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Short Paper

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Abstract

Massive Open Online Courses (MOOCs) are a scalable technology for upskilling but have primarily been successful with highly resourced and well-educated populations. In spite of their low barriers, people experiencing homelessness have not generally benefited from MOOCs. Work-Learn is a new model which utilizes action design research in order to provide individuals experiencing homelessness with the skills and scaffolding that will enable them to benefit from the digital economy. This Work in Progress reports the results of interviews and focus groups focusing on minimum hiring requirements, conducted with eight individuals who are in senior leadership, hiring managers, or training for web development or enterprise computing functions. Preliminary results suggest that after a baseline aptitude has been established, that person-position fit is the critical aspect to consider in instances of homelessness. The mainframe community may represent a unique opportunity due in part to its need for new talent.

Keywords: Workforce development; enterprise computing; action design research

Introduction

The ubiquity of digital solutions for bettering the lives of the general public is well-established. However, interactions and interventions with and for marginalized individuals, specifically individuals experiencing homelessness, remains under addressed. We suggest that this mismatch reflect the 'suboptimal outcomes' of creating technical systems at the expense of social systems (Leitch and Warren 2010). At the intersection of well-established technologies, such as online learning platforms, and under-researched groups is a knowledge and practice gap that is ripe to be addressed (Trauth et al. 2018). Of note, individuals experiencing homelessness are likely to face intersecting marginalization; for instance, they disproportionately identify as Black, Latino, and indigenous -- and are more likely to have a disability.

Work-Learn is a platform-based model for digital upskilling on tech and soft skills and scaffolding enabling learners to benefit from the digital economy (Hall et al. 2018, 2021). In the Work-Learn model, we align three critical issues using a socio-technical systems (STS) lens (Bostrom and Heinen 1977a, 1977b; Mumford 2006), namely (1) underemployed adults experiencing homelessness who are attending shelters, (2) enterprise computing training, and (3) MOOC persistence. Work-Learn approaches the upskilling problem as a formally arranged public-private partnership which engages learners, homeless shelters and staff, and industry partners. These partnerships ensure that learners have sufficient time, technology, and space to complete the learning modules. Through the shelter, learners also have access to other supportive

resources, such as food, clothing, and counseling. Furthermore, with successful completion, the industry partnerships allow for interviewing and job placement opportunities.

The research design interlocks the learning-by-doing aspects of apprenticeships and the small, targeted payments of paid crowd work to support extrinsically motivated persistence whereby learners earn small payments tied to achieving learning objectives. Adult learners are recruited in conjunction with a partnered emergency shelter and supportive housing system. Work-Learn hosts MOOCs covering Computational Thinking, the programming languages COBOL and Python, and soft skills. Industry partners submit non-proprietary near-to-real-world tasks common for entry-level positions that learners may respond to for pay, enabling the creation of a skills-based portfolio-style resume. Learners are also paid to collaborate on and peer-review these responses, mimicking and building the soft skills of a collaborative team environment. With successful course completion learners are supported in finding and passing interviews for paying positions, facilitating a transition to financially sustainable careers.

From an STS lens, a successful upskilling program embeds learner success into business-imperative learning objectives (Wang et al. 2010). Students must be able to successfully navigate and understand the materials. Hiring managers must also have confidence in the corresponding credential of the program to seriously consider interviewing or hiring a candidate. This is the focal point of this Work in Progress. The overarching research challenge is generalizability of the solution; careful design is required to isolate the effects of interest such that our findings on the minimum requirements for upskilling and later hiring of individuals experiencing homelessness is a practically and theoretically robust and valuable contribution (Baskerville et al. 2015). Equally necessary is understanding who is and isn't well-addressed by the proposed model (Trauth 2017). Accordingly, the project seeks to extend the knowledge basis about online and career technical education by asking:

What design affordances need to be implemented in a training program to support sustainable upskilling in contexts of homelessness?

The paper is structured to address the theoretical and empirical literature basis upon which the Work-Learn model is built. It then details the methods and results of a series of interviews and focus groups with senior leadership and hiring managers from seven companies in the mainframe and web development sectors. We highlight several unexpected results pertaining to the minimum criteria for the hiring and retention of non-traditional workforce pipelines, discuss the implications thereof, and conclude with an outline of coming research.

