The Past Decade View of the IS Workforce and Gender Literature: A Systematic Review

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Abstract

Due to the demand of Information Systems (IS) professionals, gender in the IS workforce (ISWF) has been a continuing research topic. Despite these efforts, there remains a need for a greater understanding of gender theory and an individual's decision to pursue, succeed, and obtain promotion within the IS workforce. This research uses a systematic literature review process to critically examine the research from the last decade on gender and the ISWF. A conceptual model, ISWF Multi-Factor Model, is introduced combining IS and vocational guidance theories to categorize the focus of research identified in the systematic literature review into four areas: Individual, Workforce, Individual Influences, and Environmental Influences. The findings of this study outline the current state of gender and ISWF research and are relevant to research and practice.

1. Introduction

The acceleration of technology adoption and demand for skilled Information Systems (IS) professionals has never been higher than the past decade. According to the Occupational Outlook Handbook, an online database developed and maintained by the U.S. Bureau of Labor Statistics, employment in computer and information technology occupations is projected to grow 11 percent over the next decade, much faster than the average for all occupations and are expected to add around 531,200 new jobs [1]. These jobs include computer and information research scientists, computer network architects, computer programmers, computer support specialists, computer systems analysts, database administrators, information security analysts, network and computer systems administrators, software developers, web developers, and digital designers.

Not only is there a growing demand for information system professionals, but the average pay is also much higher than in other industries. For example, in May 2020, the median annual wage for computer and information technology occupations was $91,250, compared to $41,950 for other occupations [1].

Despite rising salaries, employers struggle to find qualified individuals to fill vacant positions due to a shortage of skilled professionals [2]. Furthermore, fewer women are pursuing degrees in this field than in the past. In 2019, only 21% of Computer and Information Sciences bachelor's degree recipients were women, compared to 37% in 1985, according to data from the National Center for Women & Information Technology (NCWIT). Additionally, while 57% of all employed adults in the U.S. were women, only 26% of computing jobs were held by women [3].

One of the main theories concerning women in Information Systems (IS) and the gender gap is the Individual Differences Theory, which is concerned with gender group biases women encounter [4]. This theory was developed by Eileen Trauth in 2013 through a comprehensive search of peer-reviewed journal entries in an effort to identify research based in gender theory and gender influences within the IS workforce (ISWF) [5].

The Trait and Factor Theory was one of the earliest theories to explain how individuals make career choices and was introduced by Frank Parsons in 1909 [6]. This foundational theory continues to dominate career counseling practices today [7].

Extending the examination of gender and diverse minority group segments of IS environments and workforce are identified as under-researched topics [5], [8]. The purpose of this paper is to explore the state of gender in the ISWF by answering the research question, *"What is the current state of gender research in IS workforce literature?"* The study conducts a systematic literature review of IS Journals using research articles from the last decade and use constructs from both the Individual Differences Theory and the Trait and Factor Theory for the conceptual model.

The remainder of this study is organized as follows: Section 2 discusses the theoretical background of the

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study, Section 3 discusses the research methodology, Section 4 outlines the study results, Section 5 presents a discussion of the research findings and study limitations, and Section 7 concludes with implications for future research and practice.

2. Background

The Individual Differences Theory is an IS theory that helps explain women's under-representation in the IS field [9] and is based on the following three constructs.

1) Individual identity: personal demographics including age, race, nationality, and socio-economic class, and career items, including the industry in which one works and the type of IT work engaged in.

2) Individual influences: educational background, personality traits and abilities, as well as personal influences, such as mentors, role models, and life experiences.

3) Environmental Influences: the geographic region in which one lives, cultural influences, economic influences, policy influences, and infrastructure influences [10].

This theory addresses the difference between individuals of an identified group instead of differences in the dichotomous context of gender. In addition, it increases the comprehension of individual and environmental influences that reduce greater participation in the IS industry by women [11].

In 1908, Frank Parsons, commonly referred to as the "father of vocational guidance," introduced the Trait and Factor Theory to assist others in selecting occupations that could lead to a productive and successful life [6].

This career development theory is based on the following three broad factors.

1) A clear understanding of oneself: aptitude, abilities, interests, ambitions, resources, limitations, and their causes.

