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Adapting to the Evolving Digital Landscape: Development and Validation of the VirtHuLab Self Efficacy Scale

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Abstract

Measuring people's self-efficacy in navigating the digital world has become essential in an age where the Internet permeates every aspect of life. This paper describes the creation and validation of the VISES (Virthulab Internet Self-Efficacy Scale), an instrument designed for the modern Internet environment. The way we work, communicate, and access information is changing as a result of the digital revolution, and VISES encapsulates the abilities and self-assurance needed to succeed in this Web 4.0 era. The study investigated the connections between VISES scores, Internet usage habits, net frustration, self-disparagement, and Internet addiction using a rigorous methodology. The study included a sample of 773 participants who could speak Italian (66.5% women). Participants were 31.38 years old on average (standard deviation = 11.19). The 3-factor structure of VISES, which demonstrated strong reliability for each subscale, was discovered by confirmatory factor analysis (CFA). According to the

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Data Availability Statement included at the end of the article

study, there is a substantial positive link between the VISES Internet self-efficacy ratings and both the frequency and duration of online use. Additionally, VISES scores exhibited positive associations with expected outcomes of Internet use, including social outcomes, personal entertainment, and personal information. The negative link between VISES scores and net frustration and self-disparagement emphasized the importance of self-efficacy in reducing negative emotional and cognitive states while using the Internet. Surprisingly, the association between VISES scores and Internet addiction was found for just one of the dimensions of VISES.

Keywords
Internet self-efficacy, internet usage, net frustration, web 4.0

Introduction

For a number of years now, using new Internet technologies has been a requirement almost everywhere in the world for working, carrying out some basic civic duties (like voting online), finding information, spending leisure time watching films or series, gaming, or keeping in touch with other people (Central Statistic Office, 2020; Hargittai & Micheli, 2019). According to the Global Digital Overview report from the We Are Social, 2023 group, there are already 5 billion Internet users worldwide, which is 64.4% of the world's population. Every day, the average user spends more than 2.5 hours on social media platforms including Instagram, Facebook, YouTube, and WhatsApp (We Are Social, 2023).

The COVID-19 pandemic has sped up the already rapid trend towards the use of the Internet and new technologies, promoting the communication platforms as a different and secure environment for social interaction and encouraging Online Distance Learning (ODL) and working from home (Goel & Gupta, 2020; Mendrika et al., 2021; Schneider & Council, 2021).

Beyond the pandemic-related needs, since the start of the Digital Revolution, possible Internet uses have greatly evolved over time (Ande et al., 2020).

In 2023, for instance, having a basic understanding of Internet banking is necessary to make basic shopping actions as well as having a fundamental understanding of public health websites is necessary to make appointments, book tests, or prove one's identification using digital systems. To be able to work remotely, make different kinds of online purchases, pay fines or state bills, and pursue educational or training courses online, a basic literacy will also be required for every citizen in the developed world. The ability to utilize internet-related technologies is now recognized as a fundamental human right since it gives access to the economic, political, and cultural aspects of society (Reglitz, 2020).

The use of the Internet necessarily requires skills. Generally speaking, considering we can refer to the UTAUT (Unified Theory of Acceptance and Use of Technology);

which turns out to be a unified model of eight different theories that seek to understand what are the determinants and variables underlying human behavior and our case related to the functional use of the internet and new technologies. Among the theories considered in UTAUT, we can find the theory of reasoned action, the technology acceptance model and the motivational model.

The UTAUT theoretical model suggests that the actual use of technology is determined by behavioral intention. The perceived likelihood of technology adoption depends on the direct effect of four key constructs, namely performance expectancy, effort expectancy, social influence, and facilitating conditions. Performance expectancy is defined as "the degree to which an individual believes that using the system will help him or her achieve improvements in job performance" (Venkatesh et al., 2003). Effort expectancy is defined as "the degree of ease associated with using the system" (Venkatesh et al., 2003). Social influence is defined as "the degree to which an individual perceives that significant others believe he or she should use the new system" (Venkatesh et al., 2003). Facilitating conditions are defined as "the degree to which an individual believes that an organization and technical infrastructure exists to support use of the system" (Venkatesh et al., 2003). The UTAUT shows that the proposed factors account for 70 percent of the variance in intention to use, offering strong predictive power of technology acceptance (Venkatesh et al., 2003).

In reference to this model, especially considering the dimensions of effort expectancy and intention to use new technologies, there is an emphasis on how much knowledge and information for using technology, facilitates its adoption.

Otherwise, as shown by McGaughey et al. (2013), one of the barriers to the use of technological devices such as smartphones and Internet use lies in the perception of not being self-effacing, which consequently generates frustration and avoidance.

New internet self-efficacy measurement development

For the development of the VISES, the authors started by analyzing all the other available and validated scales of the Internet Self-Efficacy construct, identifying the best and most recent ideas in the scale published by Kim and Glassman (2013; ISS). Considering that the Internet Self-efficacy Scale (ISS) was created in 2013, and as mentioned in the introduction, the Internet and its usage patterns have undergone a huge change over the years, a review and updating of the items were absolutely necessary (Duradoni et al., 2022; Guazzini et al., 2022).

Four experts analyzed and evaluated each item contained in the Internet Self-efficacy Scale by Kim and Glassman (2013) using an ad-hoc sheet, first individually. To start, the 5 dimensions of the ISS (i.e., Reactive/generative, Differentiation, Organization, Communication and Search) were analyzed. Each expert expressed an evaluation of how much every dimension was updated to the times (from −2 to +2) and therefore reflected the effective use that average users have today of the internet. The same work was then carried out on each of the 17 items. The evaluation sheet, in

addition to allowing the score for each dimension and item to be noted, also allowed to note the motivation for which that score was assigned.

After the individual work, a focus group, coordinated by an author of this paper (i.e., A.G.), was created with brainstorming and discussion activities with all the experts involved in the process, in order to reach an agreement on the evaluation of each item.

In order to formulate the items of the new scale, a second check-list was created and, during the focus group, for each item of the Kim and Glassman scale, taking into consideration the individual assessments of each expert and the group discussion, it was decided whether to delete, modify or include it as it was formulated in 2013. Each item, both deleted or modified, could be also classified into multiple categories: (1) Outdated (not updated to the current ways of using the internet); (2) Not sensitive and not specific to the theme; (3) To be expanded/generalized; (4) Included in other items (the subject matter touched upon has been taken up in other items).

Within a second focus group made up of 7 psychology students and 4 junior researchers, conducted by an expert (i.e., A.G.), the constructs, activities, skills, knowledge, and competencies related to internet self-efficacy were examined and discussed. Authors proceed to make a list of activities related to Internet Self-efficacy based on previous studies and on focus group results, in order to formulate the new items capturing the updated use of the Internet in this Web 4.0 era (Khaleel Ibrahim, 2021). Figure 1 summarizes the steps taken to construct the VISES.

Specifically, only one item was kept unchanged while 9 were deleted because of their obsolescence and generality and 7 items were modified, expanded, and updated to today. Finally, 9 brand new items were added, based on the results of the focus group. In doing so, the dimension of "Organization" was completely deleted, while the "Generative dimension" has been transformed into a dimension of "Digital citizenship" that includes the new aspects of Internet use (e.g., digital identity verification systems or online payment systems).

Moreover, when analyzing the data, searching and differentiating were merged into one dimension as they showed a correlation of 0.91 (see VISES items in Appendix A).

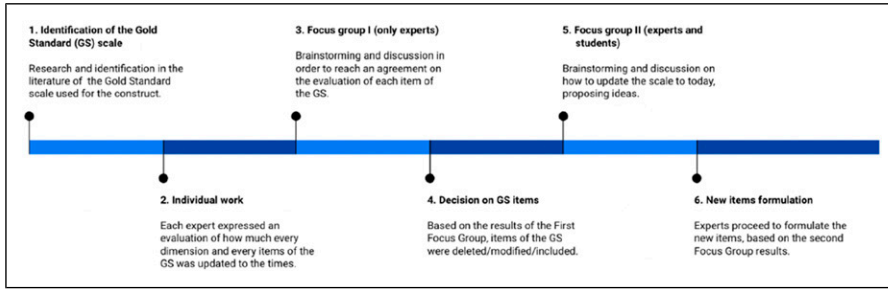

Figure 1. VISES construction process.