Theoretical Foundation and Background

On Socio-technical Systems in Information Systems Theory and Practice

Socio-technical systems is a theoretical lens which views social and technical aspects of information systems as co-equal (Mumford 2006). STS is a long-established IS paradigm to address the intersection between *people, tasks and processes, structure, and technology* (Bostrom and Heinen 1977a, 1977b). Specifically, STS centers humans in technological processes via participatory design or action research for successful Artefact design (Bostrom and Heinen 1977a; Scacchi 2004). Given its origins in bettering lives of factory workers (Scacchi 2004), STS has a natural fit with social justice-oriented artefact development and evaluation (Mumford 2006). Numerous contemporary STS works rather concentrate on system development with and for 'standard' populations (see e.g., (Wang et al. 2010) for a successful online education use case); the reasons for this could be many but the unsolved aspect of engaging novice users is a likely driver. When the end-user is ill-defined, heterogenous, or lacking in foundational knowledge, participatory design remains challenging as the output will unlikely yield a satisfactory IS design or artefact (Scacchi 2004). This becomes a chicken-egg problem and a core knowledge gap for individuals at the margins of the digital divide. Without experience they cannot engage as equals in IT and IS development; without their perspectives IS and IT artefacts will continue to center other, more accessible user groups. A likely method to overcome the novice user problem could be found in the QUICKethics framework, which scaffolds the requirements definition phase of IS system development in participatory design scenarios (Leitch and Warren 2010; Mumford 1997). Originally intended to 'create and maintain management interest' (Leitch and Warren 2010), QUICKethics creates a mechanism that enables meaningful participation structures in resource constrained scenarios.

An Intractable Problem: Homelessness

Homelessness is a public policy conundrum. In an interview with *The New York Times*, Steven Banks, former commissioner of New York City's Department of Social Services, described homelessness "[…] as the failure of every other social system a government can provide."[1] Popular discourse tends to treat homelessness as an accumulation of individual factors (poor life choices, mental illness, addiction) (Gould and Williams 2010; Pavlakis 2021), applying a deficit perspective whereby the individual is at fault for their circumstances. This perspective tends to ignore the limited supply of local affordable housing (Buckner 2014), as well as the role of systemic discrimination in shaping individual outcomes (Walsh et al. 2016). A more holistic lens considers exposure to adverse life events as a barrier to exiting homelessness.

There is some evidence that the age at which an individual first experiences homelessness is linked to the number of adverse experiences they will be exposed to over time, which is predictive of long-term shelter need (Brown et al. 2016; Caton et al. 2005). There is limited research on educational interventions with adults experiencing homelessness, though research on child and youth homelessness may provide insights. Homelessness in childhood and young adulthood can hinder educational attainment (Miller 2011; Pavlakis 2018) and place individuals at risk for unemployment, poverty, and continued homelessness in their later years. Youth who interfaced with the foster care system are also at increased risk of homelessness after aging out (Villagrana et al. 2020).

There is an urgent need for training opportunities that promote sustainable financial security (Committee on STEM Education 2018), but there are few research-backed responses to this need. Meaningful employment is one key to creating and maintaining financial stability (Morrell-Bellai et al. 2000) and high well-being and social connectivity (Miller 2011; Walsh et al. 2016) but not all employment provides these benefits. Estimates suggest that over 40% of people experiencing homeless have jobs or have worked in the past quarter ("Employment and Homelessness" 2009). These are the working poor, and they generally suffer from a skill-to-market mismatch, in which a person does not have the skills needed by the local workforce for stable, living wage employment. Skill-to-market mismatches and/or low credential attainment is another risk factor known to contribute to homelessness (Gould and Williams 2010).

Individuals who are caught in this gap face obstacles far more substantial than the general public in training for meaningful employment that offers sustainable pay (Hall et al. 2018). In addition to the more obvious challenges, such as financial hurdles in accessing professional clothing and transportation to and from interviews or jobs, they may also face a lack of agency in daily scheduling. Hourly employees tend to have limited control over their work shifts, and coordinating with various social and emergency services is time consuming (Brown et al. 2016), leaving many people without the ability to invest in long-term, high-skill training opportunities. The training opportunities that fit well with a frequently changing schedule are generally for service-sector or labor-intensive jobs. High-skill training is often time-intensive, personally and financially costly, and requires a regular time commitment. Individuals without high-demand skills or training, or who are currently in the service sector and are experiencing homelessness will often have an atypical resume, which is another hurdle for job applicants (Brown et al. 2016). In a competitive job market, these barriers can become almost insurmountable, making it difficult to exit homelessness.

