 2004, it joined NATO and the EU, making strides towards fuller democratic functioning (Freedom House 2019). Parallel data for Ukraine and Latvia addressing technology and gender are rare, but the Social Progress Index (2020a, 2020b) provides a few relevant contextual highlights. Both nations share a high ranking for access to information and communication technologies and mobile phone subscriptions, with Latvia having a higher

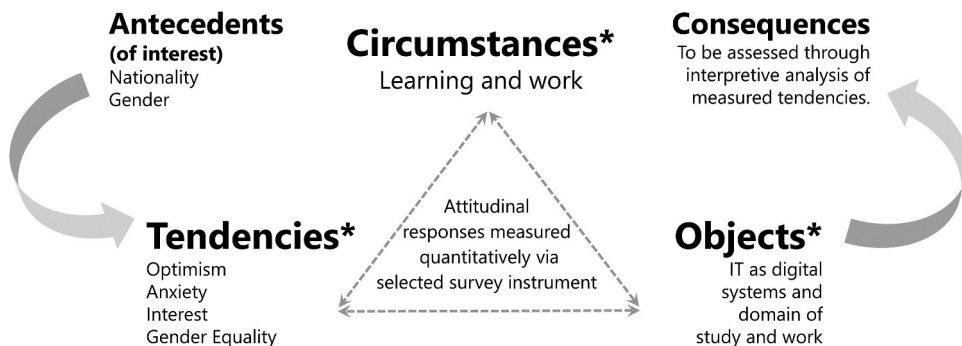


Figure 2. Application of the foundational model. (The asterisked items were inherited from an existing survey instrument, described below under methodology.).

percentage of Internet users (as a percentage of the population) than Ukraine. On the gender side, Latvia ranks slightly higher on measures addressing women's equality of political power, gender parity in secondary education, and average years in school.

The International Telecommunication Union (2018), which does not have data for Ukraine, indicates that Latvia has a much higher proportion of men possessing mid-level technology skills than women. The World Values Survey addresses general attitudes towards technology at the national level with data from Ukraine only. Item V68 (Wave 6: 2010–2014) asked if 'more emphasis on technology in everyday life would be a good thing' (Institute for Comparative Survey Research 2019). Over 70% of Ukrainians selected a strongly positive response. By comparison, less than 50% of American and 59% of Estonian respondents, Latvia's Baltic neighbour, were equally enthusiastic. When this measure is crossed with gender, the data show 75% of Ukrainian males and 65% of females responded in this way – a trend attested elsewhere in the technology attitudes research (Cai, Fan, and Du 2017).

In this context, it is noteworthy that Ukraine's IT sector has seen substantial growth in recent years (Kossov 2020). Although Latvia has a small share of technology products in total exports and reports a need for highly skilled technologists, the IT sector is also growing (Menaker and Ozoliņa 2018). The digitalisation of manufacturing, particularly as envisioned by Industry 4.0 (Sanchez, Exposito, and Aguilar 2020; Xu, Xu, and Li 2018), is an economic-development priority for both nations. To address this priority, Ukraine is leveraging a strong network of technology-focused universities, and Latvia benefits from its membership in the EU, where Industry 4.0 is approaching significant levels of maturity (Kyiv International Economic Forum 2016; OECD 2018).

Overall, both nations have demonstrated progress towards full participation in global processes of high-technology implementation, which includes higher education reforms aligned with emerging digital work environments (Huisman, Smolentseva, and Froumin 2019).

Research questions

Three research questions were established to investigate the attitudes of university students in Ukraine and Latvia towards IT.