2) A knowledge of the requirements and on compensation, opportunities, and prospects in different lines of work.

3) True reasoning on the relations of the individual and workforce factors [6, p. 5].

Although the Trait and Factor Theory has been criticized over the years, it has influenced the work of other popular career theories [12] and continues to dominate career counseling practices today [7]. A study conducted in 2016 found that using the Trait and Factor Theory significantly increased high school students' career maturity and their ability to make a career choice [13].

Merging the constructs of a career development theory with those of an IS theory can broaden the understanding of gender research in the IS workforce. For this reason, we propose the following conceptual model, the ISWF Multi-Factor Model, combining the unique constructs of Individual Differences Theory developed by Trauth and the Trait and Factor Theory developed by Parsons, to explore the research question, *"What is the current state of gender research in IS workforce literature?"* and classify the literature in our review (Figure 1). Due to their similarities, Trauth's construct "Individual Identify" was integrated with Parson's construct "Individual" to form the Individual/Individual Identity category in our conceptual model.
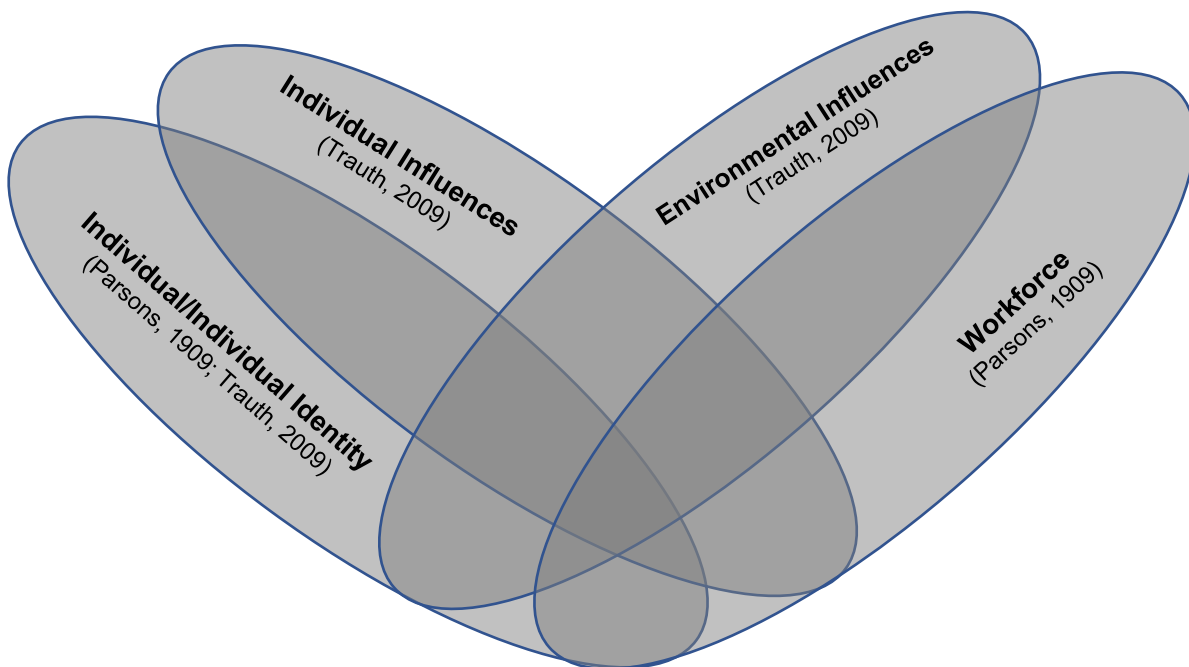
Figure 1. ISWF Multi-Factor Model

3. Methodology

The Kitchenham & Charters [14] guidelines for systematic literature reviews (SLR) were the guiding direction to answer the research questions of our study. The guidelines provided an evidence-based approach to document and report evidence from the extant literature. Planning, conducting, and reporting are the critical activities identified for performing systematic literature reviews [14] described below.

