

In this issue:

- 4. Use of Artificial Intelligence to Grade Student Discussion Boards: An Exploratory Study**  
Stephen M. Rutner, Georgia College and State University  
Rebecca A. Scott, University of North Carolina Wilmington
  
- 19. The Role of Task Value and Online Learning Strategies in an Introductory Computer Programming Course**  
Pratibha Menon, California University of Pennsylvania
  
- 32. Comparison of Information Technology Professionals' Perception of Job Satisfaction and Inclusion by Gender: Insights for Recruitment and Retention of Female Students**  
Leah Schultz, Tarleton State University  
Mark Adams, Tarleton State University
  
- 45. Redesigning Assessment in the Computer Science Program at a Regional University**  
Ernst Bekkering, Northeastern State University  
Patrick Harrington, Northeastern State University
  
- 89. Against "Flexibility": Tightening the Cage of Academic Rigor with Instructors' Responsibility and Rationality Student Group Satisfaction Perceptions using**  
Yaojie Li, Columbus State University  
Jason Xiong, Appalachian State University  
Jennifer Pitts, Columbus State University  
Scott Hunsinger, Appalachian State University
  
- 97. Upskilling and Reskilling for the Future of Work: A Typology of Digital Skills Initiatives**  
Guido Lang, Quinnipiac University  
Tamilla Triantoro, Quinnipiac University

The **Information Systems Education Journal** (ISEDJ) is a double-blind peer-reviewed academic journal published by **ISCAP** (Information Systems and Computing Academic Professionals). Publishing frequency is six times per year. The first year of publication was 2003.

ISEDJ is published online (<https://isedj.org>). Our sister publication, the Proceedings of EDSIGCON (<https://proc.iscap.info>) features all papers, panels, workshops, and presentations from the conference.

The journal acceptance review process involves a minimum of three double-blind peer reviews, where both the reviewer is not aware of the identities of the authors and the authors are not aware of the identities of the reviewers. The initial reviews happen before the EDSIGCON conference. At that point papers are divided into award papers (top 15%), other journal papers (top 25%), unsettled papers, and non-journal papers. The unsettled papers are subjected to a second round of blind peer review to establish whether they will be accepted to the journal or not. Those papers that are deemed of sufficient quality are accepted for publication in the ISEDJ journal. Currently the target acceptance rate for the journal is under 40%.

Information Systems Education Journal is pleased to be listed in the Cabell's Directory of Publishing Opportunities in Educational Technology and Library Science, in both the electronic and printed editions. Questions should be addressed to the editor at [editor@isedj.org](mailto:editor@isedj.org) or the publisher at [publisher@isedj.org](mailto:publisher@isedj.org). Special thanks to members of ISCAP/EDSIG who perform the editorial and review processes for ISEDJ.

### 2022 ISCAP Board of Directors

Eric Breimer Siena College President	Jeff Cummings Univ of NC Wilmington Vice President	Jeffry Babb West Texas A&M Past President/ Curriculum Chair
Jennifer Breese Penn State University Director	Amy Connolly James Madison University Director	Niki Kunene Eastern CT St Univ Director/Treasurer
RJ Podeschi Millikin University Director	Michael Smith Georgia Institute of Technology Director/Secretary	Tom Janicki Univ of NC Wilmington Director / Meeting Facilitator
Anthony Serapiglia St. Vincent College Director/2022 Conf Chair	Xihui "Paul" Zhang University of North Alabama Director/JISE Editor	

Copyright © 2022 by Information Systems and Computing Academic Professionals (ISCAP). Permission to make digital or hard copies of all or part of this journal for personal or classroom use is granted without fee provided that the copies are not made or distributed for profit or commercial use. All copies must bear this notice and full citation. Permission from the Editor is required to post to servers, redistribute to lists, or utilize in a for-profit or commercial use. Permission requests should be sent to Paul Witman, Editor, [editor@isedj.org](mailto:editor@isedj.org).

# INFORMATION SYSTEMS EDUCATION JOURNAL

## Editors

**Paul Witman**  
Editor  
California Lutheran  
University

**Thomas Janicki**  
Publisher  
U of North Carolina  
Wilmington

**Donald Colton**  
Emeritus Editor Brigham  
Young University  
Hawaii

**Dana Schwieger**  
Associate Editor  
Southeast Missouri  
State University

**Ira Goldman**  
Teaching Cases  
Co-Editor  
Siena College

**Michelle Louch**  
Teaching Cases  
Co-Editor  
Carlow College

**Brandon Brown**  
Cyber Education  
Co-Editor  
Coastline College

**Anthony Serapiglia**  
Cyber Education  
Co-Editor  
St. Vincent College

# Upskilling and Reskilling for the Future of Work: A Typology of Digital Skills Initiatives

Guido Lang  
guido.lang@quinnipiac.edu

Tamilla Triantoro  
tamilla.triantoro@quinnipiac.edu

Quinnipiac University  
Hamden, CT 06518

## Abstract

Governments, businesses, and educational institutions need to collaborate and make significant investments in order to address the growing digital skills crisis. In Europe, hundreds of digital skills initiatives have been launched with different forms of government and private industry support in the last five years alone. Consequently, digital skills initiatives have come to encompass a wide array of interventions. In this context, this paper proposes a typology of digital skills initiatives that was developed based on the analysis of over 300 initiatives listed in the European Commission's repository of best digital skills initiatives. The proposed typology consists of four categories: target group, digital skills, learning format, and sponsoring organization. In terms of target group, digital skills initiatives tend to target one or more of five distinct groups: the general public, educators, adults, seniors and youth. In terms of digital skills, digital skills initiatives tend to focus on general digital skills or specialized digital skills. In terms of learning format, digital skills initiatives tend to offer training and/or a learning resource. In terms of sponsoring organization, the initiatives tend to be sponsored by organizations that are either affiliated or unaffiliated with a technology vendor. The typology is followed by a presentation of mini cases, which highlight different archetypes of the proposed typology. The paper closes with a discussion of practical implications for policy makers, administrators, and scholars interested in digital skills initiatives and the future of work.