- (1) What are the measured attitudinal tendencies of Ukrainian and Latvian, male and female students towards IT? (RQ1)
- (2) Are there significant attitudinal differences between national and gender, groups and subgroups? (RQ2)
- (3) What are the potential consequences of these attitudinal tendencies and group differences towards IT? (RQ3)

Methodology

The Attitudes towards Information Technology (A-IT) scale (Gokhale, Brauchle, and Machina 2013) was deployed for measuring the attitudinal tendencies of Ukrainian and Latvian participants towards IT. This instrument was developed in the United States to explore IT worker shortages and validated with a sample of 373 students from Illinois

State University. It was selected for this study owing to its coverage of under-researched attitudinal complexes that extended beyond the well-studied self-efficacy construct. It also offered a vital ‘gender subtext’ (Gokhale, Brauchle, and Machina 2013, 13) aligned with the sponsoring projects. The full instrument incorporates 30 items (including five subscales and seven residual items) measuring five attitudinal complexes on a 5-point Likert scale of agreement. For deployment in Latvia and Ukraine in early 2019, permission was obtained from the instrument authors and the scientific-research councils of participating institutions. The instrument was translated from English to Ukrainian and Latvian by two multi-lingual scholars (and reviewed by two other scholars).

In Ukraine, voluntary respondents were recruited by research teams from the student body of Ternopil National Economic University (TNEU), which serves about 24,000 students in economics, business finance and IT. In Latvia, respondents were recruited from the student population of Rēzekne Academy of Technologies, an economics, educational-studies and computer science institute, and three partner faculties at the University of Latvia, Liepaja University and Daugavpils University. Table 1 shows the respondent groups and subgroups by country and gender.

Analytical strategy

To address the research questions, the authors selected four subscales, as shown in Table 2. A fifth subscale and seven residual items were considered extraneous to this study and ignored. Also, for reasons reported below, two items from the selected subscales were excluded from analysis (shown in italics in Table 2).

Validating the selected subscales

The four subscales were tested following the recommendations of Crutzen and Peters (2017). An initial Confirmatory Factor Analysis (CFA) was conducted, with the results suggesting a marginally good fit for the inherited factor model. An exploratory factor analysis was run to review item loadings. One marginally correlated item from the PE subscale was highlighted and then removed following a semantic review. (It was the only item in the subscale that did not specifically address *work* effects.) Also, one poorly correlated item in the NI subscale was removed when a semantic review indicated that translators missed an essential negative nuance in the English text. With these items

Table 1. Respondent characteristics by nation, gender and nation-gender subgroups.

Characteristics (N = 1006)		N	Percentage
Nation	Ukraine	749	74%
	Latvia	257	26%
Gender	Male	326	32%
	Female	680	68%
Nation-gender	Ukrainian males	282	28%
	Ukrainian females	467	46%
	Latvian males	44	4%
	Latvian females	213	21%

Table 2. Four A-IT subscales selected for this study.

Subscale	Latent attitudinal complex	Items
PE	Optimism towards the effects of IT at work	PE1: In general, information technology (Information Technology) will create more jobs than it eliminates PE2: Because of Information Technology, work will become more appealing PE3: Family-friendly environments are more available in Information Technology occupations than others PE4: Because of Information Technology, there will be more opportunities for the next generation*
NI	Anxiety about the potential negative impacts of IT	NI1: Information Technology makes our way of life change too fast* NI2: Advancements in Information Technology will eventually destroy the earth NI3: People would do better by living a simpler life without so much Information Technology NI4: Information Technology applications create an artificial and inhuman way of living
LN	Interest in learning IT-related knowledge and skills	LN1: I enjoy learning about new Information Technology discoveries LN2: I am well informed about new developments in Information Technology LN3: I am interested in new applications of Information Technology for improving our lives LN4: I like to read about Information Technology-related topics LN5: I like to watch films and videos that have Information Technology-related themes LN6: I have looked for information about Information Technology advances on the Internet
GE	Perceptions of gender equality in IT workplaces	GE1: The same opportunities to succeed in Information Technology are available to men and women GE2: The same opportunities to develop Information Technology abilities are available to men and women GE3: The work environment faced by females in Information Technology fields is the same as that faced by males

*Item removed before analyses.

Table 3. Results of confirmatory factor analysis (N = 1006).