The Coming COBOL Crisis

A needs assessment with five IT hiring managers established that the technology sector has a forward- and backward-facing skill gap (Hall et al. 2018). The forward-facing gap represents the struggle of companies outside of the tech industry that are in a race for talent and are unable to capitalize on cutting edge programming languages and technologies for enabling strong business practices. The backward-facing gap is the challenge of many industries: mainframe systems.

It is widely acknowledged that the demand for talented technologists exceeds the number of graduates every year (Holdren and Lander 2010). Retirees continue to outnumber new entrants, who often must be trained on mission-critical internal processes and systems before they are fully utilized. In the case of mainframe systems, the gap is even more critical as to date only an estimated one in four universities teach COBOL or similar languages (Roggio et al. 2003) and many mainframers are retired or retiring (Allyn 2020).

[1] The Man Who Fought Homelessness and Won (Sort Of) - The New York Times (nytimes.com)

Though frequently denounced as dead or dying, COBOL is in fact largely still intact across industries (Ovide 2022)—a 2022 report found that there are an estimated 800 billion lines of code running on production systems and in daily use (Microfocus 2022). Industry reports point to no strong plans in place to replace COBOL-running systems across sectors (Ensono 2017; Hartman 2019; IBM 2019), nor for keeping a viable development and/or maintenance workforce active. This presents a problem when systems run into glitches or need updates, and companies or government agencies no longer have COBOL experts on hand. The lack of COBOL programmers most recently made news during the COVID-19 pandemic, when American stimulus funds required US-state governments to quickly modify existing social security programs (Allyn 2020). The COBOL problem becomes a slow-moving crisis when one considers eye-popping statistics like:

- 80% of in-person bank transactions and 95% of all ATM swipes are processed with COBOL (Hartman 2019); Americans interact with COBOL 13 times per day, every day (IBM 2019).
- As late as 2014, there were 200 times more transactions processed daily by COBOL applications than there were Google and You Tube searches daily (Lindoo 2014).
- The average COBOL programmer age is between 45 and 55 (Ensono 2017; Hartman 2019).

The highlighted challenges also present an opportunity. COBOL is relatively easy to learn, and there is a definite demand for COBOL skills. Our needs analysis suggests that technologists who have gone through traditional educational paths have the perception that COBOL is an obsolete language, and that learning COBOL might signal a lack of in-demand skills (Hall et al. 2018). Thus, recruiting a non-traditional workforce base may be a highly effective method to address the lack of prepared workers.

Theory-ingrained Artefact

Even though MOOCs are widely available, individuals at the margins of the digital divide rarely benefit from them. Much of what is known about successful use of online learning tools is based on already highly-educated populations (Hall et al. 2021). Global research on MOOCs consistently finds low completion rates (under 10%) (Kizilcec et al. 2017). Researchers have specifically linked non-completion and affluence in their review of MOOCs (Reich and Ruipérez-Valiente 2019). An open question to be addressed is the degree to which non-completion attributes found in literature based mainly on well-off subgroups holds for adults experiencing homelessness. Qualitative work focusing on MOOC non-completers suggests that a primary reason is that the expected value of the content is lower than the resources (time and other costs) required for completion (Liyanagunawardena et al. 2014). Work-Learn addresses the value-add problem by pairing intrinsic and extrinsic motivation strategies. We hypothesize that, in contexts of homelessness, the additional value-add of paid learning will buttress learners' intrinsic motivation of gaining financially stable careers, resulting in a higher completion rate than the generally achieved 10%.

The research effort behind this hypothesis has value regardless of a positive or negative finding; if supported, the findings could inform upskilling programs broadly speaking. If our data is consistent with the global research findings of MOOCs being a tool for <10% of the population more fundamental research into the design and delivery of these platforms is required as it suggests that the specific affordances of MOOCs (or their corresponding completion credentials, as pointed out in (Reich and Ruipérez-Valiente 2019)) are likely driving the low completion rate.