3.1. Review Planning

The planning stage requires the authors to identify and define the different aspects of the research objective and conduct a preliminary search to confirm that the questions posed have not been answered in prior reviews. Therefore, an essential part of this process was to define the research question posed in the introduction. Trauth's literary analysis informed the search strategy journal and keyword selection [5]. Articles were selected from the Association of Information System's Senior Scholars Basket of Eight Journals, which include European Journal of Information Systems, Information Systems Journal, Information Systems Research, Journal of the Association for Information Systems, Journal of Information Technology, Journal of MIS, Journal of Strategic Information Systems and MIS Quarterly, The other journals included were: The Database for Advances in Information Systems, Information & Management, Information & Organization, Information Technology & People, Journal of Information, Communication, and Ethics in Society, International Journal of Technology and Human Interaction. The criteria for selecting articles were the appearance of the word "gender" in the title, abstract, or keywords that were published in English in the past decade (2011 to 2020). For inclusion in the final review, articles must be research studies and focus on the theme of ISWF.

3.2. Review Process

The process to select the relevant papers followed these steps:
1) All the returned studies were exported to library management software – Zotero and duplicates were removed.

2) The resulting articles were screened based on title and abstract.
3) The remaining articles underwent a full-text review for eligibility based on the inclusion and exclusion criteria.
4) The resulting ISWF articles were included in the study for synthesis.
5) The articles were coded for the factors in our conceptual model.

Two authors independently screened titles and abstracts using the predefined eligibility criteria by independently evaluating a randomly selected study sample. The consensus method was used to solve debates between the two researchers. In cases of disagreements, all four authors discussed the eligibility criteria, and, where applicable, the full text was retrieved to facilitate decision-making. Lastly, the authors did a full paper review to code the factors in our conceptual model.

3.3. Data Extraction and Synthesis

A data extraction process was established to aid the data synthesis that sought to gather all relevant information needed to address the research questions. A pre-designed data extraction form in Excel was used to retrieve primary information on each study, including title, use of gender theory, use of IS theory, IS publisher, and citation.

In the next step, the authors independently examined the extracted data and classified the details according to the Multi-Factor ISWF Model's dimensions. Accordingly, the following procedures were followed:
1) Familiarization with the data by reading through the excel summary.
2) Generating an initial independent set of codes by and re-reading the summary and often the full text to understand the full context of the paper.
3) Reviewing, defining, and categorizing the literature to the dimensions of the Multi-Factor ISWF Model (Individual, Workforce, Individual Influence and Environmental Influence).
4) Producing a report that is presented in the result Table 1.

4. Results

4.1. Study Selection

The original search of the IS database collections identified 108 items based on the criteria with no removals due to duplicate entries. The articles were first reviewed for the identification of articles with an ISWF research focus. There were 36 articles categorized as ISWF by the reading of the abstract. Some articles required additional reading to confirm category selection. The articles were further critically investigated by a full article review that reduced the total number of articles through the exclusion of 1 editorial, 1 panel discussion, 1 flyer, 1 education not workforce, 1 work in progress, and 1 structured literature review. The final total of 30 articles are presented in Figure 2. Figure 3 shows our search results by year.
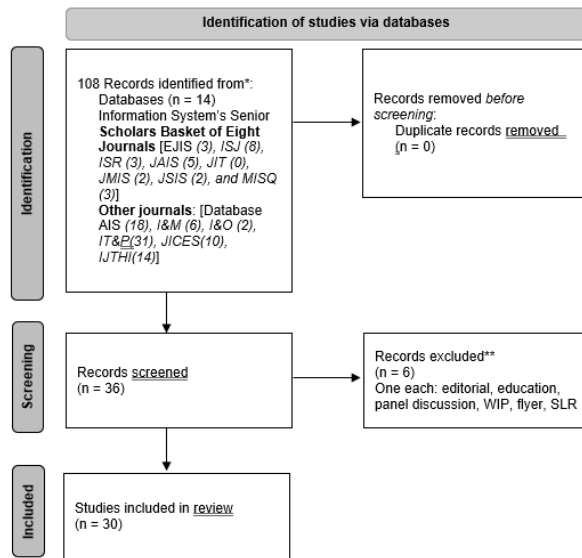