**Keywords:** future of work, digital skills, digital skills gap, digital skills initiatives, typology

## 1. INTRODUCTION

Technological advancements and digital transformation require the society to adapt digital experiences and acquire digital skills. Digital transformation powered by digital and AI technologies and accelerated by the COVID-19 pandemic, influences individual, organizational, and societal levels. Thus, the development of digital skills has become a focal point on the agenda of policymakers, practitioners, and scholars to empower citizens to fully participate in the increasingly digitized world (Iordache et al., 2017).

Digital skills are dynamic and evolving skills necessary to use software or operate a digital device (van Laar et al., 2020). The future of work depends on digital skills. Governments, businesses, and educational institutions need to collaborate and make significant investments to address the digital skills crisis, which is a gap between necessary digital skills and available digital skills. Approximately 90% of jobs in developed economies require some level of digital skills, while one third of the labor force has a limited ability to use digital skills productively (Broadband Commission for Sustainable Development, 2017). This digital skills gap negatively affects all industries, workers, and

societies and is projected to grow in the foreseeable future. In Europe, hundreds of digital skills initiatives have been launched with different forms of government, academic and organizational support in the last five years alone. Consequently, digital skills initiatives have come to encompass a wide array of actions and offerings.

The goal of this paper is to advance the development of digital skills initiatives by creating a typology based on the analysis of existing digital skills initiatives. A typology is a classification of practice that is used to extract complex data via unearthing key categories (Nind & Lewthwaite, 2020). As such, the proposed typology is useful both as a descriptive tool and as a thinking tool. The complexity of digital transformation brings challenges, which in turn make a typology a valuable tool for policymakers, practitioners, and scholars. Specifically, this paper addresses the following research question: *What categories can be used to classify digital skills initiatives?* The proposed typology, which consists of four categories, has been developed by analyzing the European Commission's Digital Skills & Jobs Coalition Initiatives Repository (European Commission, n.d.). The European Commission, in collaboration with European Union (EU) member states, identified over 300 best digital skills initiatives in Europe, and created a public repository with detailed information about each initiative (European Commission, n.d.), which served as the data source for the present study.

The paper is structured as follows: The next section presents an overview of related literature. Section three describes the methodology used to develop the typology. Section four presents the proposed typology, including its four categories. Section five summarizes mini cases that represent archetypes, or typical examples of digital skills initiatives. Finally, the last section discusses practical implications for policy makers, practitioners, and scholars.

## 2. RELATED LITERATURE

Digital skills are a key to a successful information society. A recent report by the European Commission (2021) suggests that digital skills are required in all types of jobs, including those that are not directly associated with digitization including farming, construction, and vocational skills. Digital skills are necessary to use software and enable people to use digital services, engage in online activities, consume information, and communicate online. According to the latest Digital Economy and Society Index report (DESI,

2020), although there is an improvement year over year in terms of basic internet user skills and advanced information and communication technology (ICT) skills, there remains a shortage of ICT specialists. In fact, 64% of large enterprises and 56% of small and medium enterprises reported difficulties in filling vacancies for ICT specialists in 2018.

Prior research suggests that the divide between digital skills adoption depends on demographic and socio-economic factors such as age, gender, education, income, and employment status (DiMaggio et al., 2004; Iordache et al., 2017). Digital skills are a prerequisite for the general public to be able to access government related information, participate in online banking, obtain telehealth treatments, consume information, and communicate online. Unfortunately, only 58% of citizens in the EU had basic digital skills in 2019 (DESI, 2020). Despite the attention given to bridging the digital divide, there is a growing concern that the digital divide may have been deepening because of unequal distribution of digital skills and access to digital media (van Dijk & van Deursen, 2014). The unequal access can be generation based. For example, senior citizens are on the lower spectrum of internet adoption, and significant efforts are required to provide basic digital skills to this demographic group (Blažič & Blažič, 2020). On the other side of the spectrum are young adopters of technology. Technology skills among youth are important for the future of work as the new economy requires reskilling with a focus on digital solutions, with an expected doubling of digital labor demand by 2030 (Bughin et al., 2017). Moreover, digital technologies increasingly provide access to communication, entertainment, creativity, citizenship, and civic participation (Donoso et al., 2020). Educators play a significant role in bringing technology skills to the lives of younger individuals via the use of e-learning tools and ICT (Leahy & Wilson, 2014).