Methodology

We apply Sein and colleague's action design research framework (2011), outlining the stages and principles of action design research and how the Work-Learn project responds to the requirements (Table 1).

Stage	Principle	Work-Learn Methodology
Problem Formulation	Practice-Inspired Research	- Forward and backwards facing talent gap in technology job market. - Labor market – job credential mismatch increases barriers to financially stable careers for individuals experiencing homelessness. - Lack of research-backed solution to close the gap. *Knowledge Gap 1*: Suitability of IT Artefact (MOOC) to task. *KG 2A:* Validation of proposed model. *KG 2B:* Participatory design with heterogenous novice users.

		KG3: Universal design for MOOCs.
	Theory-Ingrained Artefact	- Reduce the financial gap between lesser-resourced communities and traditional learners by paying students for achieved learning outcomes. *Problem Structure:* MOOCs are designed inaccessibly for extremely marginalized users. *Solution Possibilities:* Apply STS approach to redesign online learning in high demand critical technology functions *Guide Design:* Establish minimum standards for extremely marginalized users for artefact use and curricular materials.
Building, Intervention, and Evaluation	Reciprocal Shaping	Align MOOC, learners, and hiring managers with job role expectations via iterative interviews, focus groups, and usability testing.
	Mutually Influential Roles	*Research Team:* Theorize, develop, and implement artefact; create and analyze research environment and corresponding data; iterative improvements driven by Management and Learners. *Management:* Inform and iterate on minimum hiring requirements; shepherd and mentor learners through tech-industry hiring processes; expand partnership network. *Learners:* Active participation in design testing and learning activities; mutual support and review of cohort partners.
	Authentic and Concurrent Evaluation	- Formative, Artefact-driven iterations are instantiated via established feedback mechanisms from management and learners. - Summative evaluation driven by research team based on observation data on success and barriers.
Reflection and Learning	Guided Emergence	Potential pivot points including: the curriculum and expected learning outcomes; soft-skills training; readability and aesthetics; on- vs off-line learning; renumeration; cohort recruitment; partner network recruitment; and job market size.
Formalization of Learning	Generalized Outcomes	- Research validating use of IT in social justice programming. - We hypothesize that the extrinsic value-add of paid learning will scaffold the intrinsic motivation of gaining financially stable careers. - Positive finding; If effective, the findings could inform upskilling programs broadly speaking. - Negative finding: If pass rate is consistent with 10% global benchmark, more fundamental research into the design and delivery of these platforms is required as it suggests that the specific affordances of MOOCs are likely driving their low completion rate.

Table 1. Action Design Research Methodology in a Work-Learn Context

The Work-Learn model assumes *tasks* have an *n-to-n* relationship between two groups of people; *hiring managers* who wish to verify that *learners* have the necessary skills to succeed in an entry-level position. Thus, two sets of analyses need to be performed: one considering the needs of company representatives on minimum requirements for hiring our learners, and one considering the usability and structure of the learning platform technology. We first concentrate on the hiring side as the necessary affordances from this perspective guide the structure of the learning materials. Like this, the Work-Learn model supports skills-based outcomes while respecting the time and commitment resources of the learners. Forthcoming iterative usability tests of the learning content and IT artefact by adults experiencing homelessness will gauge the strengths and weaknesses of the materials and artefact. Usability testing will follow the resource preserving QUICKethic guidelines (Mumford 1997).

Semi-structured focus groups (Morgan 2003) and interviews (Myers and Newman 2007) with industry partners are being conducted, with concurrent data collection and analysis. Completed transcripts have been open coded and categorized to aid in the development of emerging themes. Interviews and focus groups were guided by a protocol and conducted virtually and recorded over Zoom (Roberts et al. 2021).

Table 2 outlines the participants of the completed focus groups and interviews; all names are pseudonyms. All interviewees are currently employed in a technology-based industry which either relies on mainframe technologies, web development, or both. We concentrate on senior leadership, hiring managers, and in-house technical trainers. Hiring managers and trainers are closest to new hires in terms of the day-to-day skills needed; senior leadership enables Work-Learn to integrate hiring strategy perspectives.