Subscales	χ^2	df	χ^2/df	CFI	RMSEA	ci. (90%)	SRMR	PNFI
PE, NI, LN, GE	308.71	84	3.68	.95	.052	.045 –.06	.043	.74

For χ^2/df , good-fit ratios range from 5.0 to 2.0 with lower being better; for CFI, a good-fit value is greater or equal to .90, with some preferring .95; RMSEA values below .07 suggest a good fit; SRMR values below .05 suggest an excellent fit; PNFI good-fit values range from .5 to .9 (Hooper, Coughlan, and Mullen 2008).

removed, a second CFA indicated that the four-factor model, consisting of three items for PE, NI and GE and six for LN was a good fit, as shown in Table 3.

The next step was to examine the internal reliability of the scales with McDonald’s omega, a preferred alternative to Cronbach’s alpha (Dunn, Baguley, and Brunsten 2014). The LN subscale produced an expectedly high omega of .86 given the conceptual homogeneity of the six constituent items. The GE and NI subscales produced omega values of .7, and the PE subscale a value of .6. By general rules of thumb, values falling below .7 are often considered problematic. However, when the nature and breadth of the three-item PE subscale were reviewed, this level of internal consistency was considered adequate for this study (Crutzen and Peters 2017).

Table 4. Descriptive attitudinal profiles of nation and gender groups, and subgroups.

PE: optimism						
Group/Subgroup	N	Mean	SD	High*	Neutral	Low**
Latvia	257	3.24	.66	33.5%	52.9%	13.6%
Ukraine	749	3.34	.73	43.4%	44.1%	12.6%
All males	326	3.32	.77	40.8%	46.0%	13.2%
All females	680	3.31	.68	40.9%	46.5%	12.6%
Latvian males	44	3.15	.92	27.3%	54.5%	18.2%
Ukrainian males	282	3.35	.76	42.9%	44.7%	12.4%
Latvian females	213	3.26	.62	34.7%	52.6%	12.7%
Ukrainian females	467	3.33	.71	43.7%	43.7%	12.6%
NI: Anxiety						
Group/Subgroup	N	Mean	SD	High*	Neutral	Low**
Latvia	257	2.94	.81	22.6%	46.7%	30.7%
Ukraine	749	2.70	.80	15.5%	41.4%	43.1%
All males	326	2.66	.82	15.0%	39.9%	45.1%
All females	680	2.81	.80	18.4%	44.1%	37.5%
Latvian males	44	2.70	.95	20.5%	36.4%	43.2%
Ukrainian males	282	2.65	.80	14.2%	40.4%	45.4%
Latvian females	213	2.99	.77	23.0%	48.8%	28.2%
Ukrainian females	467	2.73	.79	16.3%	42.0%	41.8%
LN: learning interest						
Group/Subgroup	N	Mean	SD	High*	Neutral	Low**
Latvia	257	3.23	.75	43.2%	43.6%	13.2%
Ukraine	749	3.50	.70	54.3%	39.8%	5.9%
All males	326	3.66	.74	65.0%	29.1%	5.8%
All females	680	3.32	.68	45.0%	46.3%	8.7%
Latvian males	44	3.61	.86	65.9%	22.7%	11.4%
Ukrainian males	282	3.67	.72	64.9%	30.1%	5.0%
Latvian females	213	3.16	.70	38.5%	47.9%	13.6%
Ukrainian females	467	3.39	.66	48.0%	45.6%	6.4%
GE: gender equality						
Group/Subgroup	N	Mean	SD	High*	Neutral	Low**
Latvia	257	4.04	.62	83.7%	14.4%	1.9%
Ukraine	749	3.78	.76	69.6%	23.8%	6.7%
All males	326	3.87	.76	74.5%	20.2%	5.2%
All females	680	3.83	.72	72.5%	21.9%	5.6%
Latvian males	44	4.01	.59	84.1%	13.6%	2.3%
Ukrainian males	282	3.85	.78	73.0%	21.3%	5.7%
Latvian females	213	4.05	.63	83.6%	14.6%	1.9%
Ukrainian females	467	3.73	.74	67.5%	25.3%	7.3%

*Inclusive of respondents reporting high and very high *agreement*. **Inclusive of respondents reporting low and very low *disagreement*.