Digital skills can be characterized as general and specialized. General skills are non-specialized, generic skills (Lintzeris & Karalis 2020). In the context of digital skills, they include basic functional digital skills necessary for social inclusion and participation in modern day-to-day life, such as access to the Internet, understanding social and digital media, and accessing services online (Broadband Commission for Sustainable Development, 2017). Specialized digital skills are a prerequisite for digital transformation and are necessary to create competitive business models and demonstrate profitability and sustainability. Specialized skills are particularly in high demand

among organizations and include mobile technologies, data analytics, cloud computing, and the Internet of things (Krcmar et al., 2017). Post-pandemic trends accelerate the need for reskilling and upskilling for adults. Some of the trends include the ability of employees to fully operate in a remote world while being productive within the company's ecosystem that includes clients, partners, suppliers, and public authorities. This includes not only moving to a more technology and data-enabled model, but also a basic understanding of critical technology and data concepts including coding, robotics, 3D printing, cybersecurity, data visualization, applied machine learning, and advanced analytics, among others (Agrawal et al., 2020).

To bridge the gap and transform the digital profiles of their countries, many governments spearheaded policy interventions and digital skills initiatives. For example, the Institute of Coding is a £40m initiative of the UK government to transform the digital skills of the country (Davenport et al., 2020). The government of France designated one billion euros for digital education development (Broadband Commission for Sustainable Development, 2017). At the same time, there is interest in increasing the level of digital skills from the private industry. Microsoft launched a global skills initiative aimed at bringing digital skills to 25 million people globally by combining resources from LinkedIn, GitHub, and Microsoft (Smith, 2020). Amazon Web Services (AWS) stated that by 2025, they will provide free cloud computing skills training to 29 million people worldwide (Carlson, 2020).

Prior research focused on the origins and concepts of digital literacy (Bawden, 2008), covered models of constructing a modern and comprehensive skills classification that includes digital skills along with information, communication, collaboration, critical thinking, creativity, and problem-solving skills (Lintzeris & Karalis, 2020; van Laar et al., 2020). Instruments have been developed to measure digital skills related to the internet and web (Hargittai & Hsieh, 2012; Van Deursen et al., 2016). The assessment of digital competencies was conducted in schools (Calvani, 2008) and workplaces (Vieru et al., 2015).

While previous studies provided a thorough overview of digital skills and some of the applications, there has been no systematic effort to classify digital skills initiatives. In addition, there has been a lack of studies with a cross-case approach to existing digital skills initiatives. The cross-case approach to creating a typology based

on methods that have been used in practice is considered important research (Nind & Lewthwaite, 2020). In this respect, our study fills an important research gap by offering a typology of existing digital skills initiatives. In addition, prior research considered the demand side, mainly focusing on necessary digital skills for a consumer (e.g., Lintzeris & Karalis, 2020; van Laar et al., 2020). The focus of this research is on the supply side, with a focus on the evaluation of existing resources while providing a framework to assess and develop digital skills initiatives. Based on our knowledge, this is the first paper to analyze different initiatives related to the development of digital skills.

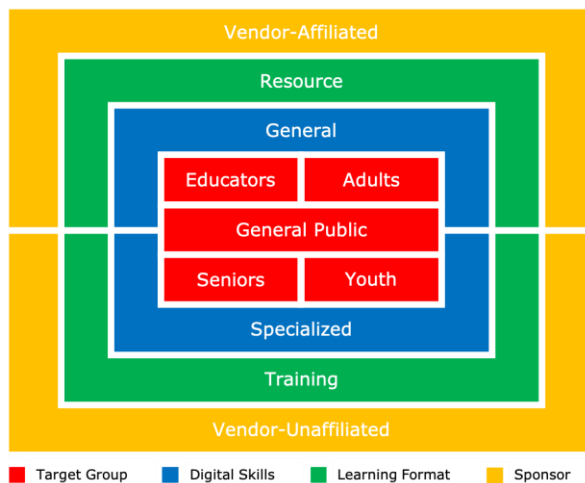
### 3. METHODOLOGY

The typology was developed using an inductive strategy (Bailey, 1994) by analyzing data from the Digital Skills & Jobs Coalition Initiatives Repository of the European Commission (n.d.). The repository contains 312 digital skills initiatives which the EU considers to be the best digital skills initiatives in Europe. The data included detailed descriptions for each digital skills initiative. The descriptions were iteratively analyzed: Starting without any preconceived categories, the authors first independently identified recurring categories in about 50 initiatives, before collaboratively agreeing on a set of categories. The categories were chosen to form groups of digital skills initiatives that are internally homogenous but distinct from each other (Bailey, 1994). Subsequently, the authors independently re-analyzed all previously analyzed initiatives along with the next set of 50 initiatives. Afterwards the authors collaboratively revised the categories, as needed, to derive a set of categories that maximize both homogeneity within groups and heterogeneity between groups (Bailey, 1994). This process was repeated until all digital skills initiatives were analyzed. For example, after reading the descriptions of the first 50 digital skills initiatives, one of the authors noticed that digital skills initiatives are sponsored by an organization which is either affiliated with a technology vendor or not affiliated with a technology vendor. After discussing the initial finding with the other author, both authors then independently analyzed the next 50 digital skills initiatives with regards to the vendor affiliation of the sponsor. Afterwards both authors agreed that vendor affiliation of the sponsor can be used to separate digital skills initiatives into two roughly equal-sized groups. A shared Google Doc was used to record observations, markup the descriptions, and assign categories. Finally, the authors jointly selected archetypes, or typical

examples, for the proposed typology as described in section 5.

