# Optimism, interest and opportunity: Technology attitudes of university students in Latvia and Ukraine from a gender perspective

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**Abstract**: As digitalisation transforms professional activity, those entering the workforce do well to expand their digital skills and adopt a positive disposition toward information technology. Extending prior research that measured the digital competences of Eastern European university students as an indicator of workforce readiness, this study addresses key psychological dispositions. More specifically, attitudes toward information technology of 1,006 Latvian and Ukrainian university students were measured using four validated subscales from an American questionnaire with a gender subtext. These subscales addressed optimism toward technology at work, interest in learning about information technology, and perceptions of gender equality in IT workplaces. By analysing descriptive profiles and conducting quantitative analyses, similarities and significant differences between gender and nation groups were identified in each attitudinal dimension. From an educational perspective, a noteworthy finding was that males in both countries expressed a significantly greater interest in learning about information technology than females. In the end, this study aims to raise awareness of gender divides, influence educational reform, and stimulate further study of gender, culture and technology in Eastern Europe to improve workforce readiness of university students.

**Keywords**: gender; attitudes; information technology; digitalisation; Ukraine; Latvia.

# 1 Introduction

Information technology continues to drive global transformations in education and work. As envisioned by Industry 4.0 (Oztemel & Gursev, 2018; Xu, Xu, & Li, 2018) and Society 5.0 (Fukuda, 2019), societies are entering a deeper phase of digitalisation beyond the computerisation of office tools, conversion of analogue media, globalisation of communication, and automation of repetitive tasks. The key innovation is intelligent systems that can sense, analyse, predict and produce both material and virtual goods more efficiently, reliably and adaptively than before. Such systems integrate several emerging technologies including machine learning, Internet of Things, big data analytics, smart sensors, augmented reality, collaborative robots and advanced human-machine interfaces (Atzori, Iera, & Morabito, 2010; Rüßmann et al., 2015). From a labour perspective, digitalised systems are radically altering professional activities, roles and responsibilities (Frey & Osborne, 2017), requiring humans to develop new attitudes, knowledge and skills (Adolph, Tisch, & Metternich, 2014).

For those advantaged with high quality and well-aligned education, digitalisation will likely introduce many new opportunities for flexible and meaningful technological work. However, many factors influence the ability of humans to respond positively to a changing technology landscape, and across societies several "digital divides" can result (Scheerder, van Deursen, & van Dijk, 2017; van Deursen & Helsper, 2017; van Deursen & van Dijk, 2014; van Deursen, van Dijk, & Peter, 2015). Gender, age, education and socio-economic status are all major factors influencing technology use, attitudes, skills, with direct consequences for quality of life (Fatehkia, Kashyap, & Weber, 2018; Gokhale, Rabe-Hemp, Woeste, & Machina, 2015; Litt, 2013; Wang & Degol, 2017). Attitudes have risen to prominence in the well-established technology-acceptance literature as a key determiner of use (Dwivedi, Rana, Jeyaraj, Clement, & Williams, 2017). Research specifically addressing technology-related attitudes and gender is also advanced. The quantitative meta-analysis of Cai, Fan, & Du (2017) recently updated two prior syntheses (Liao, 1999; Whitley, 1997). A primary finding was that males still held more favourable *beliefs* about the usefulness of digital technology and their ability to learn technological skills, even though the gender gap in confidence of technology use (self-efficacy) had closed considerably (Cai et al., 2017). A secondary finding was that gender-related attitudinal differences were not consistent across national/regional contexts suggesting that cultural factors were influencing dispositions toward technology (Cai et al., 2017).

Set within a five-year program of cross-cultural digital-readiness research, the authors initially explored the technology confidence (self-efficacy) and use of university students in Ukraine and Georgia for new forms of collaborative online learning (Blayone, Mykhailenko, Kokhan, et al., 2018; Blayone, Mykhailenko, vanOostveen, et al., 2018; Mykhailenko, Blayone, & vanOostveen, 2016). This research profiled technical, social, informational and computational competencies as facets of digital readiness. However, they failed to address attitudes toward technologies and gender that continually rise to prominence in collaborative explorations of digital learning in Eastern Europe. Thus, with support from the Latvian and Ukrainian governments, and with the assistance of partner universities, this study investigates technology-related attitudes of male and female students in Ukraine and Latvia. By focusing attention on two post-Soviet contexts, this study addresses a geographical gap in the research and calls attention to relationships between context, gender and technology.