Figure 2. Data Extraction Process and Results

4.2. Publication Statistics

Figure 3 shows the results of ISWF gender research articles published by year. The largest number of articles in one year was six in 2018. Five articles were published in 2012. An average of three research articles were published per year from 2011 to 2020.
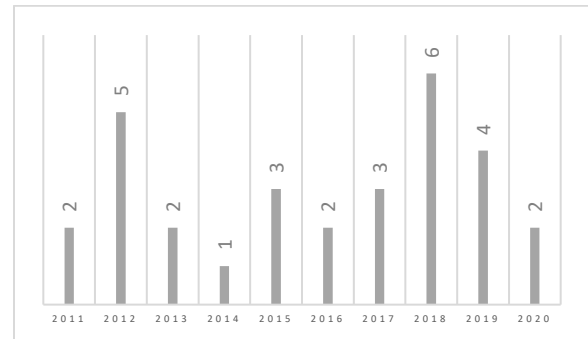

Figure 3. Search Results by Year

4.3. Research Findings

Our research findings are presented in Table 1. ISWF Multi-Factor and Theory Categorization and displayed in Figure 4. ISWF Multi-Factor Model with the counts. Section 5 answers our research question by analyzing the results of our conceptual model mapping and providing a discussion on the findings.

Table 1. ISWF Multi-Factor and Theory Categorization

AUTHOR	INDIVIDUAL	WORKFORCE	ENVIRONMENT INFLUENCES	INDIVIDUAL INFLUENCES	IS OR GENDER THEORY
AL-SAGGAF ET AL. (2015)		X	X	X	Neither
ANNABI & LEBOVITZ (2018)	X	X	X	X	Both
ARMSTRONG & RIEMENSCHNEIDER (2018)		X	X	X	Neither
ARMSTRONG ET AL. (2018)		X	X	X	Both
CAIN & TRAUTH (2013)			X	X	Both
CALIFORNIA STATE UNIVERSITY MONTEREY BAY ET AL. (2019)		X	X	X	Neither
CLAYTON ET AL. (2012)	X	X		X	Both
COLOMO-PALACIOS ET AL. (2020)	X		X	X	Neither
CRAIG (2016)		X	X		Gender
CROASDELL ET AL. (2011)	X	X		X	Both
DHAR-BHATTACHERJEE & RICHARDSON (2018)			X		Neither
DUBEY ET AL. (2017)		X		X	Neither
FOTH (2016)	X		X		IS
GE ET AL. (2015)		X	X		Both

	Individual	Individual Influences	Environmental Influences	Workforce	
GEORGIA STATE UNIVERSITY ET AL. (2015)	X				Both
JIA & JIA (2019)	X			X	IS
KIRTON & ROBERTSON (2018)		X		X	Gender
LANG (2012)		X		X	Both
LANGER ET AL. (2020)	X	X	X	X	Both
MCGEE (2018)		X			Gender
PANTELLI (2012)	X	X	X	X	Gender
POZZEBON ET AL. (2014)	X	X	X	X	Neither
QUESENBERRY AND TRAUTH (2012)		X	X	X	Gender
RIDLEY AND YOUNG (2012)		X			Both
UNIVERSITY OF ARKANSAS ET AL. (2017)	X	X	X	X	Both
UNIVERSITY OF MARYLAND ET AL. (2019)			X		Both
WALLGREN ET AL. (2011)		X	X	X	Neither
WIJAYAWARENA ET AL. (2017)			X	X	Both
WINDELER & RIEMENSCHNEIDER (2013)	X	X	X	X	Gender
ZHANG ET AL. (2019)			X	X	Both
COUNT	**12**	**21**	**21**	**22**	

