The Use of Knowledge Management Systems and ICT Service Desk Management to Minimize the Digital Divide Experienced in the Museum Sector

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Abstract—Since the introduction of ServiceNow, the UK's Science Museum Group's (SMG) ICT service desk portal, there has not been an analysis of the tools available to SMG staff for Just-in-time knowledge acquisition (Knowledge Management Systems) and reporting ICT incidents with a focus on an aspect of professional identity namely, gender. Therefore, it is important for SMG to investigate the apparent disparities so that solutions can be derived to minimize this digital divide if one exists. This study is conducted in the milieu of UK museums, galleries, arts, academic, charitable, and cultural heritage sector. It is acknowledged at SMG that there are challenges with keeping up with an ever-changing digital landscape. Subsequently, this entails the rapid upskilling of staff and developing an infrastructure that supports just-in-time technological knowledge acquisition and reporting technology related issues. This problem was addressed by analysing ServiceNow ICT incident reports and reports from knowledge articles from a six-month period from February to July. This study found a statistically significant relationship between gender and reporting an ICT incident. There is also a significant relationship between gender and the priority level of ICT incident. Interestingly, there is no statistically significant relationship between gender and reading knowledge articles. Additionally, there is no statistically significant relationship between gender and reporting an ICT incident related to the knowledge article that was read by staff. The knowledge acquired from this study is useful to service desk management practice as it will help to inform the creation of future knowledge articles and ICT incident reporting processes.

Keywords—Digital divide, ICT service desk practice, knowledge management systems, workplace learning.

I. Introduction

THE SMG in the United Kingdom (UK) acknowledges the challenges of keeping up to date with an ever-changing digital landscape and the need to proactively respond to changes in technology. These changes involve the leveraging of novel IT solutions for the purpose of increasing productivity [1]. Subsequently, this entails the rapid upskilling of staff by providing the necessary infrastructure for staff to quickly acquire just-in-time knowledge of these novel technologies. Moreover, SMG need to provide their staff with technology that supports the reporting of technical issues pertaining to these novel technologies in an efficient manner.

The aim of this study is to analyse data from the tools available to SMG staff that are used for just-in-time knowledge acquisition and the tools used for reporting Information Communication Technology (ICT) incidents. Two research questions (RQ) were stated to examine SMG staff's use of knowledge articles and the ICT incident reporting portal. This was conducted to specifically ascertain if gender plays a role in an individual's proclivity to read the knowledge articles and if gender plays a role in an individual's intention to report ICT related incidents.

- RQ1: What are the relationships between gender and reporting ICT incidents?
- RQ2: What are the relationships between gender and reading ServiceNow™ Knowledge articles?

A. Service Desk Practice in the Literature

Information Technology Service Desk Management (ITSM) best practice has a dearth of academic literature that delineates what constitutes best ICT Service Management practice. This means there are few academic resources available discussing the evaluation of ICT Service Management practice. However, in the available literature, authors postulate that ITSM has evolved from a technological-centric practice to a field that focuses on managing IT operations and processes as a service [2], [3].

Numerous authors [4]-[6] suggest that male and female experience ICT usage differently. Therefore, it is important for SMG ICT service desk management to investigate if these apparent disparities exist and if they do, derive solutions that can embedded in service desk practice to help minimize this digital divide.

B. Main Contributions

According to [7] the utility of the tools available to staff for knowledge acquisition (i.e., Knowledge Management Systems) and reporting ICT incidents remain scarce. This is especially so in the UK museum sector. Due to the scarcity of research in this area, the current study is important to senior ICT management as it will assist in improving the embedding of Knowledge Management Systems (KMS) in ICT service desk practice. Moreover, the current study will help SMG's ICT service desk team to support one of SMG's strategic priorities which is to grow science capital in individuals and society. This will be achieved by acknowledging a digital divide and improving the integration of KMS with ICT service desk practice to minimize this digital divide. Additionally, the

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knowledge acquired from the current study is useful to ICT service desk management practice as it will help to inform the creation of future knowledge articles that are used in the KMS and improve ICT incident reporting processes.