#### 4. PROPOSED TYPOLOGY

The analysis revealed a large variety of digital skills initiatives with different and evolving concepts. To bring order into this complexity, we introduce a typology based on four overarching categories. Each category addresses a fundamental question behind digital skills initiatives. Figure 1 depicts the proposed typology, showing the four categories in onion-like layers with the target group at the center, surrounded by the digital skills, learning format, and ultimately the sponsor.



**Figure 1: Proposed typology of digital skills initiatives**

The following sections describe each of the four categories of the proposed typology in greater detail.

##### Target Group

This category addresses the question “whose digital skills are improved?”. Digital skills initiatives tend to target one or more of five distinct groups: the general public, educators (such as K-12 teachers, vocational school instructors, university professors, etc.), adults (such as professionals wishing to reskill or upskill, veterans, the unemployed or underemployed, women, disadvantaged groups, etc.), seniors, and youth (such as children, students, young adults, young refugees, etc.).

##### Digital Skills

This category addresses the question “what digital skills are improved?”. Digital skills initiatives tend to focus on general digital skills such as Internet usage, word processing, etc.,

and/or specialized digital skills such as coding, robotics, 3D printing, etc.

##### Learning Format

This category addresses the question “how are digital skills improved?”. Digital skills initiatives tend to offer training such as classes, workshops, summer camps, etc., and/or learning resources such as e-books, websites, videos, games, etc.

##### Sponsor

This category addresses the question “how is the digital skills initiative funded?”. Digital skills initiatives require scaling up that necessitate an investment, particularly from governments and the industry (Broadband Commission for Sustainable Development, 2017) and may include monetary investments, donations or loans of hardware and software, and volunteer work. As a result, digital skills initiatives tend to be sponsored by organizations that are vendor-affiliated or vendor-unaffiliated. Here, vendor affiliation refers to the relationship between the sponsoring organization and a technology vendor (i.e. an organization that sells products or services related to digital technology). Technology vendor affiliation is relevant to the sponsoring of digital skills initiatives since they have the potential to increase the demand for certain digital products or services in the future.

The proposed typology consisting of four categories is as simple as possible and as complex as necessary to classify the variety of existing digital skills initiatives. The following section elucidates the usefulness of the proposed typology by presenting archetypes, or typical examples.

#### 5. ARCHETYPES

Theoretically, there are 40 different combinations of target group, digital skills, learning format, and sponsor possible. We have selected one archetype, or typical example (Bailey, 1994), from the Digital Skills & Jobs Coalition Initiatives Repository of the European Commission (n.d.) for each target group. We chose the target group as the defining category for the archetypes, as the needs and characteristics of the target group should be at the center of any digital skills initiative. Table 1 summarizes the resulting five archetypes.

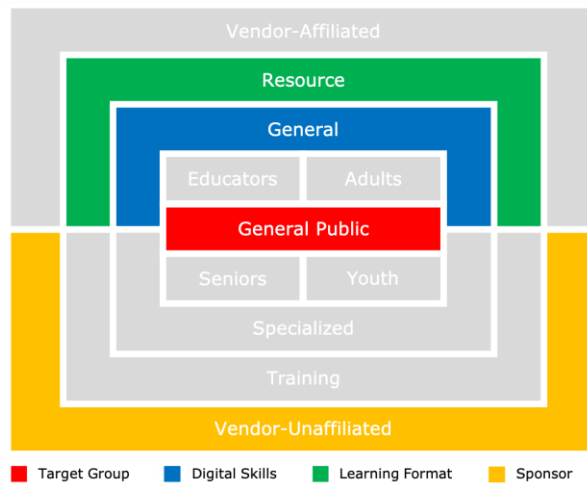
Arche-type	Target Group	Digital Skills	Learning Format	Sponsor
1	General public	General	Resource	Vendor-Unaffiliated
2	Educators	Specialized	Training	Vendor-Affiliated
3	Adults	Specialized	Training	Vendor-Affiliated
4	Seniors	General	Training	Vendor-Unaffiliated
5	Youth	Specialized	Training	Vendor-Unaffiliated

**Table 1: Overview of Archetypes**

The aim of the following sections is to highlight the similarities and differences across a wide range of digital skills initiatives, thereby showcasing the appropriateness of the proposed typology.

**Archetype 1: Digital Duel (Belgium)**

The first archetype represents digital skills initiatives that provide the general public with general digital skills by offering a resource while being sponsored by a vendor-unaffiliated organization. Figure 2 depicts archetype 1.



**Figure 2: Depiction of Archetype 1**

An illustrative example of a digital skills initiative in archetype 1 is *Digital Duel*. *Digital Duel* is a digital skills initiative that targets citizens in Belgium. It has been designed to enable all Belgian citizens to become active members of the digital society. Thus, the target group of *Digital Duel* is the general public.