## 1.1 Research Contexts

Ukraine and Latvia are post-Soviet Eastern European countries, each sharing borders with Russia and EU countries. Ukraine, a nation of over 42 million people, was a Soviet republic for about 70 years. It has produced two peoples' revolutions—the Orange Revolution in 2004 and the Revolution of Dignity in 2014—each challenging government corruption and catalysing socio-economic reforms aligned with Western European models. Latvia, a Baltic nation of about 2 million people, experienced 45 years as a Soviet republic. In 2004, it joined NATO and the EU, making tremendous strides towards full democratic functioning (Freedom House, 2019). Parallel data for Ukraine and Latvia addressing attitudes toward technology and gender are rare, but the 2019 Social Progress Index (2019a, 2019b) provides a few relevant comparative measures. Although Latvia's overall country score (addressing health, technological, environmental and human rights issues) placed them one tier above Ukraine, both nations have the highest ranking for levels of adult literacy, gender parity in secondary education and mobile phone subscriptions. Probing further on the technology side, Latvia has a higher percentage of Internet users than Ukraine, and on the gender side, higher rankings on measures addressing women's property rights, political power and average years in school.

The International Telecommunication Union (2018), which does not have data for Ukraine, positioned Latvia as a mid-performer among EU countries in the area of basic digital skills. However, like many countries, Latvia struggles with advanced technology skills, falling behind two other post-Soviet nations, Estonia and Kazakhstan.

This same data set also indicates that Latvia has a much higher proportion of men possessing mid-level technology skills than women. Another data source, the World Values Survey, which presents data for Ukraine only, addresses attitudes toward technology and science. Item V68 (Wave 6: 2010-2014), asked respondents if "more emphasis on technology in everyday life would be a good thing" (Institute for Comparative Survey Research, 2019). Over 70% of Ukrainians selected the most enthusiastic response. (By comparison, less than 50% of American respondents and 59% of Estonian respondents—Latvia's Baltic neighbour—were equally enthusiastic.) When this measure is crossed with gender, the data shows 75% of Ukrainian males and 65% of females responded in this way, following the broad trend toward higher male enthusiasm for technology (Cai et al., 2017).

In summary, Ukraine and Latvia are dynamic post-Soviet nations with well-developed technological and moderate to good levels of social progress related to women's rights. Basic technology skills are well-developed in Latvia, and Ukraine reports a world-leading enthusiasm for science and technology. These nation-level empirical insights illuminate the contexts and shape expectations for this study.

### 1.2 Research Questions

Two research questions were established to investigate the attitudes of university students in Ukraine and Latvia toward information technology.

1. What is the technology-attitude profile of Ukrainian and Latvian, male and female students?
2. Are there significant attitudinal differences between national and gender, groups and subgroups?

## 2 Methodology

American scholars, concerned about worker shortages and gender disparity in IT workplaces, developed the Attitudes toward Information Technology (A-IT) scale for measuring student attitudes toward information technology (Gokhale, Brauchle, & Machina, 2013). It was theorised using Allport (1935), who defined attitudes as a psychological state of readiness, developed through experience and influencing individual responses to *associated objects and situations*—in this case, information technology as a field of learning and work (Gokhale et al., 2013). The instrument was populated with 30 items addressing several attitudinal complexes, measured on a 5-point Likert scale of agreement. Items did not address self-efficacy because this construct was well-

represented in the research, and most studies found no significant differences between males and females (Gokhale et al., 2013). Indicators were grouped via factor and semantic analyses, producing five-subscales and seven residual items (Gokhale et al., 2013). The subscales addressed five attitudinal complexes, including beliefs in the value, effects and impacts of IT, motivation to learn about IT, and perceptions of gender equality in IT workplaces.

For data collection in Latvia and Ukraine, permission was obtained from the A-IT instrument authors and the scientific-research councils of participating institutions. The full scale was then translated from English to Ukrainian and Latvian by two multi-lingual scholars (and reviewed by two other scholars). In early 2019, it was deployed online by the research teams in each country. In Ukraine, voluntary respondents were recruited from Ternopil National Economic University (TNEU), which serves about 24,000 students in economics, business finance and information technology. In Latvia, respondents were recruited from Rēzekne Academy of Technologies, an educational-studies and IT 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. Additional socio-demographic data (e.g., age, year and specific domain of study) was not collected fully or consistently in both countries, and therefore are not shown.