Aim of the Study and Hypotheses Development

Considering that the most recent measurement scale for Internet self-efficacy is from 2015 (Kim and Glassman's ISS), and having reported above how Internet use has changed in the meantime, the aim of our study is to present and validate, both internally and externally, a new instrument for measuring Internet self-efficacy, that is as relevant as possible to current Internet use.

Hypothesis

Previous research has investigated the impacts of training on Internet self-efficacy and attitudes toward computers and internet usage (Torkzadeh et al., 2002; Zhang, 2007). Wu and Tsai (2006) explored university students' attitudes and self-efficacy toward the Internet. The experiences learners have on the Internet could enhance their perceived control in using it. Moreover, it was found that students who used the Internet more frequently tended to exhibit higher levels of communicative self-efficacy related to Internet usage. Therefore, students' actual Internet usage can contribute to the development of adequate self-efficacy for Internet-based communication (Wu & Tsai, 2006).

Previous studies examining computer self-efficacy have shown a notable and positive correlation between computer efficacy and actual computer usage (Burkhart & Brass, 1990; Compeau & Higgins, 1995, 1999; Oliver & Shapiro, 1993; Tsai & Tsai, 2010; Zhao et al., 2010). Also, Eastin and LaRose (2000) found that there is a direct relationship between Internet use and Internet self-efficacy because individuals are more inclined to engage in and continue using the Internet when they feel confident in their ability to perform the required tasks.

The relationship between the Internet and computer use and users' perceived self-efficacy in online activities is now well-known, as it has been the subject of much research (Torkzadeh et al., 2002; Wu & Tsai, 2006; Zhang, 2007). In particular, users' actual Internet usage can contribute to the development of adequate self-efficacy for Internet-based communication (Wu & Tsai, 2006), showing a notable and positive correlation between online self-efficacy and actual computer and Internet usage, both in terms of frequency and time of use (Burkhart & Brass, 1990; Compeau & Higgins, 1995, 1999; Eastin & LaRose, 2000; Oliver & Shapiro, 1993; Tonioni et al., 2012; Tsai & Tsai, 2010; Zhao et al., 2010).

Based on this literature, we formulated our first hypothesis:

H1. VISES Internet self-efficacy scores will be positively correlated with Internet usage (frequency and time of use).

According to Compeau and Higgins (1995), computer self-efficacy plays a role in shaping expectations regarding future outcomes of computer use, such as job performance and personal accomplishments. In the context of the Internet, social outcomes

are derived from online social interactions, while personal outcomes refer to individual achievements, like entertainment or obtaining information (Eastin & LaRose, 2000).

A positive correlation is expected between Internet self-efficacy and outcome expectations (i.e., Social Outcome, Personal Entertainment; Personal Information).

So, our second hypothesis was:

H2. VISES Internet self-efficacy scores will be positively correlated with expected outcomes of Internet Use (i.e., Social Outcome, Personal Entertainment; Personal Information).

Research conducted by LaRose and colleagues in 2001 found that self-efficacy has a positive impact on online performance. As performance improves, the likelihood of users experiencing negative and stressful outcomes is reduced, consistent with Bandura's social cognitive theory (Bandura, 1982, 1997). Confirming the significant role of Internet self-efficacy in moderating stress levels, it has been observed that people with less experience in using the internet tend to experience higher levels of stress when using this resource (Kraut et al., 1998). Since it has been confirmed that there is a moderate positive correlation between stress and frustration (Tindall & Curtis, 2019), it is plausible to assume that:

H3. VISES Internet self-efficacy scores will be negatively correlated with Net-frustration.

Considering that self-disparagement occurs when an individual judges his or her own performance to be inferior to that of others (Eastin & LaRose, 2000), it has been confirmed by several studies that self-efficacy appears to be negatively correlated with self-disparagement, even with regard to Internet use (Eastin & LaRose, 2000; LaRose et al., 2001). In fact, self-disparagement of one's ability to use the Internet may negate the incentive to persist in the face of failure or negative outcomes. Self-disparagement can afflict even those with high levels of Internet self-efficacy, if they compare their abilities with the unrealistic standards set by more skilled Web users and constantly evolving Internet technology (LaRose et al., 2001).We therefore formulated our fourth hypothesis as follows:

H4. VISES Internet self-efficacy scores will be negatively correlated with Self-Dispargment.

Despite the flourishing literature on the positive relationship between Internet addiction and information literacy (e.g., Park & Hyun, 2014; Stodt et al., 2016) and the consequent Internet self-efficacy (Leung & Lee, 2012), some research reports a negative relationship between the two (Langarizadeh et al., 2018), demonstrating that in the general population, the relationship is more complex than it appears. In fact, it is not certain that those who use the Internet very well and for a long time (for example, for work) are addicted, just as it is not sure that a person with an online addiction is

competent in all the various and possible actions that can be performed online (Tabachuk et al., 2018).

Based on this evidence, we formulated our fifth and last hypothesis:

H5. VISES Internet self-efficacy scores will be negatively correlated with Internet addiction.

Methods

In the first step, the initial version of the new ISS was piloted on 30 participants of different ages and education levels, in order to investigate if there could be any understanding problems in the formulation of the items.

After this phase, the research group proceeded to define an adequate sample size based on the type of analyses that were intended to be performed (i.e., confirmatory factor and correlation analyses). In this regard, the analysis with the highest requirements in terms of observations was used to set the threshold for the sample size to be reached. For CFA, we followed the advice of having at least a 10:1 ratio of participants to items (Comrey, 1988), and a sample size greater than 200 was regarded "adequate" to properly complete the confirmatory factor analysis (Comrey & Lee, 2013; Kline, 2023). Furthermore, we used G*Power (Faul et al., 2007) to do a power analysis for Pearson's correlation. According to the power analysis, a sample size of 661 people would be required at the very least to achieve a statistical power of 0.80 while being able to capture even relatively small effect sizes ($r = 0.10$). Since the pilot test did not reveal any particular problems or need for adjustments, the VISES was administered to 773 participants, recruited through a voluntary census with dedicated messages on the web, social media, and mailing lists via snowball sampling method.

Given that 773 surpassed the 661 threshold indicated by power analysis, we deemed our sample size as adequate.

The questionnaire consisted of an introductory part in which participants were asked to provide demographic information regarding their age, gender, and educational qualification. Regarding gender, the participant could choose between: cisgender male, cisgender female, transgender male, transgender female, not binary, and "I prefer not to answer."

The final sample consisted of 66,5% cisgender women, 29,4% cisgender men, 2.1% not binary, 1.7% preferred not answering, 0.3% transgender men and 0.1% transgender women, with a mean age of 31.38 (sd = 11.19).

A part of the sample has a high school educational level (33.9%) while 29.9% have a Bachelor's degree and 22.8% have a Master's degree.

Participants need to speak and understand the Italian language and be at least 14 years of age to complete the survey. We conducted the data collection process in accordance with Italian data protection regulations (Legislative Decree DL -101/2018), EU regulations (2016/679), and APA guidelines. Data was collected from 11/03/2022 to 10/07/2023.

Measures

Participants first responded to demographic questions on age, gender, and qualification, and additionally, the following measures were used to achieve the objectives of the study.

The *Internet Self-efficacy Scale*, developed by Kim and Glassman (2013), is a questionnaire consisting of 17 items. The study used the validated Italian version of the scale (Duradoni et al., 2022). Participants are asked to rate their confidence levels on a 7-point Likert scale (ranging from 1 "not at all confident" to 7 "very confident") regarding their ability to perform specific tasks on the Internet. The scale aims to measure individuals' perception of self-efficacy in dealing with Internet-based problems that vary in complexity. Through exploratory factor analysis, five subscales were identified: reactive/generative self-efficacy (6 items), differentiation self-efficacy (4 items), organization self-efficacy (3 items), communication self-efficacy (2 items), and search self-efficacy (2 items). The subscales exhibited good reliability, with Cronbach's alphas of 0.91, 0.90, 0.89, 0.82, and 0.77, respectively, and an overall alpha of 0.91 for the entire ISS scale. To establish validity, the researchers analyzed correlations between the ISS and related concepts such as Internet outcome expectancy (social and personal information outcomes) and Internet anxiety.