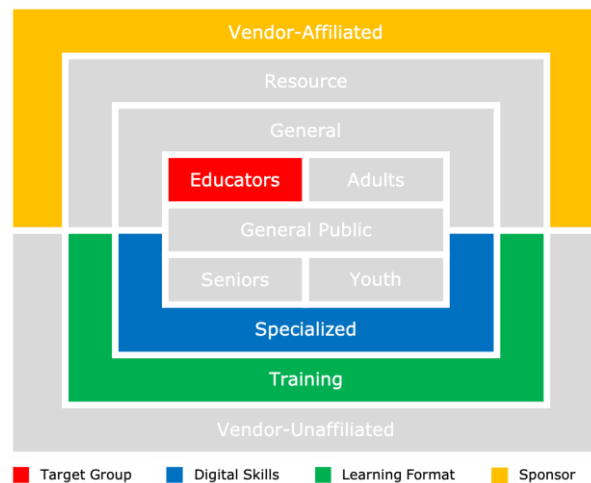
*Digital Duel* aims to help citizens assess and improve their digital skills in five key areas: information processing, communication, content creation, safety, and problem solving. Thus, the digital skills provided by *Digital Duel* are general in nature.

*Digital Duel* is an online game. It consists of ten interactive challenges which require participants to apply their digital skills. For example, instead of asking participants to rate their ability to conduct online searches, participants have to actually conduct an online search in order to complete a challenge in the game. After completing the ten challenges, participants can see their level of digital skills in each of the five key areas. Finally, participants are given access to free online courses to improve their digital skills in the identified areas. Thus, the learning format offered by *Digital Duel* is that of a resource.

*Digital Duel* is sponsored by Federal Public Service Economy, a federal government agency tasked with ensuring Belgium’s competitiveness in the international economy. Thus, the sponsor of *Digital Duel* is vendor-unaffiliated.

**Archetype 2: Informatica365 (Romania)**

The second archetype represents digital skills initiatives that provide educators with specialized digital skills by offering training while being sponsored by a vendor-affiliated organization. Figure 3 depicts archetype 2.



**Figure 3: Depiction of Archetype 2**

An illustrative example of a digital skills initiative in archetype 2 is *Informatica365*. *Informatica365* is a digital skills initiative that targets middle school teachers in Romania. The initiative aims to train teachers so that they can teach computer science (CS) to middle school students. Thus, the target group of *Informatica365* is educators.

*Informatica365* aims to help teachers acquire the knowledge necessary to teach CS at grades 5-8 (ages 11-15). Topics covered include algorithms, sequencing, loops, conditionals, operators,



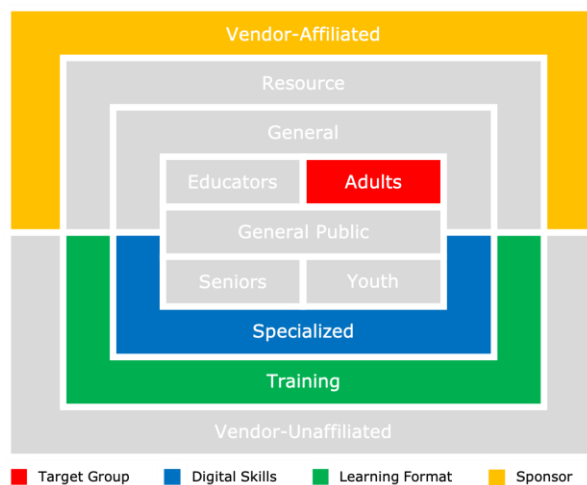
events, variables, and functions. The topics are taught in a middle school appropriate context using Microsoft Minecraft Education Edition. Microsoft Minecraft Education Edition is a version of the popular Minecraft game with additional education-specific features. The curriculum is aligned with the CS curriculum standards by the International Society for Technology in Education and the Computer Science Teachers Association. Thus, the digital skills provided by *Informatica365* are specialized in nature.

*Informatica365* consists of 42 hours of face-to-face teacher training, which has been accredited by Romania’s National Center for Teacher Training. Selected teachers received additional training to become master trainers, who can then train other teachers. In addition, lesson plans and other teacher training materials have been developed or translated to Romanian. Thus, the learning format offered by *Informatica365* is that of training.

*Informatica365* is sponsored by Microsoft Philanthropies. Microsoft Philanthropies is part of Microsoft’s corporate social responsibility initiative and aims to increase access to digital skills and CS education for youth around the globe. Thus, the sponsor of *Informatica365* is vendor-affiliated.

**Archetype 3: AWS re:Start (UK)**

The third archetype represents digital skills initiatives that provide adults with specialized digital skills by offering training while being sponsored by a vendor-affiliated organization. Figure 4 depicts archetype 3.



**Figure 4: Depiction of Archetype 3**

An illustrative example of a digital skills initiative in archetype 3 is *Amazon Web Services (AWS)*

*re:Start*. *AWS re:Start* targets adults in the UK who are under the age of 30 and not in employment, education, or training (so called NEETs), as well as military veterans, members of the military reserve, those leaving the Armed Forces, and service spouses in the UK. Thus, the target group of *AWS re:Start* is adults.