II. RESEARCH HYPOTHESES

A. Gender and Reporting ICT Incidents

There is a dearth of research on gender and requests for ICT service desk support. However, answers to genders and their inclination to request for help may be found in the area of psychology, in particular, help-seeking. Reference [8], investigating the relation among components of the male sex role and aspects of help seeking, suggests that 'Men are traditionally socialized to seek power and control, and to be autonomous and self-reliant' (p.296). There is a large body of empirical research that supports the belief that men are unwilling to seek help from professionals [9]. Although, these arguments are mainly in the milieu of health, in the current study these arguments will be transposed to the context of reporting ICT related incidents. Therefore, it can be inferred that males are less likely to seek ICT service desk help. Research on digital economy and society reveals that there are gender gaps in basic ICT skills. According to [10], as the complexity of the problem increases, the skills gap becomes more pronounced. Reference [10] argues that this is due to females being more technophobic than males. Thus, in order to address RQ1, the following hypotheses will be tested:

- Hypothesis 1: Gender and reporting ICT related incidents are not independent of one and other.
- Hypothesis 2: Gender and level of ICT incident reported are not independent of one and other.

B. Gender and Knowledge Management Systems

Reference [11] argues that the success of any knowledge management system (KMS) depends on two factors; 1) the individuals contributing content to it as well as 2) the individuals seeking knowledge from it. It can be argued that these two factors are determined by the nature of the culture of the organization and the individuals' motivation and proclivity to use the KMS to add content and the reliability and trustworthiness of the knowledge being sought from the content. Reference [12] claims that sharing knowledge is typically unusual. Individuals are unwilling to share their knowledge as they believe their knowledge is important, valuable and a source of power [13]. Reference [12] suggests that hoarding knowledge and looking upon others' knowledge sceptically, are natural tendencies. Interestingly, research [13] on knowledge sharing cultures found that female employees perceive knowledge sharing culture differently than their male counterparts. Their research found that both male and females require a more positive social interaction culture before they perceive knowledge sharing as positive. However, this is less so important for Males. The research of [13] also supported [12]'s notion of sceptically viewing others' knowledge, albeit, from the perspective of gender. They argue that male workers in the same field are more likely to share knowledge with the same gender, then with employees of a minority gender. Although [13]'s research is insightful regarding predicting knowledge sharing culture and gender interactions of knowledge sharing, it does not explain which gender is more likely to be seekers of shared knowledge. Although [14]'s research does not explain which gender is more likely to be seekers of knowledge, their findings using independent t-tests did not show any statistically significant difference between male and female in terms of KMS usage. This was despite having more male (64.1%) participants than female (35.9%). Therefore, in order to address RQ2 the current study will advance the following hypotheses:

- Hypothesis 3: Gender and reading Knowledge Articles are not independent of one and other.
- Hypothesis 4: Gender and reporting an ICT incident related to Knowledge Articles are not independent of one and other.

III. METHODOLOGY

A. Data Collection

ServiceNow ICT incident report logs and report logs from knowledge articles were used as the data source for this study. The sample used in this analysis was extracted from both the ServiceNow report logs and a report of read ServiceNow Knowledge Articles from a six-month period from February to July.

Prior to pooling the data, the samples from both reports were analysed and obtained from 6280 knowledge base articles views, and 11,241 ICT incident report records. Thus, simple random sampling, a random sampling technique, was used.

Microsoft Excel was used to generate the random numbers used to select the sample reports used in the analysis. IBM SPSS 20 was used to perform the chi square and Phi-coefficient tests.

B. Data Screening

The first phase of data screening was performed on 36,417 ICT incident records that had been recorded from ServiceNow's inception at SMG. Several filters were used to remove several thousand records as not all records were relevant to this study. Incidents falling into Comms, Server, Network, Backups and Storage categories were not relevant to this study, thus these are incidents that could not be resolved using ICT training interventions. Additionally, other filters were applied to return only incidents reported within a specific six-month period.

The second phase of data screening was to analyse the ServiceNow Knowledge articles, reporting the number of views received. Collectively, 6280 views were received since its inception. A filter was applied displaying only Knowledge Articles that had been viewed within a specific six-month period. Several other filters were applied to remove 4739 Knowledge Article views. Those removed belong to system administrators who are authors of the knowledge articles. Applying these filters yielded 1160 knowledge article views. These knowledge article views were used in the subsequent

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analysis.

C. Data Analysis

Data were analysed using Pearson Chi-square statistics. A Pearson Chi-square ($\chi2$) is a non-parametric, statistical significance test. It has two common uses: (1) determines whether a sample distribution corresponds with a hypothetical population (goodness of fit); (2) provides evidence of a significant association between two Nominal/Categorical variables from a single population.