To measure *Internet usage*, three different indicators were used, as described in Teo (1999)'s article: frequency of Internet usage, daily Internet usage and diversity of Internet usage (DeLone, 1988; Igbaria et al., 1989; Thompson et al., 1991). Frequency of Internet usage was measured on a 6-point scale (from 1 never to 6 several times a day); daily Internet usage was measured by the amount of time spent daily online on a 6-point scale (from 1 never to 6 more than 3 hours per day). The measurement of Internet usage diversity was based on the range of tasks individuals performed online. These tasks encompassed activities such as information retrieval, seeking product support, online communication, accessing free resources, making purchases, job application, and engaging in swapping or selling transactions. Participants were asked to indicate the extent of their use for these tasks on a 5-point scale (from 1 = not at all to 5 = to a great extent). This method of measuring the diversity of usage in terms of the variety of tasks performed has been used successfully in previous research pertaining to the usage of computers (Igbaria et al., 1995). For the purpose of our study, the items were translated into Italian using a back-translation method (Brislin, 1970). The items were initially translated into Italian by native Italian speakers and then back-translated from Italian to English by a native English speaker. Next, the authors chose the option that best reflected the tone and intention of the source content.

The perceived likelihood of developing relationships over the Internet was assessed using a five-item *Social Outcome scale* ($\alpha = .86$). To measure the likelihood of finding entertainment online, a four-item Personal Entertainment Outcome scale ($\alpha = .87$) was utilized. Additionally, the possibility of finding immediate information on the Internet was measured through a six-item Personal Information Outcome scale ($\alpha = .83$) (Charney & Greenberg, 2002; Eastin & LaRose, 2000). In each of these measures, the

likelihood of expected outcomes (rated on a scale from very likely (7) to very unlikely (1)) was multiplied by the corresponding evaluation of that outcome (rated as very good (+3) to very bad (−3)), following the expectancy-value approach recommended by Ajzen and Fishbein (1980). For the purpose of our study, the items were translated into Italian using a back-translation method (Brislin, 1970), that is the items were translated into Italian by two Italian psychologists and then back-translated into English by two native English speakers who had never seen the scale before.

The *Net Frustration scale* is 11 items scale on a 5-point rated from (1) not at all to (5) very much (α = .87). The items that received the highest ratings in terms of frustration were associated with users expressing frustration over the duration it takes to access desired content on the Internet (Charney, 1996). For the purpose of our study, the items were translated into Italian using a back-translation method (Brislin, 1970), that is the items were translated into Italian by two Italian psychologists and then back-translated into English by two native English speakers who had never seen the scale before.

Self-disparagement consisted of three Likert-type items rated from strongly agree (7) to strongly disagree (1) (α = .71; Eastin & LaRose, 2000). Self-disparagement, similar to self-efficacy, serves as a self-monitoring mechanism. It refers to the tendency of individuals to perceive their own performances as inferior to others. People exhibiting self-disparagement tend to misrepresent their accomplishments or recall past events in a negative light. (Bandura, 1977; 1997). High scores on this scale indicate higher self-dispargment perceptions. For the purpose of our study, the items were translated into Italian using a back-translation method (Brislin, 1970), that is the items were translated into Italian by two Italian psychologists and then back-translated into English by two native English speakers who had never seen the scale before.

Internet Addiction Test (Servidio, 2017; Young, 1998; Italian validation by) is a 20-item questionnaire with each item rated on a 5-point Likert-type scale ranging from 0 (not applicable) to 5 (always). The first version of the IAT, developed by Young (1998), was based on the DSM-IV criteria for pathological gambling. The IAT assesses the personal perception of risk associated with Internet use, such as attempts to conceal the time spent online. It evaluates the impact of technological misuse on various aspects of daily life, including routine, social interactions, productivity, and sleep quality.

Data Analysis

For internal validation purposes, we performed a confirmatory factor analysis utilizing the JASP software to assess the scale's dimensionality. The maximum likelihood estimation (MLE) method was employed to estimate model parameters. Model fit assessment encompassed an array of goodness-of-fit indices, including the Chi-square to degrees of freedom ratio (χ^2/df; Jöreskog, 1969), the Tucker–Lewis index (TLI; Tucker & Lewis, 1973), the standardized root mean square residual (SRMR; Bentler, 1995), the root mean square error of approximation (RMSEA; Browne & Cudeck, 1992), and the comparative fit index (CFI; Bentler, 1990). We employed specific thresholds to evaluate model adequacy: TLI >0.95, CFI ~0.95 (0.90 to 0.95 indicating a

good fit), SRMR <0.08, and RMSEA <0.06 (0.06 to 0.08 signifying a satisfactory fit; Hu & Bentler, 1999). VISES reliability was assessed through McDonald's omega and Pearson's correlation. Eventually, concurrent and external validities were assessed through Pearson's r or Spearman's rho in the case of non-normally distributed data.

Results

Confirmatory Factor Analysis

Firstly, we tested a 4-factor measurement model through confirmatory factor analysis, which mirrored the original scale from which we derived the VISES. However, due to unsatisfactory fit indices and based on modification index analysis, we iteratively reduced the item pool by eliminating items 1, 2, and 14. Additionally, we introduced a covariance between the errors of items 7 and 8 and items 9 and 10, which belonged to the same factor and exhibited very similar wording. These modifications resulted in an adequate fit of the model (χ^2/df = 4.25; p. <.001; TLI = .95; CFI = .96; RMSEA = .065; SRMR = .041). However, aiming to define the best model in terms of parsimony, and noticing a strong correlation of 0.91 between the "Search" and "Differentiation" factors, we further tested a 3-factor model, combining these two factors. The fit of this model, after deleting items 6 and 11 due to their

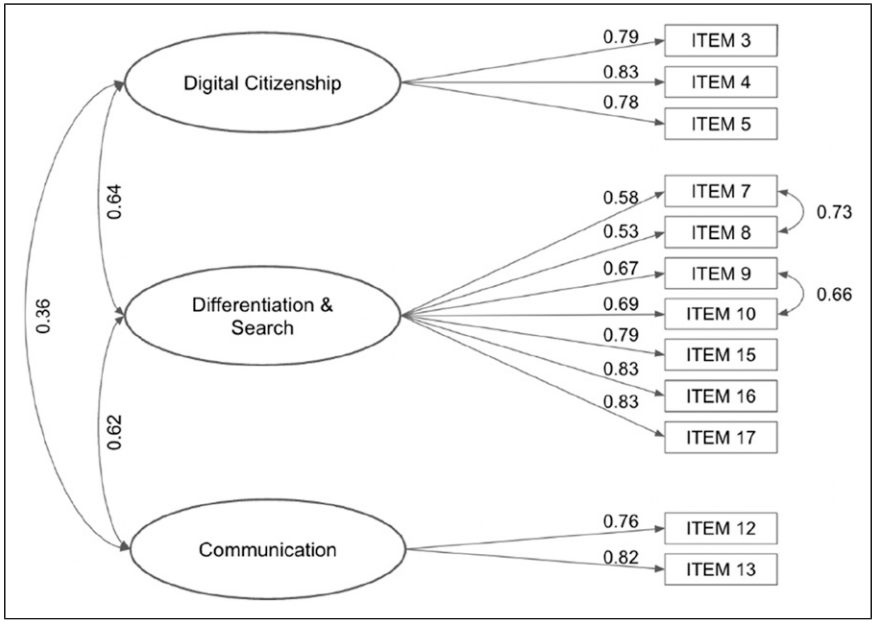

Figure 2. Results of confirmatory factor analysis of the Virthulab Internet Self-Efficacy Scale (VISES), showing the 3-factor model.

poor performances highlighted by modification index analysis, significantly improved (χ^2/df = 1.96; p. <.001; TLI = .99; CFI = .99; RMSEA = .035; SRMR = .027), suggesting a better data fit for the 3-factor model (Figure 2).

Reliability

To evaluate the reliability of the Italian VISES, we employed both McDonald's omega and the inter-item Pearson's correlation. This approach was chosen as researchers from various disciplines have argued that Cronbach's alpha coefficient and McDonald's omega may be unsuitable and lack significance when applied to two-item scales (e.g., Cramer et al., 2006; Verhoef, 2003), as is the case in our study. All factors showed at least acceptable reliability (Digital Citizenship ω = 0.84; Differentiation and Search ω = 0.89; Communication ω = 0.76, Communication inter-correlation 0.63; Nunnally & Bernstein, 1994).

Descriptive Statistics

Once the factorial structure was defined, and the total scores of the dimensions were computed, we generated descriptive statistics (Table 1). As observed in Table 1, the "Digital Citizenship" dimension and the frequency of internet usage seem to violate the

Table 1. Descriptive Statistics of the Scales and Normality Assessment Through Skewness and Kurtosis Values.