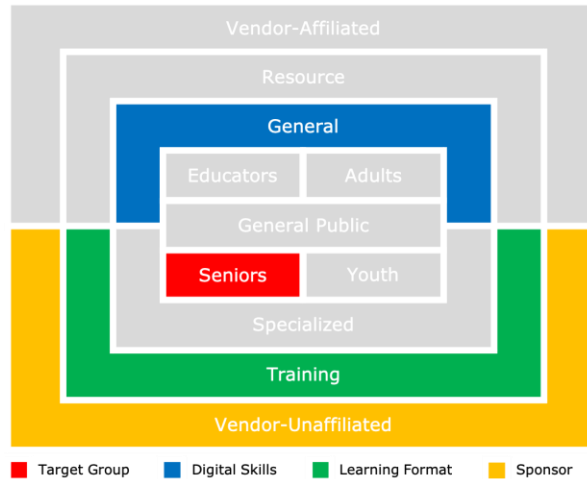
*AWS re:Start* teaches participants how to architect, design, and develop cloud-based applications using AWS. Specifically, participants learn about agile and software modelling techniques, multi-tier architectures, application programming interfaces, and micro services. The curriculum has been designed to accommodate participants without any prior technical knowledge. After completing *AWS re:Start*, participants are eligible for technical positions such as help desk support, IT support analyst, software developer, IT support technician, network engineer, IT recruitment consultant, and IT sales roles. Thus, the digital skills provided by *AWS re:Start* are specialized in nature.

*AWS re:Start* consists of a four-week technical training provided in-person. Before beginning the training, potential participants attend a taster day at Amazon offices, where they learn about the program and can assess their desire to work in the industry. After completing the four-week technical training, participants gain practical experience during three months of on-the-job training with one of over 100 AWS customers and partner organizations. Finally, participants are given employability workshops to help them secure full-time positions – potentially with the organization that provided them the on-the-job training. Thus, the learning format offered by *AWS re:Start* is training.

*AWS re:Start* is sponsored by Amazon as part of its effort to bridge the digital skills gap in Europe. Thus, the sponsor of *AWS re:Start* is vendor-affiliated.

**Archetype 4: Connect Seniors to the Digital World (Germany, Lithuania, Romania, Spain)**

The fourth archetype represents digital skills initiatives that provide seniors with general digital skills by offering training while being sponsored by a vendor-unaffiliated organization. Figure 5 depicts archetype 4.



**Figure 5: Depiction of Archetype 4**

An illustrative example of a digital skills initiative in archetype 4 is *Connect Seniors to the Digital World (CSDW)*. *CSDW* is a digital skills initiative that targets senior citizens living in retirement homes or frequenting libraries in parts of Germany, Lithuania, Romania, and Spain. Thus, the target group of *CSDW* is seniors.

*CSDW* teaches seniors to use tablet computers to become digitally active citizens. This includes such tasks as using video conferencing software to speak with family (for example Skype), scanning QR codes in museums, and borrowing ebooks from the library. Thus, the digital skills provided by *CSDW* are general in nature.

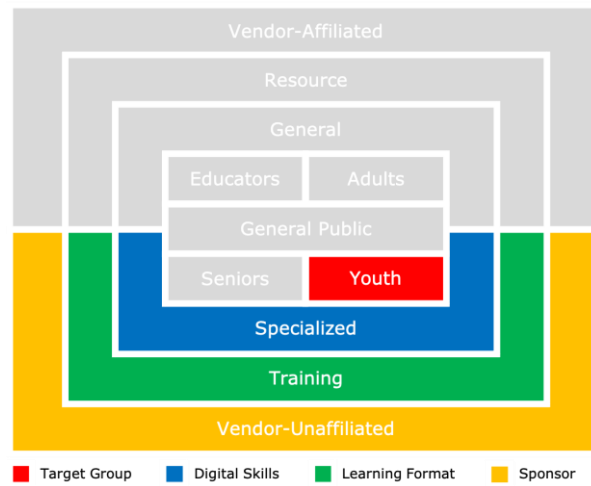
*CSDW* consists of a two-step process. In a first step, *CSDW* provides an online course to so-called multipliers, who are individuals wanting to become trainers, such as social workers or staff members in libraries or retirement homes. The online course is self-paced and consists of technical instructions on how to use a tablet computer (including handouts to provide to seniors) as well as pedagogical methods for training seniors. It is assumed that potential multipliers are proficient in using personal computers. To support adoption and localization in various countries, the online course has been developed in English. The multipliers then provide in-person training to seniors in libraries and retirement homes. Thus, the learning format provided by *CSDW* is training.

*CSDW* is sponsored by the Digital Opportunities Foundation, a German nonprofit organization that researches the social consequences of digitization, advocates for equal access to the Internet for all people, and promotes digital skills. The Digital Opportunities Foundation is under the

patronage of the German Federal Ministry of Economics and Energy and the German Federal Ministry for Family Affairs, Senior Citizens, Women and Youth. Thus, *CSDW* is sponsored by a vendor-unaffiliated organization.

**Archetype 5: Code+Create (Greece)**

The fifth archetype represents digital skills initiatives that provide youth with specialized digital skills by offering training while being sponsored by a vendor-unaffiliated organization. Figure 6 depicts archetype 5.



**Figure 6: Depiction of Archetype 5.**

An illustrative example of a digital skills initiative in archetype 5 is *Code+Create*. *Code+Create* is a digital skills initiative that targets Greek adolescents and adolescent refugees. Thus, *Code+Create* targets youth.

*Code+Create* teaches web development (using HTML, CSS, JS, Git, Node, Angular, Bootstrap), 3D printing, robotics, Internet of Things (IoT) applications, Python programming, and office automation using LibreOffice. Thus, *Code+Create* teaches digital skills that are specialized in nature.