5. Discussion

5.1. Theoretical Factors and Justification

The classification results of the four theoretical factors in our conceptual model resulted in 76 coded instances (Figure 4). The lowest number of instances were coded in Individual (12), followed by Workforce (21), Environmental Influences (21), and Individual Influences (22). Twenty-six of the thirty articles had more than one area of focus and no article solely focused on the factor, Individual Influences. Six articles focused on all four factors and six other articles focused on three of the four factors (Individual Influences, Environmental Influences, and the Workforce). The ISWF Multi-Factor Model below, contains the count of articles in each intersection of factors.
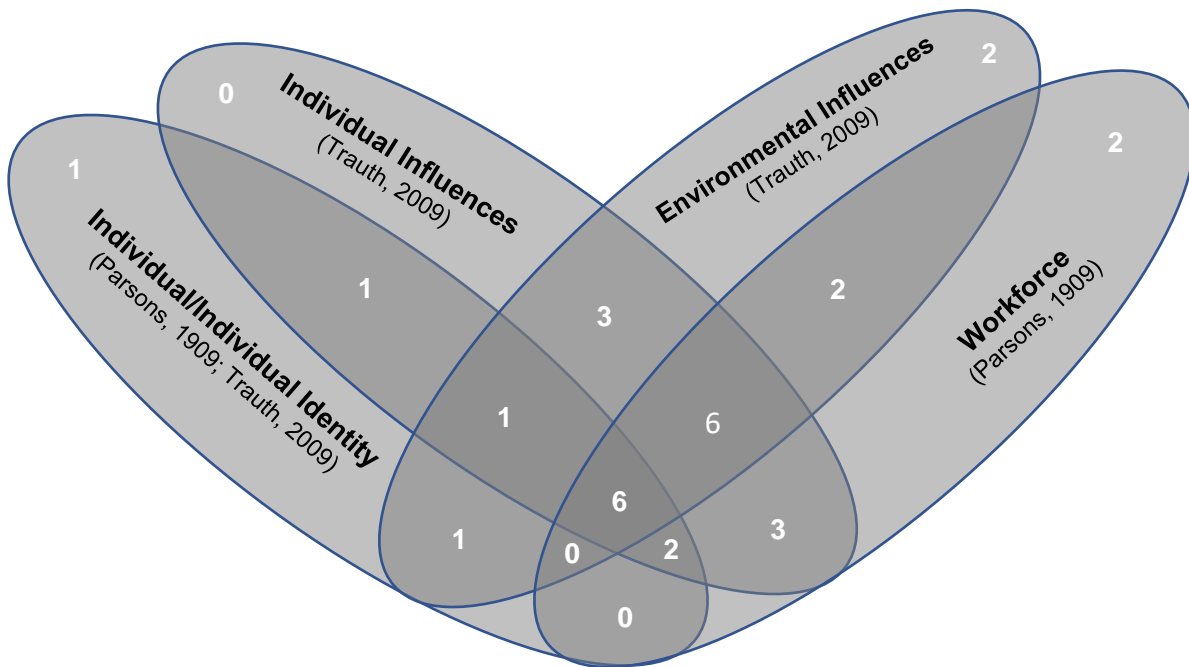

Figure 4. ISWF Multi-Factor Model with Counts

5.1.1. Individual/Individual Identify. The search process revealed 11 articles relating to an individual's aptitudes [15]–[17], abilities, interests [18]–[21], and ambitions [22]–[24] in careers in IS. Jia and Jia explored what makes individuals interested in IT and found that pre-dispositional factors relating to gender lead to stronger intrinsic interest in this technical field [19]. Foth researched gender differences in complying with data protection regulations and found significant differences between the genders in their attitudes [22].

Colomo-Palacios researched the role of emotions on coding and presenting and found significant differences in the interests of each gender for both tasks. Men were less likely to feel frightened than women when presenting, and women enjoy coding more than men [16].

According to the Trait and Factor Theory, when a person is employed in a job that matches their aptitudes and capacities, they are more likely to be satisfied in their career [17][6]. Other well-known career development theories also place primary emphasis on the role of individual factors relating to choosing and persisting in a specific career [25]–[27]. Despite the importance of individual traits in career development, fewer articles focused on this construct than any other construct. This may be due to the technical and environmental nature of IS research.

5.1.2. Workforce. There were 21 articles relating to the IS workforce, mainly focusing on the opportunities relating to Parson's theory of choosing a vocation, such as a knowledge of the requirements and conditions of success [15], [20]–[23], advantages and disadvantages [21], [24], compensation [24], [28], [29], and prospects in different lines of work [20]–[22], [24].