Variable	Min	Max	Mean	s.d	Skewness	Kurtosis
VISES - generative	3	21	18.53	3.49	−1.87	3.56
VISES - search and differentiation	7	49	39.46	6.67	−0.81	0.94
VISES - communication	2	14	10.42	2.71	−0.65	0.08
ISS - generative	6	42	23.40	9.04	0.20	−0.76
ISS- differentiation	4	28	21.20	5.12	−0.65	0.08
ISS - organization	3	21	16.38	3.98	−0.73	0.12
ISS- search	2	14	10.92	2.48	−0.68	0.08
ISS- communication	2	14	8.62	3.11	−0.11	−0.65
Internet frequency	1	6	5.92	.38	−6.25	51.22
Internet daily use	1	6	4.93	1.17	−0.99	0.53
Social use	5	35	22.06	6.87	−0.17	−0.58
Entertainment use	4	28	21.73	5.58	−0.99	0.77
Information use	7	49	39.82	7.11	−1.08	1.35
Net frustration	11	48	22.97	6.2	0.51	0.61
Self-disparagement	3	21	16.30	3.86	−0.76	0.34
Internet addiction	0	87	26.82	15.26	0.86	0.68

Note. *N* = 773; s.d.: standard deviation; ISS: Internet Self-Efficacy Scale; VISES: Virthulab Internet Self-Efficacy Scale.

assumption of normality based on skewness and kurtosis indices. Consequently, for subsequent analyses concerning these two variables, non-parametric tests were employed, as they do not require normal distribution as a precondition.

Concurrent Validity

To assess the concurrent validity of the VISES, especially considering recent modifications in its dimensionality and the evolution of its conceptualization, particularly within the "Digital Citizenship" dimension, we conducted an examination of the relationship between the VISES scale and the ISS scale, from which it originally emerged. The results, as presented in Table 2, revealed positive and statistically significant associations between each dimension of VISES and all the dimensions within the ISS scale. In specific terms, the "Search and Differentiation" dimension exhibited notably strong correlations (exceeding 0.65) with the corresponding dimensions of the ISS scale, which served as the basis for its development. Intriguingly, the "Search and Differentiation" dimension also displayed a robust connection with the "Organization" dimension within the ISS scale. Similarly, the "Communication" dimension demonstrated the highest effect size in relation to its association with the corresponding dimension of the ISS scale (i.e., ISS - Communication). Regarding the "Digital Citizenship" dimension, as expected, we observed relatively lower correlations ranging from 0.19 to 0.42. This aligns with the absence of a specific dimension within the ISS scale for evaluating concurrent validity in this particular domain. In summary, the "Digital Citizenship" dimension exhibited its strongest relationships with the "Search" and "Differentiation" dimensions within the ISS scale.

External Validity

To externally validate our scale, we proceeded to test our set of hypotheses through Pearson's correlation. As presented in Table 3, all dimensions of VISES exhibited

Table 2. Correlation Matrix Assessing the Relationship Between VISES and ISS.

	ISS - Generative	ISS - Differentiation	ISS - Organization	ISS - Search	ISS - Communication
VISES - digital citizenship ◆	0.19***	0.42***	0.41***	0.35***	0.23***
VISES - search and differentiation	0.48***	0.74***	0.70***	0.65***	0.46***
VISES - communication	0.56***	0.41***	0.42***	0.37***	0.60***

Note. VISES = Virthulab Internet Self-Efficacy Scale; ISS = Internet Self-Efficacy Scale; *** = p.<0.001; ** = p.<0.01; * = p.<0.05; ◆ = the association including this variable has been measured through Spearman's Rho value.

Table 3. Correlation Matrix Assessing the Relationship Between VISES and External Validity Measures.

	VISES -Digital Citizenship ◆	VISES -Search and DifferentiationS	VISES - Communication
Internet frequency ◆	0.19***	0.21***	0.12**
Internet daily use	0.11**	0.19***	0.13***
Social use	0.13***	0.26***	0.26***
Entertainment use	0.17***	0.30***	0.19***
Information use ◆	0.32***	0.50***	0.24***
Net frustration	−0.27***	−0.29***	−0.18***
Self-disparagement	−0.40***	−0.45***	−0.29***
Internet addiction	−0.14***	−0.05	0.01

Note. VISES = Virthulab Internet Self-Efficacy Scale; *** = p.<0.001; ** = p.<0.01; * = p.<0.05; ◆ = the association including this variable has been measured through Spearman's Rho value.

positive associations with individuals' Internet usage, encompassing both daily usage and frequency of use. However, it's worth noting that the effect size for the Communication dimension is relatively modest compared to the other two dimensions. Respondents displaying higher levels of Internet Self-Efficacy reported more extensive Internet usage across a spectrum of purposes, including social interactions, personal entertainment, and information seeking, aligning with our expectations. Moreover, in line with our hypotheses, we observed a substantial correlation between the "Information" dimension and VISES' "Search and Differentiation" dimension. Individuals encountering frustration while using the Internet exhibited a negative relationship with VISES scores. Similarly, respondents who perceived their Internet proficiency as inferior to others displayed a negative association with VISES scores. Notably, VISES appeared to be largely independent of Internet Addiction, with the sole exception of the "Digital Citizenship" dimension, which demonstrated a negative correlation with problematic Internet use.

Discussion

In 2018, the journal *Nature* released a supplement focused on the 'Digital Revolution,' acknowledging the essential role the digital realm had assumed in societal operations (Hodson, 2018). This highlights how digital, mobile, and social media have evolved into an essential component of daily existence for individuals across the globe (Duradoni et al., 2022).

Looking back in history, the economy and society have undergone profound changes due to the digital revolution and the process of digitalization in the last half-century. Contemporary implementations of these technologies have resulted in

innovations like robotics, artificial intelligence, computer algorithms, mobile sensors, 3D printing, and self-driving vehicles (Knell, 2021). The advent of the digital revolution generated new prospects to engage in technical advancements and acquire technological knowledge not only for industries (Knell, 2021) but also for the whole society. SPID (the acronym for Public System of Digital Identity) is an example of this, is the information system that provides verified digital access to public authorities and their services for both citizens and businesses. Even though the initiative was initiated in 2013, its practical implementation didn't commence until 2016. In terms of user adherence, by the conclusion of 2020, the spread of adoption had been swift, with the cumulative count of furnished SPIDs nearing the 20 million mark (Di Giulio & Vecchi, 2023). Additionally, Italy released the COVID-19 Green Certification (often known as a "green-pass") in June 2021. This document can be accessed digitally through the DGC National Platform of the Ministry of Health and allows for the safe mobility of persons during a pandemic.

The COVID-19 pandemic accelerated the uptake of digital solutions (e.g. data collection techniques, e-health online appointments and therapies, remote working, online learning, and social interconnectedness) at an extraordinary rate, leading to unexpected chances for expanding alternative methods in both social and economic spheres (Hantrais et al., 2021).

Given the rapid evolution of the digital world, there arises the need to renew the ISE scale, creating one capable of adequately assessing users' perceived efficacy in relation to the demands set by the network and society. Therefore, the present study aims to validate, both internally and externally, a new instrument for measuring Internet self-efficacy (i.e., Virthulab Internet Self-Efficacy Scale - VISES), that is as relevant as possible to current 2023 Internet use.

To develop VISES, a group of experts first analyzed and evaluated each item contained in the ISS (Kim & Glassman, 2013), and subsequently, some items were modified and new items were created based on the current demands of the Digital world.

The CFA results demonstrated the 3-factor structure of the VISES (i.e., Digital Citizenship with 3 items; Differentiation & Search with 7 items, and Communication with 2 items), with optimal reliability of each subscale. In Italian validation of the Kim and Glassman scale (Guazzini et al., 2022), "Search" and "Differentiation" factors showed a covariation of 0.94 between them (that is a correlation of 0.75), highlighting an almost total overlap. In our sample, the Kim and Glassman scale (2013) used for concurrent validity purposes shows an extremely high correlation of 0.72. We also have shown that the covariation between the two homologous factors of the conceptualised 4-factor VISES scale was 0.91. In contrast to the scale by Kim and Glassman (2013), we combined "Search" and "Differentiation" factors. Besides demonstrating a notably strong correlation, this is primarily attributed to the fact that, whereas in the past, the use of technology may have been considered just as an advantage, today we are fully immersed in it. Rendering questions such as "I can use the Internet to help me find good information about children and their development" or "I can use the Internet to find

good information about topics that are important to me" somewhat obsolete. In fact, the prevalence of Internet usage among both children and older adults is on the rise (Daoud et al., 2020; Gruchel et al., 2022; Ling et al., 2022; Livingstone et al., 2018; Stoilova et al., 2021; Sum et al., 2009). This trend underscores the increasing importance of the "Differentiation" factor in assessing digital literacy. Beyond the mere act of accessing online information, which has become ubiquitous, individuals must now navigate the complexities of the digital landscape, particularly amidst the infodemic phenomenon. Consequently, the ability to discern between credible sources and misinformation, recognizing fake news and reliable sources of information, has become paramount, emphasizing the evolving nature of online literacy in today's society.