Analysis and results

The composite profile, shown in Table 4, is organised by factors (dependent variables). It features two nation and gender groups and four nation-gender subgroups. In addition to showing means and standard deviations, each of the groups is divided into three response segments (high, neutral and low).

Table 5. *F*-test results with means and standard deviations by nation.

Nation	PE: optimism	NI: anxiety	LN: learning	GE: gender equality
Latvia (257)	3.24 (.66)	2.94 (.81)	3.23 (.75)	4.04 (.62)
Ukraine (749)	3.34 (.73)	2.70 (.80)	3.50 (.70)	3.78 (.76)
<i>F</i> -test (1,1002)	4.50*	4.65*	5.49*	13.11***
Effect size	.004	.005	.005	.013

* $p < 0.05$; *** $p < 0.001$. Effect size is reported using partial η^2 .

Group differences

A multivariate analysis of variance (MANOVA) was conducted in SPSS for independent variables (country and gender) and the four factors (PE, NI, LN and GE) as dependent variables (RQ2). The results for each were analysed for significance using Wilks' Lambda with an alpha value of 0.05. For tests having significance, univariate analyses were conducted to determine how the dependent variables differed for Latvian and Ukrainian, male and female respondents. Parametric tests were selected following the A-IT instrument authors (Gokhale et al. 2015) and significant empirical findings demonstrating that such tests are robust even when used for Likert data with small sample sizes, unequal variances and non-normal distributions (Norman 2010). Tables 5 and 6 show the between-group effects of Ukraine and Latvian and male and female students for the four measured attitudes. Table 7 shows between-group effects at the subgroup level.

Table 6. *F*-test results with means and standard deviations by gender.

Gender	PE: optimism	NI: anxiety	LN: learning	GE: gender equality
Male (326)	3.32 (.77)	2.66 (.82)	3.66 (.74)	3.87 (.76)
Female (680)	3.31 (.80)	2.81 (.80)	3.32 (.68)	3.83 (.72)
<i>F</i> -test (1,1002)	.48	6.70**	33.33***	.406
Effect size	.000	.007	.032	.000

* $p < 0.01$; *** $p < 0.001$. Effect size is reported using partial η^2 .

Table 7. *F*-test results with means and standard deviations by nation-gender subgroups.

Nation-gender	PE: optimism	NI: anxiety	LN: learning	GE: gender equality
Latvia				
Males (44)	3.15 (.82)	2.70 (.95)	3.61 (.86)	4.01 (.59)
Females (213)	3.26 (.62)	2.99 (.77)	3.16 (.70)	4.05 (.63)
<i>F</i> -test (1,255)	.889	4.94*	13.73***	.154
Effect size	.003	.019	.051	.001
Ukraine				
Males (282)	3.35 (.76)	2.65 (.80)	3.67 (.72)	3.85 (.78)
Females (67)	3.33 (.71)	2.73 (.79)	3.39 (.66)	3.73 (.74)
<i>F</i> -test (1,747)	.59	1.74	29.8***	4.8*
Effect size	.000	.002	.038	.006
Females				
Latvia (213)	3.26 (.62)	2.99 (.77)	3.16 (.70)	4.05 (.63)
Ukraine (749)	3.33 (.71)	2.73 (.79)	3.39 (.66)	3.73 (.74)
<i>F</i> -test (1,678)	1.96	16.66***	17.37***	30.07***
Effect size	.004	.005	.005	.013

* $p < 0.05$; *** $p < 0.001$. Effect size is reported using partial η^2 .

Discussion

In response to RQ1, addressing the attitudinal tendencies of respondent segments to IT, descriptive statistics were generated and presented for each of the four measured constructs (Table 4). In response to RQ2, addressing variations in attitudinal tendencies among national, gender and nation-gender respondent segments, significant differences were explored, and effect sizes generated as reported in Tables 5–7.