Participant Pseudonym	Modality	Role	Tenure	Gender
Amy	Interview I	Senior Leadership	>30 years	Female
Brian	Focus Group I	Hiring Manager	>10 years	Male
Calvin		Training	>20 years	Male
Diana		Hiring Manager	>10 years	Female
Elizabeth		Training	>10 years	Female
Fiana	Interview II	Senior Leadership	>20 years	Female
Greg	Focus Group II	Hiring Manager	>20 years	Male
Hans		Senior Leadership	>40 years	Male

Table 2. Focus Group and Interview Participants

Interviews and focus groups deeply probe the differences that our industry partners expect between 'standard' applicants and participants in our cohorts; address the minimum conditions that must be present in order to consider a candidate for placement; and iteratively propose and evaluate design solutions for co-creation. While considerable research exists addressing job readiness (Conley 2012) labor markets are hardly a meritocracy, a reality which literature and practice has long recognized (Bertrand and Mullainathan 2003; Kline and Walters 2021). Individuals experiencing homelessness are particularly susceptible to job market exclusion due to perceived fit of applicant to position and team, subtle and overt biases and discrimination, and fear of unknown/untested credentials. The interview and focus group process allows the research team to co-create the conditions needed for successful on-boarding with senior leadership and hiring managers. This in turn helps assure that the technology better scaffolds learners.

After hiring, continuing interviews and focus groups concentrating on direct supervisors and post-program learners will elucidate successes and barriers in hiring and retention of these newly-minted apprentices whose education and job history typically otherwise precluded inclusion. Within the Work-Learn consortium is a continuing education process whereby learners can continuing accessing materials to refresh knowledge on hard or soft skills. Continuing data collection allows the model and artefact to be fine-tuned across stakeholder groups, better matching task-level expectations and enabling the newly minted apprentices to be firmly embedded in the environmental structure of their new companies.

What are the Minimum Conditions for Learner Success?: Preliminary Results

Three major themes emerged. They concern aspects of mainframe training, hiring trends in IT, and learner attributes. We address these sequentially.

Minimum Skills for Entry-level Mainframers

What is the minimum readiness level for a paid internship or entry-level position? Especially in the case of the chronically distressed mainframe talent pipeline, participants concentrated on the prognostic abilities of soft skills for discerning hidden talent. Participants highlighted curiosity, communication skills, and transfer skills. For instance, Calvin (see Table 2), suggested that to successfully integrate into the mainframe pipeline, "it is as much about culture, as it is the technology" – and others echoed similar sentiments. This relatively frank positioning of fit before analytical skills is unexpected both compared to readiness metrics of traditional learners (Holdren and Lander 2010) and because of the critical, backbone-esque nature many mainframe systems play in enterprise delivery. This links directly to the next theme.

New Talent Pipelines to Increase Diversity

All participants also agreed that the mainframe community is mutually supportive of itself. Once accepted into the community, it was largely the view of participants that new hires would find a supportive environment. With that said, Greg and Hans highlighted the clubby elements of many mainframe departments and "the old boy's network" that exists. Depending on individual context, this could reflect a barrier to getting in the door, but an asset to those who do get in. Amy, Fiana, Brian, Calvin, Diana, and Elizabeth felt that, compared to the traditional applicant pool, there could be more excitement and awareness around a mainframe career from non-traditional hires. Greg, Hans, Amy and Fiana reported that there would be some need to deviate from automated screening processes to recruit non-traditional employees. This includes the initial application function as well as the expected need for additional support structures like mentoring to retain new hires.

Finally, a remarkable lack of attention was paid to the prospective life histories of the learner cohorts in terms of expected challenges. When directly addressed participants largely subsumed the point under the need for industry to broaden its aperture in recruiting from new, diverse talent pipelines.

Learner Attributes

When asked about ideal candidates, aptitude and resilience were the two most frequently discussed attributes. To successfully upskill, 'It's not about being smart' (Calvin); the needed skills are knowing how to think about problems and how to work through problems. Compatibility between learner and employer was also frequently addressed, as well as networking to broaden their horizons towards career paths (e.g., app modernization and QA) or for gaining community support.