As for the external validity of the scale, VISES was found to be positively related to the frequency and time of Internet usage, as well as the expected outcomes of Internet Use (i.e., Social Outcome, Personal Entertainment; Personal Information) thus confirming the first (H1) and the second (H2) hypothesis of the study. This is perfectly in line with the literature, showing that the greater the use of the Internet in daily life, the higher the Internet Self-Efficacy scores are (Burkhart & Brass, 1990; Compeau & Higgins, 1995, 1999; Eastin & LaRose, 2000; Oliver & Shapiro, 1993; Tonioni et al., 2012; Torkzadeh et al., 2002; Tsai & Tsai, 2010; Wu & Tsai, 2006; Zhang, 2007; Zhao et al., 2010), increasing the likelihood of shaping expectations regarding future online outcomes (Compeau and Higgins; 1995; Eastin & LaRose, 2000).

Moreover, H3 and H4 were confirmed by the results of the study, showing a negative relationship between VISES scores and the dysfunctional use of the Internet (as measured by the Net-frustration scale and the Self-Disparagement scale). Therefore, in line with the literature, high ISE scores were related to higher enjoyment (Eastin & LaRose, 2000; LaRose et al., 2001) and lower levels of stress when using the Internet (Kraut et al., 1998; Tindall & Curtis, 2019).

Finally, the results allow us also to partially confirm the last hypothesis (H5), supporting a negative correlation between VISES scores and Internet addiction scores. Despite the evidence reporting an increased addiction index in people who use the Internet for a long time and consequently have high levels of self-efficacy (Leung & Lee, 2012; Park & Hyun, 2014; Stodt et al., 2016), nowadays there is a growing need to consider the issue more complex than it seems. In fact, not all people who frequently use the Internet are addicted (such as workers from home), as well as it is not true that, for example, a videogame addict is able to perform other tasks well online (Langarizadeh et al., 2018; Tabachuk et al., 2018).

The literature is an aid to the theoretical interpretation of the results of the study (see Figure 3). In order to carry out any online activities, according to the UTAUT model (Venkatesh et al., 2003), a balance must be maintained between the person's perception of his or her own abilities (personal ICTs skills) and the ICTs demands that the external environment requires. In this sense, a perception of ease of use is present in situations where the subject's ICT skills exceed and are therefore superior to the environmental requirements. The possible consequences of this balance or imbalance are mediated by the self-efficacy perception. In fact, the fewer the demands and the greater the person's

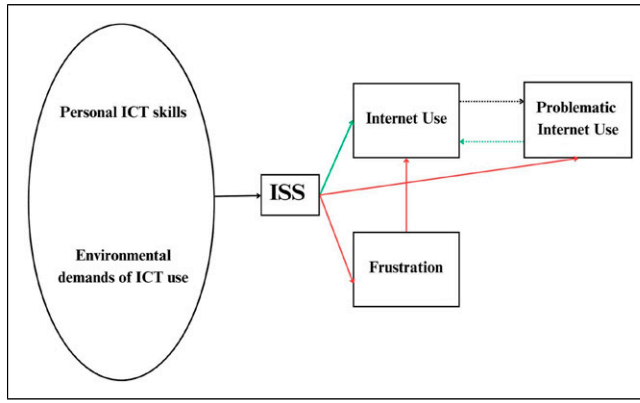

Figure 3. A theoretical framework to explain study findings.

abilities with respect to use, the greater can be the person's perceived sense of self-efficacy. Based on what has been outlined, the UTAUT model is reflected in our H1, in which the greater the person's perceived sense of self-efficacy, the greater the use of the Internet. In addition, the performance expectancy considered in the model to predict the intention of technology use also appears to be an important variable. This variable appears to be related to self-efficacy, finding confirmation in our H2 in which self-efficacy correlates positively with expected performance of internet use.

Considering the Theory of Self-efficacy (Bandura, 1977), we can state that this variable will be greater the more successes derived from the challenges that come from the environment (Biran et al., 1981; Zlomuzica et al., 2015). This is reflected in our H3. In fact, people with less success on the Internet will have less sense of self-efficacy, with a tendency to experience greater levels of stress and frustration.

Furthermore, an individual's sense of self-efficacy plays a pivotal role in shaping their environmental interactions. Drawing on the Approach/Inhibition Theory (Keltner et al., 2003), individuals with low self-efficacy tend to steer clear of situations involving tasks they doubt their ability to fulfill, gravitating instead toward less demanding scenarios. This tendency to avoid highly challenging situations can help prevent feelings of stress and frustration and reduce the likelihood of developing problematic Internet usage behaviors (Morrison et al., 2015; O'Connell et al., 2014). This theoretical framework supports our H4, in which people who judge their own performance to be inferior to that of others (self-disparagement) do not persist in the face of failure or negative outcomes, confirming a negative relationship between self-efficacy and self-disparagement.

By contrast, if there is a balance between personal skills and environmental demands, people will have different levels of self-efficacy and will not avoid challenging situations but seek them out (see the Need for Online Social Feedback, Duradoni et al.,

2023; or the classic behavioral theory applied to today's world, Gordan & Krishanan, 2014), thus increasing internet use but not necessarily in a problematic way.

In fact, ISS seems to be independent or, in one of its dimensions, negatively correlated with Internet addiction, suggesting that problematic use may result from other types of dynamics, such as compensating for unsatisfied needs offline (Jaiswal et al., 2020; Azab et al., 2019; Mano & Rosenberg, 2021; Magsamen-Conrad & Greene, 2014). Indeed, the use of the Internet, even massive, in the face of digital literacy can therefore even allow for continuous intensive use without creating a dynamic of addiction. This is in confirmation of our H5, in which internet self-efficacy appears negatively correlated with internet addiction.

Finally, the present study has some practical implications, especially in areas such as digital literacy programs, educational interventions, and/or technology design. The level of Internet self-efficacy, as measured by VISES, can be an excellent starting point and monitoring tool for directing people who need it to specific digital and Internet literacy courses. The same scale can also be used to evaluate the effectiveness of these courses and programs, through a pre-post comparison. Moreover, VISES is well-suited as a research tool. It can be used to test the effectiveness of interventions aimed at increasing subjects' knowledge, skills or self-efficacy about digital issues, whether general (such as access to the Internet) or specific (the use of particular online platforms or services). It can also be used to design technologies based on the ISS level of the target audience, for example by creating specific simplified platforms for older people, who typically have lower levels of Internet self-efficacy.

There are several limitations to take into account, despite the fact that this study has shed vital light on how to evaluate Internet self-efficacy in the context of the continuously changing digital ecosystem. A first limitation to highlight is that the sample is rather unbalanced towards women (66.6% of the sample identifies as cis or trans female) and with a high level of education (86.6% of the sample has at least a high school diploma or a degree), therefore it is not possible to generalise these results to the general population and different samples might yield to different results. In the future, it is desirable to test the validity and outcomes of the scale in different populations. Moreover, it's important to note right away that the Virthulab Internet Self-Efficacy Scale (VISES) was created with 2023s modern Internet usage habits in mind. The scale could need to change much more in order to stay current as digital technologies continue to grow at an unparalleled rate. To ensure the scale's continuous validity in gauging users' perceptions of their effectiveness in the digital space, future research should frequently evaluate and improve the scale. Second, even though the internal and external validity of VISES were demonstrated by this study, there are still undiscovered aspects of Internet self-efficacy that warrant research. The scale primarily measures elements of communication, differentiation & search, and digital citizenship. Other aspects of Internet self-efficacy, such as cybersecurity awareness can be explored in greater depth in future studies (Blackwood-Brown, 2018; Zainal et al., 2022). Future studies should also look into the complex interactions between Internet self-efficacy, usage patterns, and addiction, taking into account things like professional requirements

(Afrianty et al., 2022; Hatayama et al., 2020), as well as very recently developed frameworks and constructs like digital life balance (Duradoni et al., 2022) and the need for online social feedback (Duradoni et al., 2023).