Ge et. al., studied the impact of an economic recession on women entering the IS field and found women were 20.9% less likely than men to enter the field during an economic downturn due to environmental conditions and fewer opportunities [30]. Dubey et. al., analyzed the gender pay gap in freelance markets and discovered female freelancers undervalue themselves when compared to male freelancers with similar profiles, suggesting the need for additional guidance and counseling of female freelancers to close the pay gap issue [31]. McGee researched the influence of individual and organizational factors, specifically gender and ethnicity, on career progression in the IS workforce [29].

It is not surprising to see such a large amount of research devoted to the workforce as the need for skilled workers in IS continues to grow and the demand is unmet. According to the Trait and Factor Theory, sharing immediate and specific opportunities for employment and openings, as well as labor market demands is of critical importance for individuals to make appropriate career choices [6]. Furthermore, it is important for an individual to have an accurate knowledge of requirements and compensation. Having accurate knowledge of an occupation is an important aspect of many other theories of career development. According to Gottfredson's (1981) Theory of Circumscription of Compromise people seek occupations that (a) are congruent with their self-image and (b) reflect their knowledge of different occupations

[26]. As the field of Information Systems continues to be a high-wage, high-demand career, it is expected that research in this area will continue to grow and evolve.

5.1.3. Individual Influences. Individual influences were present in 22 articles and appeared to play a crucial role in ISWF research throughout the education pathway of middle school, high school and college and career advancement from choice, persistence and advancement. Clayton (2012) focused on middle school girls [17]. Middle school and high school student attrition of interest in IT courses and careers were investigated by Lang (2012), where findings revealed a pattern of influencing factors that encouraged some males from choosing the profession yet inhibited some young women. This study also discovered a lack of knowledge of the IS field in both genders. [32]. The challenges women face transitioning through phases of career choice, career advancement and career persistence in the IT field was studied [33], [34]. Findings resulted in expanded framework of social and structural factors influencing women's careers in IT. Research indicates influencers take many forms, such as, course of study, career choices, family, peers, media, and role models [17]. Annabi and Lebovitz (2018) created a framework of organizational interventions to address barriers and influence retention with many influences identified [35]. The importance of influencers through education years and career years was a consistent finding.

As a student moves through their educational career, their zone of acceptable occupations begins to narrow through circumspection and compromise. Circumspection is the "process by which individuals reject occupations they deem unacceptable," and compromise is "adjusting aspirations to accommodate and external reality" [26, p. 195]. Individual influences, including resources, family support, and mentors, play a very large role in careers that are deemed acceptable [26], and these factors have an influence on a woman's decision to enter and remain in the IS field [36]. It, therefore, becomes critical to identify and provide needed resources, supports, and mentors throughout each step of an individual's educational journey and career progression.

5.1.4. Environmental Influences Twenty-one articles were identified as environmentally influenced research. Fourteen of the twenty-one articles specifically focused on research in a single country; seven in the USA [30], [31], [33], [37]–[39], three in Australia [15], [24], [40], and one in Germany [19], Sri Lanka [24], China [41], and the UK [20]. Prior research establishes that environmental influence is a highly relevant factor towards success of individuals in IS with more influence dependent on gender, diverse influence pertaining to

specific geographical regions or by multi-geographical influences, and within different socio-economic, political, or other subcategories with specific or multiple geographical regions [42]. The multiple variations of influence from geographical location and culture complicate the ability to identify a specific influence that could be used to generalize multiple cultures or geographical locations. One study looked at multi-cultural influence between India and Multi-National Environments (contracts) [43] and one with comparisons across multiple geographical locations [44]. Four of the articles had multiple environmental influences such as Singapore [29] and Sweden [45] with other cultural influences. The other two articles included the United States and multi-cultural employees and facilities [46] and another India-based company and multi-cultural contracts [23]. An additional paper included Norway, Spain, and Turkey individually and collectively for individual geography influence as well as multi-geographical comparisons [16]. External influences identified in the twenty-one chosen research articles contained a diverse set of theories and topics in the area of gender and ISWF environments.

5.2. Theory Use

As shown in Table 1, the use of a gender theory and and IS theory are both included in just less than half of the publications analyzed (14). Six articles utilize gender theory alone, and two articles include IS theory alone. Eight articles have neither gender or IS theory. Common gender theories in the articles include Gender Intersectionality, Social Shaping of Gender, Lack of Fit, Stereo-Type Fit, and Inequity Regimes. Some IS theories in the publications are Perspective of Culture, Organizational Commitment, and Human Computer Interaction.