Table 1: Respondents by country and gender

| Sample Characteristics (N=1,006) | | N | % |
|---|---|---|---|
| Country | Ukraine | 749 | 74% |
| | Latvia | 257 | 26% |
| Gender | Male | 326 | 32% |
| | Female | 680 | 68% |
| Sub-Groups | Ukrainian Males | 282 | 28% |
| | Ukrainian Females | 467 | 46% |
| | Latvian Males | 44 | 4% |
| | Latvian Females | 213 | 21% |

## 2.1 Analytical Strategy

Based on a semantic review, the authors selected four subscales of interest addressing distinct orientations. A fifth subscale addressing the practical value of IT and the seven residual (uncategorised) items were removed prior to analyses owing to their semantic heterogeneity and unclear theoretical bases. This resulted in a reduced set of

seventeen total items as shown in Table 2. For reasons reported below, one item from each of the PE and NI subscales were also removed (shown in italics in Table 2).

Table 2: A-IT subscales selected for analyses

| Subscale | Latent Attitudinal Complex | Items |
|---|---|---|
| **PE** | Optimism toward 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 workplacs. | 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 prior to analyses

## 2.2 Validating the Selected Subscales

The selected subscales were tested following the recommendations of Crutzen & 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.) In addition, 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 two items removed (italicised in Table 2), the results of a second CFA (Table 3) indicated that the four-factor model, consisting of 3 items for PE, NI and GE and 6 for LN (Appendix 2) was a good fit.

Table 3: Results of Confirmatory Factor Analysis (N=1006)

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

For $\chi^2$/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, & Mullen, 2008).

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, & Brunsden, 2014). The LN subscale produced an expectedly high omega value 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 & Peters, 2017).

# 3 Analysis and Results

A composite attitudinal profile was produced for the respondent groups organised by country and gender (RQ1). To explore significant differences between groups, a multivariate analysis of variance (MANOVA) was conducted in SPSS (RQ2).

## 3.1 Attitudinal Profiles

The composite profile, shown in Table 4, is organised by factors (dependent variables) and features two nation and gender groups, and four nation-gender subgroups. In addition to showing means and standard deviations, each of the groups are divided into three response segments (high, neutral and low). These segments suggest distinct orientations towards the attitudinal trigger as discussed below.

Table 4: Descriptive attitudinal profile of national and gender groups, and nation-gender subgroups

| **1. IT Effects at Work: Optimism (PE)** | | | | | | |
|---|---|---|---|---|---|---|
| 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% |
| **2. IT's Global Negative Impact: Anxiety (NI)** | | | | | | |
| 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% |
| **3. Learning about IT: Interest (LN)** | | | | | | |
| 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% |
| **4. IT Workplaces: Perceived Gender Equality (GE)** | | | | | | |
| 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 high and very high *disagreement*.

## 3.2 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' Lamda 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 practice of the A-IT instrument authors (Gokhale et al., 2015) and substantial 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 5: *F* test results with means and standard deviations by country for four subscales

| Country | 1. IT Effects at Work: Optimism | 2. IT's Global Negative Impact: Anxiety | 3. Learning about IT: Interest | 4. IT Workplaces: Perceived 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) |
| *F* test (1,1002) | 4.50* | 4.65* | 5.49* | 13.11*** |
| Effect Size | .004 | .005 | .005 | .013 |

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$. Effect size is reported using partial $\eta^2$.

Table 6: F test results with means and standard deviations by gender for four subscales

| Gender | 1. IT Effects at Work: Optimism | 2. IT's Global Negative Impact: Anxiety | 3. Learning about IT: Interest | 4. IT Workplaces: Perceived 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) |
| *F* test (1,1002) | .48 | 6.70** | 33.33*** | .406 |
| Effect Size | .000 | .007 | .032 | .000 |

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$. Effect size is reported using partial $\eta^2$.