Conclusion

This study has established the groundwork for a reliable tool to measure Internet self-efficacy in the digital age. Continuous study will be essential to improving our comprehension of Internet self-efficacy and its implications for people's online experiences and well-being as the digital landscape continues to change.

Appendix A

Items of the VIVES final version.

ID	Item	Dimension
1	ITA: Sono in grado di usare i sistemi di verifica dell'identità digitale come lo SPID o l'autenticazione a due fattori. ENG: I Am confident using digital identity verification systems such as SPID or two-factor authentication	Digital citizenship
2	ITA: Mi sento capace di visualizzare e/o scaricare le certificazioni dai siti della pubblica amministrazione (es.: Green pass, libretto sanitario). ENG: I Am confident viewing and/or downloading certifications from government sites (e.g., green pass, health record)	Digital citizenship
3	ITA: Mi sento capace nell'utilizzare sistemi di pagamento online verso la pubblica amministrazione o privati (es.: PagoPa, PayPal). ENG: I Am confident using online payment systems for public administration or for private individuals (e.g., PagoPa, PayPal)	Digital citizenship
4	ITA: So come migliorare il mio benessere attraverso l'utilizzo di internet. ENG: I Can improve my own well-being through the use of Internet.	Differentiation and search
5	ITA: So come migliorare il benessere degli altri attraverso l'utilizzo di internet. ENG: I Can improve my own well-being through the use of Internet.	Differentiation and search
6	ITA: Sono capace di distinguere un contenuto online di qualità da uno scadente (per esempio le fake news). ENG: I Am able to distinguish quality online content from poor content (e.g., fake news)	Differentiation and search
7	ITA: Sono capace di distinguere, su Internet, fonti di informazioni affidabili da quelle che non lo sono. ENG: I Am able to distinguish reliable sources of information from those that are not on the Internet.	Differentiation and search

(continued)

(continued)

ID	Item	Dimension
8	ITA: So usare internet per trovare informazioni di qualità su argomenti che per me sono importanti. ENG: I Can use the Internet to find good information about topics that are important to me	Differentiation and search
9	ITA: So individuare le parole chiave più adeguate per rendere la ricerca di informazioni su internet il più accurata possibile. ENG: I Can identify the most appropriate keywords to make searching for information on the Internet as accurate as possible	Differentiation and search
10	ITA: In base all'informazione di cui ho bisogno so dove andare a cercarla e in che formato (video, audio, testo). ENG: Depending on the information I need, I know where and in which format (video, audio, text) to look for it	Differentiation and search
11	ITA: So essere molto efficace nel comunicare per mezzo dei social network e social media. ENG: I Can be very effective at communicating using social networking sites and social media	Communication
12	ITA: So usare internet ed i social network come un mezzo efficace per mettermi in contatto con gli altri. ENG: I Can use Internet and social network sites as an effective way of connecting with others	Communication

Note. ENG = English version of the item not yet validated; ITA = Italian version of the items that are actually validated.

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Data Availability Statement

The datasets generated and analyzed during the current study are available from the corresponding author upon reasonable request.

References

Afrianty, T. W., Artatanaya, I. G., & Burgess, J. (2022). Working from home effectiveness during COVID-19: Evidence from university staff in Indonesia. *Asia Pacific Management Review*, *27*(1), 50–57. https://doi.org/10.1016/j.apmrv.2021.05.002

Ajzen, I., & Fishbein, M. (1980). *Understanding attitudes and predicting social behavior*. Prentice-Hall.

Ande, R., Adebisi, B., Hammoudeh, M., & Saleem, J. (2020). Internet of things: Evolution and technologies from a security perspective. *Sustainable Cities and Society*, *54*(1), Article 101728. https://doi.org/10.1016/j.scs.2019.101728

Azab, H. M., Effat, S. M., & Mahmoud, O. A. A. (2019). Correlation of internet addiction with anxiety, depression and personality traits–Upper Egypt study. *Sohag Medical Journal*, *23*(1), 142–153. https://doi.org/10.21608/smj.2019.41383.

Bandura, A. (1977). Self-efficacy: Toward a unifying theory of behavioral change. *Psychological Review*, *84*(2), 191–215. https://doi.org/10.1037//0033-295x.84.2.191

Bandura, A. (1982). Self-efficacy mechanism in human agency. *American Psychologist*, *37*(2), 122–147. https://doi.org/10.1037//0003-066x.37.2.122

Bandura, A. (1997). *Self-efficacy: The exercise of control*. W. H. Freeman.

Bentler, P. M. (1990). Comparative fit indexes in structural models. *Psychological Bulletin*, *107*(2), 238–246. https://doi.org/10.1037/0033-2909.107.2.238

Bentler, P. M. (1995). *EQS structural equations program manual (vol 6)*. Multivariate software.

Biran, M., & Wilson, G. T. (1981). Treatment of phobic disorders using cognitive and exposure methods: A self-efficacy analysis. *Journal of Consulting and Clinical Psychology*, *49*(6), 886–899. https://doi.org/10.1037//0022-006x.49.6.886

Blackwood-Brown, C. G. (2018). An empirical assessment of Senior citizens' cybersecurity awareness, computer self-efficacy, perceived risk of identity Theft. In *Attitude, and motivation to acquire cybersecurity skills (Doctoral dissertation*. Nova Southeastern University.

Brislin, R. W. (1970). Back-translation for cross-cultural research. *Journal of Cross-Cultural Psychology*, *1*(3), 185–216. https://doi.org/10.1177/135910457000100301

Browne, M. W., & Cudeck, R. (1992). Alternative ways of assessing model fit. *Sociological Methods & Research*, *21*(2), 230–258. https://doi.org/10.1177/0049124192021002005

Burkhart, M., & Brass, D. (1990). Changing patterns of patterns changing: The effects of a change in technology on social network structure and power. *Administrative Science Quarterly*, *35*(2), 104–127. https://doi.org/10.2307/2393552.

Central Statistic Office. (2020). *Information society statistics - Households 2020*. Type of internet activities. Available at: https://www.cso.ie/en/releasesandpublications/ep/p-isshh/informationsocietystatistics-households2020/typeofinternetactivities/

Charney, T., & Greenberg, B. (2002). Uses and Gratifications of the internet. In C. Lin & D. Atkin (Eds.), *Communication, technology and society: New media adoption and Uses* (pp. 379–407). Hampton Press.

Charney, T. R. (1996). *Uses and Gratifications of the internet*. Michigan State University.

Compeau, D., & Higgins, C. (1995). Computer self-efficacy: Development of a measure and initial test. *MIS Quarterly*, *19*(2), 189–211. https://doi.org/10.2307/249688

Compeau, D., Higgins, C., & Huff, S. (1999). Social cognitive theory and individual reactions to computing technology: A longitudinal study. *MIS Quarterly*, *23*(2), 145–158. https://doi.org/10.2307/249749

Comrey, A. L. (1988). Factor-analytic methods of scale development in personality and clinical psychology. *Journal of Consulting and Clinical Psychology*, *56*(5), 754–761. https://doi.org/10.1037/0022-006X.56.5.754

Comrey, A. L., & Lee, H. B. (2013). *A first course in factor analysis*. Psychology press.

Cramer, M. E., Atwood, J. R., & Stoner, J. A. (2006). Measuring community coalition effectiveness using the ICE instrument. *Public Health Nursing*, *23*(1), 74–87. https://doi.org/10.1111/j.0737-1209.2006.230111.x

Daoud, R., Starkey, L., Eppel, E., Vo, T. D., & Sylvester, A. (2020). The educational value of internet use in the home for school children: A systematic review of literature. *Journal of Research on Technology in Education*, *53*(4), 353–374. https://doi.org/10.1080/15391523.2020.1783402

DeLone, W. H. (1988). Determinants of success for computer usage in small business. *MIS Quarterly*, *12*(1), 51–61. https://doi.org/10.2307/248803

Di Giulio, M., & Vecchi, G. (2023). How "institutionalization" can work. Structuring governance for digital transformation in Italy. *The Review of Policy Research*, *40*(3), 406–432. https://doi.org/10.1111/ropr.12488

Duradoni, M., Serritella, E., Avolio, C., Arnetoli, C., & Guazzini, A. (2022). Development and validation of the digital life balance (DLB) scale: A brand-new measure for both Harmonic and Disharmonic Use of ICTs. *Behavioral Sciences*, *12*(12), 489. https://doi.org/10.3390/bs12120489

Duradoni, M., Spadoni, V., Gursesli, M. C., & Guazzini, A. (2023). Development and validation of the need for online social feedback (NfOSF) scale. *Human Behavior and Emerging Technologies*, *2023*(1), 1–11. https://doi.org/10.1155/2023/5581492

Eastin, M. S., & LaRose, R. (2000). Internet self-efficacy and the psychology of the digital divide. *Journal of Computer-Mediated Communication*, *6*(1), 0. https://doi.org/10.1111/j.1083-6101.2000.tb00110.x

Faul, F., Erdfelder, E., Lang, A.-G., & Buchner, A. (2007). G*Power 3: A flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behavior Research Methods*, *39*(2), 175–191. https://doi.org/10.3758/BF03193146

Goel, A., & Gupta, L. (2020). Social media in the times of COVID-19. *Journal of Clinical Rheumatology*, *26*(6), 220–223.