The remaining task is to highlight and interpret key aspects of these quantitative findings, and in response to RQ3, explore the potential consequences of these attitudinal tendencies and measured differences. This task is addressed on a construct-by-construct and aggregate basis to offer a rich set of interpretive findings. To offer some cross-cultural insights, we reference findings from an application of the A-IT instrument among a sample of university students in the United States (Gokhale, Brauchle, and Machina 2013). To our knowledge, this is the only other context in which the same subscales were used to measure the four constructs of interest, thus producing directly comparable results. It is not our intention to present American attitudinal tendencies as any sort of international standard.

Optimism towards IT effects at work

The male and female profiles are very similar showing about a 4:1 ratio between optimistic and pessimistic respondent segments. Importantly, optimism towards IT at work is well aligned with general technology acceptance (Dwivedi et al. 2017) and increasing levels of human-machine interdependence in digitalised work environments (Blayone and vanOostveen 2020). Ukraine produced a more substantial proportion of highly optimistic respondents than Latvia (43.4% to 33.5%), with only 23% of Latvian males sharing this level of optimism, as shown in Table 4. Consistent with this profile, the average level of Ukrainian optimism was found to be significantly higher than that of Latvians [$F(1,1002) = 4.5, p = .034$] as shown in Table 5. No other statistically significant differences were found.

Focusing on the descriptive segmentation statistics (Table 4), the substantial percentages of participants from both genders reporting optimism towards technology at work are consistent with previous findings from an American study using the same self-report instrument (Gokhale et al. 2015). The higher percentages of females expressing strong levels of technology optimism in Latvia and Ukraine might be linked to the history of state socialism in which the inclusion of women in technical roles was encouraged (Davies 2019).

The extensive neutral representation among males (46%) and females (46.5%), shown in Table 4, is also noteworthy. This neutral response may represent a cautious attitude towards IT among many respondents, or it may reflect a restrained response. The latter suggestion aligns with the cultural-value profiles of Ukraine and Latvia, which tend towards reserved forms of expression (Hofstede Insights 2019b, 2019a).

Anxiety towards negative IT impacts

Although one might expect levels of anxiety towards IT to be inversely proportional to levels of optimism, the theoretical model must be kept in view (Figure 1). Attitudinal

tendencies always manifest themselves with an object *in an attitudinal context*. The anxiety subscale addressed a general context of ‘life’ and the ‘world’ rather than the workplace (like the optimism subscale). As such, this subscale measures an attitudinal complex distinct from the optimism measures.

As shown in Table 4, respondents reporting high anxiety about negative IT impacts (on life and the world) range between 14.2% and 23% for the eight analysed groups. Concerning average levels of anxiety, there are four inter-group differences to note. First, as shown in Table 5, Latvians reported significantly more anxiety than Ukrainians [$F(1,1002) = 4.65, p = .031$]. Looking at the gender groups, females reported significantly higher levels than males [$F(1,1002) = 6.70, p = .01$] as shown in Table 5. Probing deeper, although Ukrainian males and females did not report significantly different levels, Latvian males and females did [$F(1,255) = 4.94, p = .027$]. Finally, comparing the two national female groups, Latvian females reported significantly more anxiety than Ukrainian females [$F(1,678) = 16.66, p < .001$] as shown in Table 7. As shown in Table 4, 23% of Latvian females and 20.5% of Latvian males reported high levels of anxiety, while only 16.3% of Ukrainian females and 14.2% of Ukrainian males reported the same levels. When this subscale was applied in an American university context, no significant differences were found between males and females in this attitudinal dimension (Gokhale et al. 2015).