Three articles included in the review used The Individual Differences Theory of Gender and IT [35], [46], [47]. Two papers published both by Armstrong utilize Gender Theory of IT Career Stages [33], [34]. Gender Essentialism was identified in four publications [30], [37], [38], [45]. University of Arkansas et al. and Wijayawarena et al. both applied gender intersectionality to the research [23], [48]. Social Shaping of Gender was used for studies Windeler & Riemenschneider (2013) [41], Zhang et al. (2019) [44], and University of Maryland et al. (2019) [49]. Other gender theories categorized in the review include Lack of fit, stereo-type fit McGee (2018) [29], and the concept of inequity regimes Kirton & Robertson (2018) [28].

There is an average of 2.1 articles pertaining to ISWF external influences and gender theory each year from 2011 to 2021. The years 2016 and 2019 had the most publications with three each. The Information Systems Journal (ISJ) had the most articles in the last decade with six. Database had the second most with four. IT&P had three, JAIS had two, and one each for EJS, MISQ, UTHI, I&M, JICES, and ISR.

5.3. Limitations

Limitations of systematic literature review research are related to the coding and potential for misclassification. Each classification was reviewed by multiple authors and any discrepancy was discussed and addressed to ensure all coding was as accurate as possible. In addition, this review was limited to academic databases with an IS focus. Since the workforce development topic is a crucial area in industry literature, we may have biased the study towards academic research and limited the contributions from the industry. Lastly, the authors recognize a limitation of looking at English-only articles as there may be research published in other languages.

6. Future Research and Conclusions

6.1. Future Research

This research presents a conceptual model with four factors pertaining to gender in the ISWF. Additional research can focus on exploring these and other influential factors relating to the selection, retention, and advancement of individuals within the ISWF. As individual factors are considered by many to be the most essential component of career selection, future research could also focus more on individual's interests, abilities, and attributes in ISWF research including the role of cognitive biases and stereotypes. The role of self-efficacy could also be explored as current data support the assumption that self-efficacy is a key predictor of succeeding in a particular domain of expertise, such as IT [50]. Individuals will likely choose those occupations they perceive as interesting, future research is necessary to explore the perceptions of IS and ensure accurate knowledge of the field.

Future research can be expanded to each step of the educational process (middle school, high school, and post-secondary) and the career path (early career, mid-career, and late-career). This includes how to recruit, retain, and teach needed skills to those interested in the profession. Additionally, future research can also focus on studies regarding STEM activities for women [51]. Oftentimes interventions are put into place to attract individuals into the IS profession. However, more research is needed on interventions that help individuals

understand the benefits of integrating IS into all other fields and occupations.

Research could also expand into cross-sectional comparisons of individuals against the current environment. Do numbers remain low due to perceptions about the careers, or is it due to predetermined exclusions within the ISWF.

Future research could expand to IST, IEEE, and other professional publications, as well as additional keywords, to provide more industry insight.

6.2. Conclusions

Trauth's identification of the lack of gender research coupled with her passion for relevant research in the discipline prompted a deeper investigation of the ISWF and the role of gender. This has resulted in a larger collection of papers over the last decade compared to that of the previous decade and that the focus of gender theory research continues to progress.

This paper examined the focus of the ISWF research over the past decade through a systematic literature review and found that while most articles focused on multiple factors, individual factors relating to gender and workforce were studied the least. Our research question, *"What is the current state of gender research in IS workforce literature?"* has discovered the latest research focuses on workforce requirements and opportunities; individual influences such as mentors, family support and resources; and environmental influences.

As the need for more professionals in the field continues to grow and evolve, recognition of job traits, skills, career anchors, and other factors that have meaning to individuals will become more important. Increasing knowledge of IS occupations, including the current workforce demand, will reduce barriers of those considering the profession. Furthermore, the identification of traits, factors, individual perception, cultural influence, and geographical influence is imperative for recruiting and retaining skilled workers in the ISWF.

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