Gordan, M., & Krishanan, I. A. (2014). A review of B. F. Skinnerâ€™s â€Reinforcement theory of Motivationâ€™. *International journal of research in education methodology*, *5*(3), 680–688. https://doi.org/10.24297/ijrem.v5i3.3892

Gruchel, N., Kurock, R., Bonanati, S., & Buhl, H. M. (2022). Parental involvement and Children's internet uses-Relationship with parental role construction, self-efficacy, internet skills, and parental instruction. *Computers & Education*, *182*(9), Article 104481. https://doi.org/10.1016/j.compedu.2022.104481

Guazzini, A., Serritella, E., La Gamma, M., & Duradoni, M. (2022). Italian version of the internet self-efficacy scale: Internal and external validation. *Human Behavior and Emerging Technologies*, *2022*(3), 1–11. https://doi.org/10.1155/2022/9347172

Hantrais, L., Allin, P., Kritikos, M., Sogomonjan, M., Anand, P. B., Livingstone, S., Williams, M., Innes, M., & Innes, M. (2021). COVID-19 and the digital revolution. *Contemporary Social Science*, *16*(2), 256–270. https://doi.org/10.1080/21582041.2020.1833234

Hargittai, E., & Micheli, M. (2019). Internet skills and why they matter. *Society and the internet: How networks of information and communication are changing our lives*, *109*(2), 109–124. https://books.google.it/books?hl=it&lr=&id=vdShDwAAQBAJ&oi=fnd&pg=PA109&ots=zIBW99Lpj2&sig=EalLGnm8GnXr7c-6g3O-o60U1pQ&redir_esc=y#v=onepage&q&f=false.

Hatayama, M., Viollaz, M., & Winkler, H. (2020). Jobs' amenability to working from home: Evidence from skills surveys for 53 countries. *World Bank policy research working paper*, 9241. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3599548.

Hodson, R. (2018). Digital revolution. *Nature*, *563*(7733), S131. https://doi.org/10.1038/d41586-018-07500-z

Hu, L. T., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling: A Multidisciplinary Journal*, *6*(1), 1–55. https://doi.org/10.1080/10705519909540118

Igbaria, M., Iivari, J., & Maragahh, H. (1995). Why do individuals use computer technology? A Finnish case study. *Information & management*, *29*(5), 227–238. https://doi.org/10.1016/0378-7206(95)00031-0

Igbaria, M., Pavri, F. N., & Huff, S. L. (1989). Microcomputer applications: An empirical look at usage. *Information & Management*, *16*(4), 187–196. https://doi.org/10.1016/0378-7206(89)90036-0

Jaiswal, A., Manchanda, S., Gautam, V., Goel, A. D., Aneja, J., & Raghav, P. R. (2020). Burden of internet addiction, social anxiety and social phobia among University students, India. *Journal of Family Medicine and Primary Care*, *9*(7), 3607–3612. https://doi.org/10.4103/jfmpc.jfmpc_360_20

Jöreskog, K. G. (1969). A general approach to confirmatory maximum likelihood factor analysis. *Psychometrika*, *34*(2), 183–202. https://doi.org/10.1007/bf02289343

Keltner, D., Gruenfeld, D. H., & Anderson, C. (2003). Power, approach, and inhibition. *Psychological Review*, *110*(2), 265–284. https://doi.org/10.1037/0033-295x.110.2.265

Khaleel Ibrahim, A. (2021). Evolution of the web: From web 1.0 to 4.0. *Qubahan Academic Journal*, *1*(3), 20–28. https://doi.org/10.48161/qaj.v1n3a75

Kim, Y., & Glassman, M. (2013). Beyond search and communication: Development and validation of the internet self-efficacy scale (ISS). *Computers in Human Behavior*, *29*(4), 1421–1429. https://doi.org/10.1016/j.chb.2013.01.018

Kline, R. B. (2023). *Principles and Practice of structural Equation modeling*. Guilford Publications.

Knell, M. (2021). The digital revolution and digitalized network society. *Review of Evolutionary Political Economy*, *2*(1), 9–25. https://doi.org/10.1007/s43253-021-00037-4

Kraut, R., Patterson, M., Lundmark, V., Kiesler, S., Mukopadhyay, T., & Scherlis, W. (1998). Internet paradox: A social technology that reduces social involvement and psychological well-being? *American Psychologist*, *53*(9), 1017–1031. https://doi.org/10.1037//0003-066x.53.9.1017

Langarizadeh, M., Naghipour, M., Tabatabaei, S. M., Mirzaei, A., & Vaghar, M. E. (2018). Prediction of internet addiction based on information literacy among students of Iran University of Medical Sciences. *Electronic Physician*, *10*(2), 6333–6340. https://doi.org/10.19082/6333

LaRose, R., Eastin, M., Gregg, J., LaRose, R., Eastin, M. S., & Gregg, J. (2001). Reformulating the internet paradox. *Journal of online behavior*, *1*(2). https://psycnet.apa.org/record/2002-14047-001.

Leung, L., & Lee, P. S. (2012). The influences of information literacy, internet addiction and parenting styles on internet risks. *New Media & Society*, *14*(1), 117–136. https://doi.org/10.1177/1461444811410406

Ling, L., Yelland, N., Hatzigianni, M., & Dickson-Deane, C. (2022). The use of internet of things devices in early childhood education: A systematic review. *Education and Information Technologies*, *27*(5), 6333–6352. https://doi.org/10.1007/s10639-021-10872-x

Livingstone, S., Mascheroni, G., & Staksrud, E. (2018). European research on children's internet use: Assessing the past and anticipating the future. *New Media & Society*, *20*(3), 1103–1122. https://doi.org/10.1177/1461444816685930

Magsamen-Conrad, K., Billotte-Verhoff, C., & Greene, K. (2014). Technology addiction's contribution to mental wellbeing: The positive effect of online social capital. *Computers in Human Behavior*, *40*(1), 23–30. https://doi.org/10.1016/j.chb.2014.07.014

Mano, R., & Rosenberg, D. (2021). Online and offline social activity and sociability effects on wellbeing and social influence: A "Spillover" effect. *Advances in Applied Sociology*, *11*(01), 48–63. https://doi.org/10.4236/aasoci.2021.111005

McGaughey, R. E., Zeltmann, S. M., & McMurtrey, M. E. (2013). Motivations and obstacles to smartphone use by the elderly: Developing a research framework. *International Journal of Electronic Finance*, *7*(3/4), 177–195. https://doi.org/10.1504/ijef.2013.058601

Mendrika, V., Darmawan, D., Anjanarko, T. S., Jahroni, J., Shaleh, M., & Handayani, B. (2021). The effectiveness of the work from home (WFH) program during the COVID-19 pandemic. *Journal of Social Science Studies*, *1*(2), 44–46. https://doi.org/10.56348/jos3.v1i2.12

Morrison, E. W., See, K. E., & Pan, C. (2015). An approach-inhibition model of employee silence: The joint effects of personal sense of power and target openness. *Personnel Psychology*, *68*(3), 547–580. https://doi.org/10.1111/peps.12087

Nunnally, J. C., & Bernstein, I. H. (1994). *Psychometric theory New York*. McGraw-Hill.

O'Connell, R., & Kirwan, G. (2014). Protection motivation theory and online activities. *Cyberpsychology and New Media: A thematic reader*, 139–148. https://www.taylorfrancis.com/chapters/edit/10.4324/9780203796610-17/protection-motivation-theory-online-activities-richard-connell-gr%C3%A1inne-kirwan.