Concerning these anxiety measures, the somewhat greater anxiety of female and Latvian respondents is noteworthy. Concerning females, one might associate higher levels of female anxiety with cross-cultural findings that females report stronger nurturing and pro-environmental attitudes than males (Chan, Pong, and Tam 2017). Regarding the tendency towards higher levels of anxiety among Latvians than Ukrainians, this finding may relate to the Ukrainian context. Ukraine is at war with Russia, and its socio-economic struggles are severe. In this situation, students may be less inclined to regard IT as a serious global threat, especially when the IT sector presents welcome Western-oriented career opportunities. As further evidence, Nikolayenko (2009) studied the life hopes of Ukrainian adolescents, finding variations from other nations and highlighting a strong desire for more innovations in modern technologies.

Interest in learning about IT

A strong motivation to increase IT knowledge and skills is a promising foundation for human thriving in an era of global digitalisation. However, it is precisely in attitudes towards learning that we encounter the greatest disparities between males and females. As shown in Table 4, 65.9% of Latvian males and 64.9% of Ukrainian males express a strong interest in learning, while only 38.5% of Latvian females and 48% of Ukrainian females express the same level of interest. As such, the overall level of interest was significantly higher for males than females [$F(1,1002) = 33.33, p < .001$] as shown in Table 6. Looking more closely, this pattern of significant male-female difference is strongly repeated in both Latvia [$F(1,213) = 13.73, p < .001$] and Ukraine [$F(1,282) = 29.8, p < .001$] as shown in Table 7. Consistent with high levels of Ukrainian positivity towards IT, Ukrainian females are significantly more interested than Latvian females in learning about IT [$F(1,678) = 17.37, p < .001$] as shown in Table 7. Overall, these findings reproduce

a pattern of higher male interest in learning about IT noted in an American study using the same instrument. This study also found that female interest in learning about IT increased with more years of university (Gokhale et al. 2015). This finding is hopeful and deserves some attention.

In Ukraine, the teaching profession tends to be dominated by females (Kutsyuruba 2011). While conducting digital-learning workshops at universities throughout Ukraine, however, we observed the perpetuation of gender stereotypes with male teachers assigned technical-support roles. Also, in a collaborative online course we conducted for a Ukrainian university cohort (Mykhailenko, Blayone, and vanOostveen 2016), we observed a tendency for males to be more responsive to technical challenges and females to function as more enthusiastic and creative communicators.

Perceived equality of IT workplaces

Attitudes towards equality of opportunity in IT workplaces are shaped by many layers of culture and institutional praxis. Moreover, such attitudes are influenced by disparities in the number of males and females in technology-focused university programmes and IT workplaces (Gokhale, Brauchle, and Machina 2013; Kenny and Donnelly 2019). The American study (based on the same instrument) reported that female students believed that IT professions offered them fewer opportunities than males (Gokhale et al. 2015). Data from Ukraine and Latvia tell a somewhat different story, with male and female students espousing very similar beliefs. Over 70% of each gender group reported high levels of perceived equality, as shown in Table 4, with no significant difference in means, as shown in Table 6. As shown in Table 5, however, perceptions of equal opportunity are significantly higher in Latvia than in Ukraine [$F(1,1002) = 13.11, p < .001$]. To drill down further, as shown in Table 4, 83.6% of Latvian females reported positive perceptions of gender equality in IT workplaces but only 67.5% of Ukrainian females shared this positivity. These percentages produced a significant difference in means between the two groups [$F(1,678) = 30.07, p < .001$] as shown in Table 7.

A plausible hypothesis for explaining national differences in female perceptions may, once again, relate to broader sociocultural factors. Ukraine ranks below Latvia on some gender-specific social-progress indicators, including women's political power and average years in school (The Social Progress Imperative 2020a, 2020b). Moreover, Ukraine tends to maintain a male-dominant culture with strong gender stereotypes (Walker, Babenko, and Greig 2019). Responding to the statement that 'men should have more right to a job than women' (Item V45, Wave 6), 30% of Ukrainians agreed compared to just 6% of Americans. Although there is no data on this item for Latvia, 18% of respondents from the neighbouring Baltic country of Estonia agreed (Institute for Comparative Survey Research 2019).