*Code+Create* operates two learning spaces in Athens which are fully equipped with tech tools such as Raspberry Pis, NodeMCU IoT kits, Edison robots, Ultimaker 3D printers, projectors, and Linux laptops for participants. Classes last three hours and take place in-person two to three times a week. The program’s duration is eight weeks. Classes are held weekdays and weekends. Every class is run by two instructors with the aid of a teaching assistant. Instruction and all instructional materials are in English. Moreover, all instructional materials are openly licensed and

made available online for free. Thus, the learning format offered by *Code+Create* is training.

*Code+Create* is sponsored by The Organization of Open Technologies in Greece, which aims to promote the development of open standards, free software, open content, open data, and open architecture in the areas of education, the public sector, business, and the economy in Greece. Thus, *Code+Create* is sponsored by a vendor-unaffiliated organization.

## 6. DISCUSSION

This study aims to answer the question “what categories can be used to classify digital skills initiatives?”. To this end, a typology consisting of four categories (i.e. target group, digital skills, learning format, and sponsor) has been proposed and five archetypes, or typical examples, of digital skills initiatives were presented.

As the five archetypes have shown, there exists a great variety of different digital skills initiatives across a range of countries. As mentioned previously, a total of 40 different combinations of target group, digital skills, learning format, and sponsor are theoretically possible. However, a closer analysis of the archetype for each target group reveals that certain combinations are more likely to occur in practice.

For example, as shown in archetype 1, the general public can be relatively easily introduced to general digital skills using a resource – an online game, as in the example of *Digital Duel*. While it is certainly possible to provide the general public with specialized digital skills, it seems likely that there is a lesser need for specialized digital skills in the general public than in other target groups, such as adults or youth. The same applies to archetype 4, which targets seniors. General digital skills could be more needed than specialized digital skills among seniors. However, in contrast to seniors, who are probably more prone to respond to training than a resource, the general public can most likely be approached with a resource and training alike.

Similarly, archetypes 2, 3, and 5, which target educators, adults, and youth, respectively, provide specialized digital skills using training. There should be additional digital skills initiatives available for each of the three target groups to provide them with general digital skills, as needed. This could probably be accomplished equally well through training or a resource. Given the potential for demand generation in the three target groups, it seems more likely to find

vendor-affiliated organizations willing to sponsor digital skills initiatives for these target groups than for the general public or seniors.

In summary, the general public and seniors appear to lend themselves to be taught general digital skills using training and/or learning resources from a vendor-unaffiliated sponsoring organization. In contrast, educators, adults, and youth are more prone to be taught specialized digital skills using training and/or learning resources from a vendor-affiliated sponsoring organization.

### Contributions

The contribution of this research to practice and theory is three-fold. First, the proposed typology provides a common reference for researchers, practitioners, and policymakers when talking about digital skills initiatives. Up until this point, there has been no systematic effort to classify digital skills initiatives. The present work provides a valuable tool that can be easily used to classify digital skills initiatives and thereby make it clearer what one means when they talk about digital skills initiatives.

Second, the typology can be leveraged to encourage the development of new digital skills initiatives in so-called white spots. In this context, white spots are combinations of the categories in the typology that are currently missing from the landscape of digital skills initiatives in a given country or region. Policymakers could use the typology to identify such white spots and encourage the development of new digital skills initiatives by providing funding or other interventions.

Third, the typology lends itself to be used for the systematic evaluation of existing digital skills initiatives. One of the key prerequisites to a proper evaluation study is the definition of the scope of interventions to evaluate. The typology can be easily used to define what types of digital skills initiatives to include in a particular evaluation study. This, in turn, will enable researchers and policymakers to conduct evaluation studies and ultimately increase the understanding of ‘what works when’ in relation to digital skills initiatives.

### Limitations

Despite its significant contributions, the present study is not without limitations. Specifically, the typology was developed based on an iterative content analysis conducted by the two authors. It is possible that another typology with different categories could be developed using a different

methodology. Likewise, the typology and its archetypes were developed based on an analysis of the over 300 initiatives listed in the repository of the European Commission (n.d.). While this should provide a good basis for insights into digital skills initiatives in Europe, it is also a shortcoming as there might be other digital skills initiatives in Europe or in other regions with different political and socio-economic environments that would have led to the development of different categories and possibly a different typology.

### Future Research

Future research may wish to repeat the present study using the same data but a different methodology in order to establish whether or how a different typology might emerge. In addition, future research could identify other repositories of digital skills initiatives, preferably in countries that are different to the EU, and use these digital skills initiatives to refine or extend the typology and its archetypes. Lastly, the proposed typology should be used to guide the development of new digital skills initiatives or evaluation studies and thereby assess the usefulness of the proposed typology in the field.

## 7. CONCLUSION

The growing digital skills gap negatively affects all industries, workers, and societies. In response, hundreds of different digital skills initiatives have been launched in Europe in the past five years alone. The present study is the first to propose a typology of digital skills initiatives, which has been developed based on an analysis of over 300 digital skills initiatives listed in a comprehensive repository of the best digital skills initiatives as maintained by the European Commission. The proposed typology consists of four categories: target group (general public, educators, adults, seniors, youth), digital skills (general vs. specialized), learning format (training vs. resource), and sponsor (vendor-affiliated vs. vendor-unaffiliated). A subsequent analysis of five archetypes of the typology revealed that certain combinations of the four categories might be more likely to occur in practice. The proposed typology can be used by researchers and policymakers as a common reference when evaluating existing or developing new digital skills initiatives.