Oliver, T. A., & Shapiro, F. (1993). Self-efficacy and computers. *Journal of Computer-Based Interactions*, *20*(3), 81–85. https://eric.ed.gov/?id=EJ476367.

Park, C. J., & Hyun, J. S. (2014). Internet literacy vs. technology addiction: Relationship analysis with time perspectives of secondary school students. *Advanced Science and Technology Letters*, *59*(43), 23–26. https://doi.org/10.14257/astl.2014.59.05.

Reglitz, M. (2020). The human right to free internet access. *Journal of Applied Philosophy*, *37*(2), 314–331. https://doi.org/10.1111/japp.12395

Schneider, S. L., & Council, M. L. (2021). Distance learning in the era of COVID-19. *Archives of Dermatological Research*, *313*(5), 389–390. https://doi.org/10.1007/s00403-020-02088-9

Servidio, R. (2017). Assessing the psychometric properties of the internet addiction test: A study on a sample of Italian university students. *Computers in Human Behavior*, *68*(9), 17–29. https://doi.org/10.1016/j.chb.2016.11.019

Stodt, B., Wegmann, E., & Brand, M. (2016). Predicting dysfunctional Internet use: The role of age, conscientiousness, and Internet literacy in Internet addiction and cyberbullying. *International Journal of Cyber Behavior, Psychology and Learning*, *6*(4), 28–43. https://doi.org/10.4018/ijcbpl.2016100103

Stoilova, M., Livingstone, S., & Khazbak, R. (2021). *Investigating risks and Opportunities for children in a digital world: A rapid review of the evidence on children's internet use and outcomes*. UNICEF.

Sum, S., Mathews, R. M., Pourghasem, M., & Hughes, I. (2009). Internet use as a predictor of sense of community in older people. *CyberPsychology and Behavior: The Impact of the Internet, Multimedia and Virtual Reality on Behavior and Society*, *12*(2), 235–239. https://doi.org/10.1089/cpb.2008.0150

Tabachuk, N. P., Ledovskikh, I. A., Shulika, N. A., Kazinets, V. A., & Polichka, A. E. (2018). Internet activity and internet addiction: Where is the borderline in developing one's information competency? *Eurasia Journal of Mathematics, Science and Technology Education*, *14*(12), em1640. https://doi.org/10.29333/ejmste/97828

Teo, T. S., Lim, V. K., & Lai, R. Y. (1999). Intrinsic and extrinsic motivation in Internet usage. *Omega*, *27*(1), 25–37. https://doi.org/10.1016/s0305-0483(98)00028-0

Thompson, R. L., Higgins, C. A., & Howell, J. M. (1991). Personal computing: Toward a conceptual model of utilization. *MIS Quarterly*, *15*(1), 125–143. https://doi.org/10.2307/249443

Tindall, I. K., & Curtis, G. J. (2019). Validation of the measurement of need frustration. *Frontiers in Psychology*, *10*(1), 1742. https://doi.org/10.3389/fpsyg.2019.01742

Tonioni, F., D'Alessandris, L., Lai, C., Martinelli, D., Corvino, S., Vasale, M., Fanella, F., Aceto, P., Bria, P., & Bria, P. (2012). Internet addiction: Hours spent online, behaviors and psychological symptoms. *General Hospital Psychiatry*, *34*(1), 80–87. https://doi.org/10.1016/j.genhosppsych.2011.09.013

Torkzadeh, G., Van Dyke, T. P., & Dyke, V. (2002). Effects of training on Internet self-efficacy and computer user attitudes. *Computers in Human Behavior*, *18*(5), 479–494. https://doi.org/10.1016/s0747-5632(02)00010-9

Tsai, M. J., & Tsai, C. C. (2010). Junior high school students' internet usage and self-efficacy: A re-examination of the gender gap. *Computers & Education*, *54*(4), 1182–1192. https://doi.org/10.1016/j.compedu.2009.11.004

Tucker, L. R., & Lewis, C. (1973). A reliability coefficient for maximum likelihood factor analysis. *Psychometrika*, *38*(1), 1–10. https://doi.org/10.1007/bf02291170

Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D. (2003). User acceptance of information technology: Toward a unified view. *MIS Quarterly*, *27*(3), 425–478. https://doi.org/10.2307/30036540

Verhoef, P. C. (2003). Understanding the effect of customer relationship management efforts on customer retention and customer share development. *Journal of Marketing*, *67*(4), 30–45. https://doi.org/10.1509/jmkg.67.4.30.18685

We Are Social, WAS. (2023). Digital 2023. Global Overview report. We Are Social Ltd. Available at: https://wearesocial.com/uk/blog/2023/01/digital-2023

Wu, Y. T., & Tsai, C. C. (2006). University students' internet attitudes and internet self-efficacy: A study at three Universities in Taiwan. *CyberPsychology and Behavior: The Impact of the Internet, Multimedia and Virtual Reality on Behavior and Society*, *9*(4), 441–450. https://doi.org/10.1089/cpb.2006.9.441

Young, K. S. (1998). Internet addiction: The Emergence of a new clinical Disorder. *CyberPsychology and Behavior*, *1*(3), 237–244. https://doi.org/10.1089/cpb.1998.1.237

Zainal, N. C., Puad, M. H. M., & Sani, N. F. M. (2022). Moderating effect of self-efficacy in the relationship between knowledge, attitude and environment behavior of cybersecurity awareness. *Asian Social Science*, *18*(1), 55–64. https://doi.org/10.5539/ass.v18n1p55

Zhang, Y. (2007). Development and validation of an internet use attitude scale. *Computers & Education*, *49*(2), 243–253. https://doi.org/10.1016/j.compedu.2005.05.005

Zhao, L., Lu, Y., Huang, W., & Wang, Q. (2010). Internet inequality: The relationship between high school students' Internet use in different locations and their Internet self-efficacy. *Computers & Education*, *55*(4), 1405–1423. https://doi.org/10.1016/j.compedu.2010.05.010

Zlomuzica, A., Preusser, F., Schneider, S., & Margraf, J. (2015). Increased perceived self-efficacy facilitates the extinction of fear in healthy participants. *Frontiers in Behavioral Neuroscience*, *9*(8), 270. https://doi.org/10.3389/fnbeh.2015.00270

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Mirko Duradoni obtained the Ph.D. title in Information Engineering in 2020 and he holds a master's degree in psychology from the Department of Education and Psychology, University of Florence, Italy. He is currently a member of the Virtual Human Dynamics Laboratory at the University of Florence, a contract professor in Psychology of groups (2019-2022), and a teaching fellow in environmental psychology (2021-2022). He is particularly skilled in psychological dimensions assessment, research methodology, and data analysis. He taught psychometrics in the health sector (2016-2019, University of Pisa) and was enrolled for his skills in three EU-level projects, namely InSPIRES (ID: 741677), Erasmus+ Restore (IT02-KA204-063248), and "PHOENIX: The rise of citizens' voices for a Greener Europe" (ID: 101037328). Finally, he worked in the last years, together with researchers from the Department of Industrial Engineering (DIEF-UNIFI), developing knowledge and expertise in how

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Martina La Gamma obtains in 2021 a double master's degree between the University of Florence and the University of Seville in social and community psychology. Since 2017 she has been collaborating with the Florentine research laboratory Virthulab dealing with scientific dissemination, collection of participants and research. Her themes of interest are the psychology of virtual environments and the validation in Italian of scales. Since 2021 she has been collaborating with the department of psychology of the University of Cordoba (Spain), with which she has created and validated the Covid-19 Worries and Fears Scale and also continues her research work on psychological manipulation and the psychosocial impact caused by the disappearance of an acquaintance or family member. She currently collaborates with an NGO working in the suburbs of Lima (Peru) dealing with development, personal growth and empowerment with people in high vulnerability situations.

Elena Serritella obtained a master's degree title in Clinical and Health Psychology and, from November 2022, she is a PhD Student at the Department of Education and Psychology (FORLILPSI), University of Florence, Italy. In 2023 she qualified to practise psychology and is registered with the Order of Tuscan Psychologists. She is an active member of two University Laboratories at the University of Florence: Virtual Human Dynamics Laboratory focusing on virtual environments, social psychology, and AI applications and Laboratorio di Studi Longitudinali in Psicologia dello Sviluppo focusing on developmental psychology, bullying and cyberbullying.

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