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

| Country and Gender | 1. IT Effects at Work: Optimism | 2. IT's Global Negative Impact: Anxiety | 3. Learning about IT: Interest | 4. IT Workplaces: Perceived 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) |
| *F* 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) |
| *F* 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) |
| *F* test (1,678) | 1.96 | 16.66*** | 17.37*** | 30.07*** |
| Effect Size | .004 | .005 | .005 | .013 |

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$. Effect size is reported using partial $\eta^2$.

# 4 Discussion

This study produced two levels of findings. First, attitudinal profiles were generated for country and gender, groups and subgroups. The high and low respondent segments signalled bipolar attitudinal dispositions toward the target. Neutral response groups, however, are difficult to interpret because they could reflect a distinct neutral disposition or a restrained response to the target, which is consistent with cultures of restrained expression in Ukraine and Latvia. Second, analyses of variances produced several significant differences between groups.

## 4.1 Optimism toward 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 toward IT at work is well-aligned with increasing levels of digitalisation and growing interdependencies between humans and machines. Ukraine produced a larger 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. This finding is largely consistent with previous findings from an American context (Gokhale et al., 2015) and it calls attention to a generally positive and unifying disposition among males and females at work. The substantial neutral representation among males (46%) and females (46.5%) shown in Table 4 is also noteworthy and may represent a more cautious attitude toward IT or a restrained response masking either optimism or pessimism.

## 4.2 Anxiety toward Negative IT Impacts

As shown in Table 4, respondents reporting high anxiety about negative IT impacts 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 Latvia females and 20.5% of Latvia males reported high levels of anxiety, while only 16.3% of Ukrainian females and 14.2% of Ukrainian males reported the same levels. Interestingly, in an American context, no significant differences were found between males and females in this attitudinal dimension (Gokhale et al., 2015). Once again, the data points towards Ukraine as a relatively enthusiastic environment for technological innovation.

## 4.3 Interest in Learning about IT

Arguably, a strong motivation to increase IT knowledge and skills is a promising foundation for human thriving in an era of global digitalisation. Yet, 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 Latvia 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 toward information technology, Ukrainian females are significantly more interested than Latvia females in learning about information technology [F(1,678) = 17.37, p < .001] as shown in Table 7. Overall, these findings reproduce a pattern of higher male interest in learning noted in an American study using the same instrument (Gokhale et al., 2015). This American study also found that female interest in technology increased with more years of university (Gokhale et al., 2015).

## 4.4 Perceived Equality of IT Workplaces

Attitudes toward equality of opportunity in IT workplaces are shaped by many layers of culture and institutional praxis. Moreover, such attitudes are influenced by huge disparities in the number of males and females in technology-focused university programs and IT workplaces (Gokhale et al., 2013; Kenny & Donnelly, 2019). An American study reported that female university students believed that IT professions

offered them fewer opportunities than males, although education moderated this perception (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 relate to broader socio-cultural factors. For example, Ukraine ranks below Latvia on several gender-specific social-progress indicators, including women's property rights, equality of political power and average years in school (The Social Progress Imperative, 2019a, 2019b). Moreover, Ukraine tends to maintain a male-dominant culture with strong gender stereotypes (Walker, Babenko, & 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). More research is needed to unravel differences in gender perceptions in these countries and how they relate to student perceptions of IT.

## 4.5 Contributions

This study contributes to research in several ways. First, it measures and interprets key technology-attitudes in two under-researched contexts, thus addressing a contextual gap. Second, it highlights several gender and nation differences between Ukrainian and Latvia student groups, suggesting important relationships between gender, culture and attitudes worthy of further study. (An especially relevant finding from an educational perspective was that males reported significantly greater interest than females in learning about IT.) Third, this study demonstrates the validity and usefulness of four subscales drawn from the A-IT instrument for application in two post-Soviet contexts. Finally, it suggests opportunities for next-phase research aimed at (a) deepening understanding of culture, gender and technology attitudes with

interview and case-study data, or (b) broadening the analytical scope with a redeveloped instrument and more diverse samples drawn from additional East European contexts.

### 4.6 Limitations

Three limitations must be acknowledged. First, owing to inconsistencies in the collection of socio-demographic data in Latvia and Ukraine, additional independent variables such as age, domain of study and educational level were not incorporated into the analysis. Second, in testing the validity and reliability of the selected subscales, the subscale measuring workplace technology optimism (PE) was found to have marginal levels of internal consistency. Future studies might consider redeveloping the constituent items for measuring attitudes towards IT effects in the workplace. Finally, 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 et al., 2017), future studies might pursue richer models incorporating additional variables such age, educational level and major, socio-economic status, gender perceptions and cultural orientations.