## 8. REFERENCES

Agrawal, S., De Smet, A., Lacroix, S., & Reich, A. (2020). To emerge stronger from the COVID-19 crisis, companies should start reskilling

their workforces now. *McKinsey Insights (Issue May)*.

Bailey, K. D. (1994). *Typologies and Taxonomies: An Introduction to Classification Techniques*. Thousand Oaks, CA: Sage.

Bawden, D. (2008). Origins and Concepts of Digital Literacy. In C. Lankshear (Ed.), *Digital literacies: concepts, policies and practices* (17-32). New York, NY

Blažic, B. J., & Blažic, A. J. (2020). Overcoming the Digital Divide with a Modern Approach to Learning Digital Skills for the Elderly Adults. *Education and Information Technologies*, 25(1), 259-279.

Broadband Commission for Sustainable Development. (2017). Working Group on Education: Digital skills for life and work.

Bughin, J., Staun, J., Andersen, J., Schultze-Nielsen, M., Aagaard, P., & Enggaard, T. (2017). Digitally-enabled automation and artificial intelligence: Shaping the future of work in Europe's digital front-runners.

Calvani, A., Cartelli, A., Fini, A., & Ranieri, M. (2008). Models and Instruments for Assessing Digital Competence at School. *Journal of E-Learning and Knowledge Society*, 4(3), 183-193

Carlson, T. (2020). Amazon to help 29 million people around the world grow their tech skills with free cloud computing skills training by 2025. Last accessed 8/01/2021 from <https://www.aboutamazon.com/news/workplace/amazon-to-help-29-million-people-around-the-world-grow-their-tech-skills-with-free-cloud-computing-skills-training-by-2025>

Davenport, J. H., Crick, T., & Hourizi, R. (2020, April). The Institute of Coding: A University-Industry Collaboration to Address the UK's Digital Skills Crisis. In *2020 IEEE Global Engineering Education Conference (EDUCON)*, 1400-1408.

European Commission (2020). Digital Economy and Society Index (DESI) 2020: Full Economic Analysis.

DiMaggio, P., Hargittai, E., Celeste, C., & Shafer, S. (2004). From unequal access to differentiated use: A literature review and agenda for research on digital inequality. In

- K. Neckerman (Ed.), *Social inequality* (pp. 355–400). New York, NY: Russell Sage Foundation
- Donoso, V., Pyżalski, J., Walter, N., Retzmann, N., Iwanicka, A., d’Haenens, L., & Bartkowiak, K. (2020). Report on Interviews with Experts on Digital Skills in Schools and on the Labour Market.
- European Commission (n.d.). Digital Skills & Jobs Coalition Initiatives Repository. Last accessed 5/01/2021 from <https://ec.europa.eu/digital-single-market/en/digital-skills-jobs-coalition-initiatives>
- European Commission (2021). ICT for work: Digital skills in the workplace.
- Hargittai, E., Hsieh, Y. P. (2012). Succinct survey measures of web-use skills. *Social Science Computer Review*, 30(1), 95–107.
- Iordache, C., Mariën, I., & Baelden, D. (2017). Developing Digital Skills and Competences: A Quick Scan Analysis of 13 Digital Literacy Models. *Italian Journal of Sociology of Education*, 9(1), 6-30.
- Nind, M., & Lewthwaite, S. (2020). A Conceptual-Empirical Typology of Social Science Research Methods Pedagogy, *Research Papers in Education*, 35(4), 467-487.
- Hoberg, P., Krcmar, H., & Welz, B. (2017). Skills for digital transformation. *IDT survey*.
- Leahy, D., & Wilson, D. (2014, July). Digital skills for employment. In *IFIP Conference on Information Technology in Educational Management* (pp. 178-189). Springer, Berlin, Heidelberg.
- Lintzeris, P., & Karalis, T. (2020). Towards an inclusive skills typology. *European Journal of Social Sciences Studies*, 5(1).
- Smith, B. (2020). Microsoft launches initiative to help 25 million people worldwide acquire the digital skills needed in a COVID-19 economy. Last accessed 8/01/2021 from <https://blogs.microsoft.com/blog/2020/06/30/microsoft-launches-initiative-to-help-25-million-people-worldwide-acquire-the-digital-skills-needed-in-a-covid-19-economy/>
- van Deursen, A.J.A.M., Helsper, E.J., Eynon, R. (2016). Development and validation of the Internet Skills Scale (ISS). *Information, Communication & Society*, 19(6), 804–823.
- van Dijk J.A.G.M., van Deursen A.J.A.M. (2014) Introduction. In: *Digital Skills*. Palgrave Macmillan’s Digital Education and Learning. Palgrave Macmillan, New York.
- van Laar, E., van Deursen, A. J., van Dijk, J. A., & de Haan, J. (2020). Determinants of 21st-century skills and 21st-century digital skills for workers: A systematic literature review. *Sage Open*, 10(1).
- Vieru, D., Bourdeau, S., Bernier, A., & Yapó, S. (2015, January). Digital competence: A multi-dimensional conceptualization and a typology in an SME context. In *2015 48th Hawaii International Conference on System Sciences* (pp. 4681-4690). IEEE.

**Editor’s Note:**

*This paper was selected for inclusion in the journal as an EDSIGCON 2021 Meritorious Paper. The acceptance rate is typically 15% for this category of paper based on blind reviews from six or more peers including three or more former best papers authors who did not submit a paper in 2021.*