Strongly linked to soft skills, these hard to quantify attributes may also represent coded language. This links directly to a threat to validity of the Work-Learn model. The demonstration of skills via a portfolio is a cornerstone aspect of the Work-Learn model, but it is unclear if aptitude and demonstrated skills are a near enough proxy. Aptitude is typically demonstrated with i.e., assessment center testing and spatial reasoning tests which do not feature in Work-Learn's model. It is also an open question how to additionally demonstrate these attributes such that the cohorts are not excluded from the workforce. Further research to disentangle the meaning and demonstration of aptitude, resilience, and compatibility is ongoing.

Conclusion and Ongoing Research

This Work in Progress paper presents the first results of interviews and focus groups addressing the artefact design requirements that would be required of a training program focusing on upskilling adults experiencing homeless. We propose to address two chronic issues, homelessness and the mainframe talent pipeline, via a well-established learning technology. Work-Learn implements a skills-forward demonstration of ability in paying learners to create near-to-real-world portfolios of successfully completed programs, QA tasks, and peer code review. Our expected contribution at the conclusion of the project is a theoretically and practically valid and robust set of design principles modelled on the methodologies of (Mumford 2006; Sein et al. 2011) for successful workforce development projects in critical technology sectors.

Initial results suggest that a skills-forward design is useful for hiring managers but that once a baseline aptitude is established, learners need to concentrate on establishing person-position fit. Perhaps due to the hiring pipeline or unique structural factors, the mainframe sector represents a distinct opportunity to recruit and retain non-traditional workers. The stability of the mainframe career pathway is assured for the near future as there remain no strong replacement plans across industry (Ensono 2017; Microfocus 2022), and the positions are financially secure compared to other sectors such as service or labor (IBM 2019; Ovide 2022).

Given the prevalence of the deficit perspective of individual fault in experiencing homelessness, life histories were expected to be a substantial entrance barrier. However, our analysis to date suggests that outside of aptitude and person-position fit, there was expressed openness to hiring those who have experienced homelessness who wish to upskill into the tech workforce. While more research is needed, this is highly encouraging for the success of the overall project.

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References

Allyn, B. 2020. "'COBOL Cowboys' Aim To Rescue Sluggish State Unemployment Systems," *National Public Radio (NPR)*. (https://www.npr.org/2020/04/22/841682627/cobol-cowboys-aim-to-rescue-sluggish-state-unemployment-systems.).

Baskerville, R. L., Kaul, M., and Storey, V. C. 2015. "Genres of Inquiry in Design-Science Research," *MIS Quarterly* (39:3), pp. 541–564. (https://www.jstor.org/stable/26629620).

Bertrand, M., and Mullainathan, S. 2003. "Are Emily and Greg More Employable than Lakisha and Jamal? A Field Experiment on Labor Market Discrimination," No. 9873, *NBER*. (http://www.nber.org/papers/w9873).

Bostrom, R., and Heinen, J. S. 1977a. "MIS Problems and Failures: A Socio-Technical Perspective. Part I: The Causes," *MIS Quarterly* (1:3), pp. 17–32. (https://www.jstor.org/stable/248710).

Bostrom, R., and Heinen, J. S. 1977b. "MIS Problems and Failures: A Socio-Technical Perspective, Part II: The Application of Socio-Technical Theory," *MIS Quarterly* (1:4), pp. 11–28. (https://doi.org/10.2307/249019).

Brown, R. T., Goodman, L., Guzman, D., Tieu, L., Ponath, C., and Kushel, M. B. 2016. "Pathways to Homelessness among Older Homeless Adults: Results from the HOPE HOME Study," *PLOS ONE* (11:5), Public Library of Science, p. e0155065. (https://doi.org/10.1371/JOURNAL.PONE.0155065).

Buckner, J. C. 2014. "The Why and the Who of Family Homelessness," *Supporting Families Experiencing Homelessness: Current Practices and Future Directions*, Springer, New York, NY, pp. 3–21. (https://doi.org/10.1007/978-1-4614-8718-0_1).

Caton, C. L. M., Dominguez, B., Schanzer, B., Hasin, D. S., Shrout, P. E., Felix, A., McQuistion, H., Opler, L. A., and Hsu, E. 2005. "Risk Factors for Long-Term Homelessness: Findings from a Longitudinal Study of First-Time Homeless Single Adults," *American Journal of Public Health* (95:10), pp. 1753–1759. (https://doi.org/10.2105/AJPH.2005.063321).