Summary of findings and potential consequences

The measured attitudinal tendencies of Ukrainian and Latvian male and female students towards IT (RQ1) and significant differences between national and gender segments (RQ2) were presented and discussed in detail above. Our guiding model positioned the measured attitudinal complexes with reference to critical outcomes such as choosing to

study IT or seeking employment in the IT sector, and RQ3 addressed these potential consequences. However, owing to the variety of measured attitudinal tendencies and various patterns of difference between national and gender segments, it is challenging to address outcomes with any degree of specificity.

Ukraine's optimism towards IT at work, coupled with modest anxiety about the adverse effects of technology, may bode well for the ongoing development of its IT sector. From a gender perspective, one moderating challenge is that Ukrainians, significantly more so than Latvians, perceive IT workplaces as lacking equal opportunities for males and females, thus potentially hindering fuller female participation. Moreover, the significantly greater male interest in learning about IT in both nations highlights an ongoing 'challenge' of attracting female students into some technologically focused university programmes.

Some may view 'shortages' of female IT workers as a problem. However, we encourage a more holistic perspective on gender and technology. For example, in some contexts, females are incorporating digital technologies into their daily professional practices in more diverse and effective ways than their male counterparts (Wiseman et al. 2017). Indeed, global processes of digitalisation are extending human-technology interaction across sectors where female representation is high, such as education, healthcare and marketing communications. Most recently, researchers have noted that the COVID-19 pandemic is accelerating the digitalisation of health services (Javaid et al. 2020). One would expect that new forms of work-based technology training will accompany these emerging forms of digitalisation and that positive attitudes towards socially beneficial IT use in female-dominated professions will result. In the end, does digital fluency necessarily require education and work that positions hardware and software as the primary objects of study and activity (Blayone 2019)?

Contributions

This study contributes to research in several ways. First, it measures and interprets key technology-attitudes in two under-researched geographical contexts, thus addressing a contextual gap. Second, it highlights several gender and national differences between Ukrainian and Latvian student groups, suggesting meaningful relationships between gender, culture and attitudes worthy of further study. Third, this study demonstrates the validity and usefulness of four subscales drawn from the American A-IT instrument for application in two post-Soviet contexts. Finally, it suggests opportunities for next-phase research aimed at (a) deepening understanding of relationships between culture, gender and technology attitudes (e.g. with interview and case-study data); and (b) broadening the analytical scope with a redeveloped instrument and more diverse samples drawn from additional East European contexts.

Limitations

Five limitations are acknowledged. Firstly, owing to inconsistencies in data collection in Latvia and Ukraine, additional independent variables (e.g. age, the domain of study and educational level) were not incorporated into the analysis. Secondly, the subscale measuring workplace technology optimism (PE) was found to have marginal levels of internal

consistency. Future studies might consider redeveloping the indicators for measuring attitudes towards IT effects in the workplace. Thirdly, effect sizes reported in the results tables, based on partial eta squared (a variance-explained measure) are consistently small. Although this is typical for quantitative analyses of gender and technology attitudes (Cai, Fan, and Du 2017), future studies might pursue more complex models incorporating additional variables such as age, educational level and major, socio-economic status, gender perceptions and cultural orientations. Fourthly, student respondents from Ukraine and Latvia were drawn from similar but not identical sets of social science, education and technical departments. Finally, by comparing our findings with those from an American study using the same instrument, we noted patterns of similarity and difference. Importantly, post-Soviet nations share many non-Western features (by virtue of a common Soviet experience and Russian language) and also exhibit many distinct socio-cultural characteristics amongst themselves. Thus, the findings produced by this study are not generalisable to other contexts.

Conclusion

As global processes of digitalisation increase the proximity and interdependence of humans and machines, attitudes towards IT become vital indicators of student readiness for successful learning and work. This study identified similarities and differences between university student groups in Latvia and Ukraine in attitudes towards learning about IT, perceptions of gender equality in IT workplaces and the impact of technology on the world. These findings, derived from a two-nation Eastern European sample, address a contextual gap in the literature and suggest fruitful avenues for next-stage research.

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