### 4.7 Conclusion

As global processes of digitalisation increase the proximity and interdependence of humans and machines, attitudes toward information technology are vital indicators of student readiness for workplace success. This study identified significant differences between university student groups in Latvia and Ukraine in attitudes toward 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. Going forward, the researchers welcome the participation of new academic partners seeking to explore interactions between culture, gender and digitalisation in non-Western contexts.

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# 5 References

Adolph, S., Tisch, M., & Metternich, J. (2014). Challenges and approaches to competency development for future production. *Educational Alternatives, 12*, 1001-1010.

Allport, G. W. (1935). Attitudes. In C. Murchinson (Ed.), *A handbook of social psychology* (pp. 789-844). Worcester, MA: Clark University Press.

Atzori, L., Iera, A., & Morabito, G. (2010). The Internet of Things: A survey. *Computer Networks, 54*(15), 2787-2805. doi:10.1016/j.comnet.2010.05.010

Blayone, T., Mykhailenko, O., Kokhan, M., Kavtaradze, M., vanOostveen, R., & Barber, W. (2018). Profiling the digital readiness of higher education students for transformative online learning in the post-soviet nations of Georgia and Ukraine. *International Journal of Educational Technology in Higher Education, 15*(1), 1-22. doi:10.1186/s41239-018-0119-9

Blayone, T., Mykhailenko, O., vanOostveen, R., Grebeshkov, O., Hrebeshkova, O., & Vostryakov, O. (2018). Surveying digital competencies of university students and professors in Ukraine for fully online collaborative learning. *Technology, Pedagogy and Education, 27*(3), 1-18. doi:10.1080/1475939X.2017.1391871

Cai, Z., Fan, X., & Du, J. (2017). Gender and attitudes toward technology use: A meta-analysis. *Computers & Education, 105*, 1-13. doi:10.1016/j.compedu.2016.11.003

Crutzen, R., & Peters, G. Y. (2017). Scale quality: Alpha is an inadequate estimate and factor-analytic evidence is needed first of all. *Health Psychology Review, 11*(3), 242-247. doi:10.1080/17437199.2015.1124240

Dunn, T. J., Baguley, T., & Brunsden, V. (2014). From alpha to omega: a practical solution to the pervasive problem of internal consistency estimation. *British Journal of Psychology, 105*(3), 399-412. doi:10.1111/bjop.12046

Dwivedi, Y. K., Rana, N. P., Jeyaraj, A., Clement, M., & Williams, M. D. (2017). Re-examining the Unified Theory of Acceptance and Use of Technology (UTAUT): Towards a revised theoretical model. *Information Systems Frontiers, 21*(3), 719-734. doi:10.1007/s10796-017-9774-y

Fatehkia, M., Kashyap, R., & Weber, I. (2018). Using Facebook ad data to track the global digital gender gap. *World Development, 107*, 189-209. doi:10.1016/j.worlddev.2018.03.007

Freedom House. (2019). *Latvia Country Report*. Retrieved from https://freedomhouse.org/report/freedom-world/2019/latvia

Frey, C. B., & Osborne, M. A. (2017). The future of employment: How susceptible are jobs to computerisation? *Technological Forecasting and Social Change, 114*, 254-280. doi:10.1016/j.techfore.2016.08.019

Fukuda, K. (2019). Science, technology and innovation ecosystem transformation toward society 5.0. *International Journal of Production Economics*. doi:10.1016/j.ijpe.2019.07.033

Gokhale, A. A., Brauchle, P. E., & Machina, K. F. (2013). Scale to measure attitudes toward information technology. *International Journal of Information and Communication Technology Education, 9*(3), 13-26. doi:10.4018/jicte.2013070102

Gokhale, A. A., Rabe-Hemp, C., Woeste, L., & Machina, K. (2015). Gender differences in attitudes toward science and technology among majors. *Journal of Science Education and Technology, 24*(4), 509-516.

Hooper, D., Coughlan, J., & Mullen, M. R. (2008). Structural equation modelling: Guidelines for determining model fit. *Electronic Journal of Business Research Methods, 6*(1), 53-60.