Committee on STEM Education. 2018. "Charting a Course for Success: America's Strategy for STEM Education," *National Science and Technology Council* (December), pp. 1–35. (http://www.whitehouse.gov/ostp.).

Conley, D. T. 2012. "A Complete Definition of College and Career Readiness," *IN EPI Center (Ed.)*.

"Employment and Homelessness." 2009. (https://www.nationalhomeless.org/factsheets/Employment.pdf).

Ensono. 2017. "The Mainframe Talent Drain." (https://www.ensono.com/resources/white-papers/mainframe-talent-drain/).

Gould, T. E., and Williams, A. R. 2010. "Family Homelessness: An Investigation of Structural Effects," *Journal of Human Behavior in the Social Environment* (20:2), pp. 170–192. (https://doi.org/10.1080/10911350903269765).

Hall, M., Friend, M., and Krause, M. 2018. "Micro-Internships on the Margins," in *Universal Access in Human-Computer Interaction. Virtual, Augmented, and Intelligent Environments*, Springer, pp. 486–495. (https://link.springer.com/chapter/10.1007/978-3-319-92052-8_38).

Hall, M., Pavlakis, A. E., and Friend, M. 2021. "Work-Learn: Necessary and Sufficient Conditions for Upskilling Homeless Adults with Entry-Level Programming and Tech Sector Skills," *ICIS 2021 TREOs*, TX. (https://aisel.aisnet.org/treos_icis2021/53).

Hartman, T. 2019. "Cobol Blues," *Reuters*. (http://fingfx.thomsonreuters.com/gfx/rngs/USA-BANKS-COBOL/010040KH18J/index.html).

Holdren, J. P., and Lander, E. 2010. "Engage to Excel: Producing One Million Additional College Graduates with Degrees in Science, Technology, Engineering, and Mathematiccs," Washington D.C. (http://www.whitehouse.gov/sites/default/files/microsites/ostp/pcast-engage-to-excel-v11.pdf).

IBM. 2019. "The Hottest Jobs Are Growing in the Quiet Corners of Core Technology." (https://www.ibm.com/case-studies/ibm-academic-initiative-systems-hardware-mainframe-skills).

Kizilcec, R. F., Saltarelli, A. J., Reich, J., and Cohen, G. L. 2017. "Closing Global Achievement Gaps in MOOCs," *Science* (355:6322), pp. 16–18. (https://doi.org/10.1126/science.aag2063).

Kline, P., and Walters, C. 2021. "Reasonable Doubt: Experimental Detection of Job-Level Employment Discrimination," *Econometrica* (89:2), John Wiley & Sons, Ltd, pp. 765–792.
Leitch, S., and Warren, M. J. 2010. "ETHICS: The Past, Present and Future of Socio-Technical Systems Design," in *IFIP AICT* (Vol. 325), pp. 189–197.
Lindoo, E. 2014. "Bringing COBOL Back into the College IT Curriculum," *Journal of Computing Sciences in Colleges* (30:2), pp. 60–66.
Liyanagunawardena, T. R., Parslow, P., and Williams, S. 2014. "Dropout: MOOC Participants'perspective," in *EMOOCs 2014, the Second MOOC European Stakeholders Summit*, Lausanne, CH. (https://centaur.reading.ac.uk/36002/).
Microfocus. 2022. "COBOL Market Shown to Be Three Times Larger than Previously Estimated in New Independent Survey." (https://www.microfocus.com/en-us/press-room/press-releases/2022/cobol-market-shown-to-be-three-times-larger-than-previously-estimated-in-new-independent-survey).
Miller, P. M. 2011. "A Critical Analysis of the Research on Student Homelessness," *Review of Educational Research* (81:3), pp. 308–337. (https://doi.org/10.3102/0034654311415120).
Morgan, D. L. 2003. "Focus Groups," *Annual Review of Sociology* (22), Annual Reviews 4139 El Camino Way, P.O. Box 10139, Palo Alto, CA 94303-0139, USA , pp. 129–152.
Morrell-Bellai, T., Goering, P., and Katherine, B. 2000. "Becoming and Remaining Homeless: A Qualitative Investigation," *Issues in Mental Health Nursing* (21:6), pp. 581–604. (https://doi.org/10.1080/01612840050110290).
Mumford, E. 1997. "Requirements Analysis for Information Systems," in *Systems for Sustainability*, Springer, Boston, MA, pp. 15–20. (https://doi.org/10.1007/978-1-4899-0265-8_3).
Mumford, E. 2006. "The Story of Socio-Technical Design: Reflections on Its Successes, Failures and Potential," *Information Systems Journal* (16:4), John Wiley & Sons, Ltd, pp. 317–342.
Myers, M. D., and Newman, M. 2007. "The Qualitative Interview in IS Research: Examining the Craft," *Information and Organization* (17:1), pp. 2–26. (https://doi.org/10.1016/j.infoandorg.2006.11.001).
Ovide, S. 2022. "The Latin of Software Code Is Thriving," *The New York Times*, New York City. (https://www.nytimes.com/2022/07/06/technology/cobol-jobs.html).
Pavlakis, A. E. 2018. "Poverty and Student Homelessness at the Metropolitan Margins: Sensemaking among School and Community Leaders in a Growing Suburb," *Teachers College Record: The Voice of Scholarship in Education* (120:11), pp. 1–58. (https://doi.org/10.1177/016146811812001104).
Pavlakis, A. E. 2021. "At the Nexus of Two Terrains: A Critical Ethnographic Case Study of an Afterschool Center for Homelessness," *International Journal of Qualitative Studies in Education* (34:2), Austin, TX: Routledge, pp. 125–144. (https://doi.org/10.1080/09518398.2020.1735558).
Reich, J., and Ruipérez-Valiente, J. A. 2019. "The MOOC Pivot," *Science* (363:6423), American Association for the Advancement of Science, pp. 130–131. (https://doi.org/10.1126/SCIENCE.AAV7958).
Roberts, J. K. K., Pavlakis, A. E., and Richards, M. P. 2021. "It's More Complicated Than It Seems: Virtual Qualitative Research in the COVID-19 Era," *International Journal of Qualitative Methods* (20), SAGE PublicationsSage CA: Los Angeles, CA. (https://doi.org/10.1177/16094069211002959).
Roggio, R. F., Comer, J. R., Worth, F., and Colton, D. 2003. "IS Programs Become Accredited : COBOL in Crisis," *Information Systems Education Journal* (1:15).
Scacchi, W. 2004. "Socio-Technical Design," *The Encyclopedia of Human-Computer Interaction*, (W. S. Bainbridge, ed.), Berkshire Publishing Group. (http://www.ics.uci.edu/~wscacchi).
Sein, M. K., Henfridsson, O., Purao, S., Rossi, M., and Lindgren, R. 2011. "Action Design Research," *MIS Quarterly* (35:1), pp. 37–56. (https://doi.org/10.2307/23043488).
Trauth, E. 2017. "A Research Agenda for Social Inclusion in Information Systems," *The DATA BASE for Advances in Information Systems* (48:2), pp. 9–20.
Trauth, E., Joshi, K. D., and Yarger, L. K. 2018. "ISJ Editorial," *Information Systems Journal* (28:6), John Wiley & Sons, Ltd, pp. 989–994. (https://doi.org/10.1111/ISJ.12201).
Villagrana, K. M., Mody, E. H., Lawler, S. M., Wu, Q., and Ferguson, K. M. 2020. "Educational Outcomes for Homeless Young Adults with and without a History in Foster Care," *Children and Youth Services Review* (116:January). (https://doi.org/10.1016/j.childyouth.2020.105153).
Walsh, C. A., Lorenzetti, L., St-Denis, N., Murwisi, P., Lewis, T. R., and Lewis, T. R. 2016. "Community Voices: Insights on Social and Human Services from People with Lived Experiences of Homelessness," *Review of Social Sciences* (1:2), LAR Center Press, pp. 27–41. (https://doi.org/10.18533/rss.v1i2.7).
Wang, J., Solan, D., and Ghods, A. 2010. "Distance Learning Success-a Perspective from Socio-Technical Systems Theory," *Behaviour and Information Technology* (29:3), pp. 321–329.