Institute for Comparative Survey Research. (2019). World Values Survey. Online Database Retrieved from http://www.worldvaluessurvey.org

International Telecommunication Union. (2018). *Measuring the information society report*. Retrieved from https://www.itu.int/en/ITU-D/Statistics/Documents/publications/misr2018/MISR-2018-Vol-1-E.pdf

Kenny, E. J., & Donnelly, R. (2019). Navigating the gender structure in information technology: How does this affect the experiences and behaviours of women? *Human Relations*. doi:10.1177/0018726719828449

Liao, Y.-K. C. (1999). Gender differences in attitudes towards computers: A meta-analysis. *Eric Document Reproduction Service, ED 432 287*, 1-8.

Litt, E. (2013). Measuring users' internet skills: A review of past assessments and a look toward the future. *New Media & Society, 15*(4), 612-630. doi:10.1177/1461444813475424

Mykhailenko, O., Blayone, T., & vanOostveen, R. (Producer). (2016). Exploring democratized learning and dimensions of culture for educational transformation in Ukraine. *RIDRU Conference: Higher Education Reforms in Post-Maidan Ukraine, October 25, 2016*. [Video Presentation] Retrieved from https://www.youtube.com/watch?v=6_xOb3LpLfY#t=3h4m56s

Norman, G. (2010). Likert scales, levels of measurement and the "laws" of statistics. *Advances in Health Science Education, 15*(5), 625-632. doi:10.1007/s10459-010-9222-y

Oztemel, E., & Gursev, S. (2018). Literature review of Industry 4.0 and related technologies. *Journal of Intelligent Manufacturing*. doi:10.1007/s10845-018-1433-8

Rüßmann, M., Lorenz, M., Gerbert, P., Waldner, M., Justus, J., Engel, P., & Harnisch, M. (2015). *Industry 4.0: The future of productivity and growth in manufacturing industries*. Retrieved from https://www.bcg.com/en-ca/publications/2015/engineered_products_project_business_industry_4_future_productivity_growth_manufacturing_industries.aspx

Scheerder, A., van Deursen, A. J. A. M., & van Dijk, J. A. G. M. (2017). Determinants of Internet skills, uses and outcomes. A systematic review of the second- and third-level digital divide. *Telematics and Informatics*. doi:10.1016/j.tele.2017.07.007

The Social Progress Imperative. (2019a). 2019 Social Progress Index: Latvia Scorecard. Retrieved from https://www.socialprogress.org/?tab=2&code=LVA

The Social Progress Imperative. (2019b). 2019 Social Progress Index: Ukraine Scorecard. Retrieved from https://www.socialprogress.org/?tab=2&code=UKR

van Deursen, A. J. A. M., & Helsper, E. J. (2017). Collateral benefits of Internet use: Explaining the diverse outcomes of engaging with the Internet. *New Media & Society*, 1-19. doi:10.1177/1461444817715282

van Deursen, A. J. A. M., & van Dijk, J. A. G. M. (2014). The digital divide shifts to differences in usage. *New Media & Society, 16*(3), 507-526. doi:10.1177/1461444813487959

van Deursen, A. J. A. M., van Dijk, J. A. G. M., & Peter, M. (2015). Increasing inequalities in what we do online: A longitudinal cross sectional analysis of Internet activities among

the Dutch population (2010 to 2013) over gender, age, education, and income. *Telematics and Informatics, 32*(2), 259-272.

Walker, C., Babenko, S., & Greig, A. (2019). Masculinities and transition in Ukraine: Country Brief. Retrieved from https://opendocs.ids.ac.uk/opendocs/handle/20.500.12413/14691

Wang, M. T., & Degol, J. L. (2017). Gender gap in science, technology, engineering, and mathematics (STEM): Current knowledge, implications for practice, policy, and future directions. *Educational Psychology Review, 29*(1), 119-140. doi:10.1007/s10648-015-9355-x

Whitley, B. E. (1997). Gender differences in computer-related attitudes and behaviour: A meta-analysis. *Computers in Human Behavior, 13*(1), 1-22.

Xu, L. D., Xu, E. L., & Li, L. (2018). Industry 4.0: State of the art and future trends. *International Journal of Production Research, 56*(8), 2941-2962. doi:10.1080/00207543.2018.1444806