Reference [15] recommends that when performing a $\chi2$ test, it should be combined with a suitable test of strength, e.g., Cramer's V or Phi. Cramer's V is used to measure the strength of an association between two categorical variables based on $\chi2$ statistic [16]. This was used to ascertain if any association between the two variables existed.

IV. RESULTS AND DISCUSSIONS

This section reports the results from the analysis of the tools available to SMG staff that are used for just-in-time knowledge acquisition and reporting ICT incidents. Furthermore, this section presents a discussion of the findings that was empirically tested through a series of chi square tests.

A. Participants

This section describes the descriptive statistics for the 1145 staff reported ICT incidents and the knowledge articles that were read during a specific six-month period.

In this study, the sample population was 1145 where men made up 35% while women made up 65%. The data were compared with the documented total of people employed by SMG which is 1071 excluding agency and contracting staff as of 31st March 2017, of those, 62% were women and the remaining 38% were men [17]. These totals are the most up to date documented figures available at the time of writing.

B. Goodness of Fit – Sample and SMG Populations

The findings from the chi square goodness of fit (see Table I) found that the observed frequencies do not differ from the expected frequencies for gender. $\chi2$ (df1, N = 1145) = 3.585, p = 0.058 meaning it cannot be concluded that the observed data are statistically different from the expected values. Therefore, the test failed to reject the null hypothesis. Essentially, the sample used in this study accurately reflects the population of SMG in terms of demographics i.e., gender.

TABLE I
CHI-SQUARE GOODNESS OF FIT RESULTS

	Observed	Expected	Residual
Female	741	709.9	31.1
Male	404	435.1	-31.1
Total	1145	1145	

C. Gender and Reporting ICT Incidents

There is a significant but weak relationship between gender and reporting an ICT incident, $\chi2$ (df1, N = 1145) = 7.872, p = 0.005. Women (65.2%) were more likely to report an ICT incident than were men (34.8%). The effect size is small 0.083.

The findings from this test support the research findings from [8] and [9]. A possible reason for this result is that male staff at SMG typically conform to traditional masculine norms e.g., responsibility, self-agency, self-reliance, and aggression [18] as part of their occupational identity. Thus, viewing help seeking negatively. The observed and expected frequencies are presented in Tables II and III, respectively.

TABLE II
REPORT ICT INCIDENTS (OBSERVED) FREQUENCIES

	No	Yes	Totals
Female	7	734	741
Male	13	391	404
Total	20	1125	1145

TABLE III
REPORT ICT INCIDENTS (EXPECTED) FREQUENCIES

	No	Yes	Totals
Female	12.9	728.1	741
Male	7.1	396.9	404
Total	20	1125	1145

D. Gender and Priority Level of ICT Incidents Reported

There is a statistically significant relationship between gender and the priority level of ICT incident reported, $\chi2$ (df2, N= 6326) = 12.630, p = 0.002. Meaning this has not happened by chance. Although this relationship is statistically significant, the strength of the relationship is weak based on the phi-coefficient test that was carried out on these categorical variables. The result of the phi-coefficient test was 0.045 which means the effect size is small. Based on [19]'s rule of thumb, an effect size is considered small if the results are equal to 0.1, moderate = 0.3 and large = 0.5.

Originally there were four ICT call priority level categories. 1 – Critical, 2 – High, 3 - Moderate, 4 – Low. However due to two cells (25%) that have expected counts less than 5, values from the 1 – Critical category were added to 2 – High and the chi square statistic was re-calculated.

Across the two of the three categories of call priority levels, women are more likely to report an ICT incident to service desk. However, if the incident is high priority, men (63.2%) are more likely to report the incident then women (36.8%). This indicates that male staff are more likely to try to resolve low to moderate issues than women. The findings from this analysis found a weak but statistically significant relationship between gender and the priority level of ICT incident reported. These findings confirm that male staff at SMG typically view help seeking negatively and will only seek help if there are no alternatives. The observed and expected frequencies are summarized in Tables IV and V, respectively.

TABLE IV
PRIORITY LEVEL OF INCIDENT REPORTED (OBSERVED) FREQUENCIES

	High	Moderate	Low	Totals
Female	7	40	4319	4366
Male	12	28	1920	1960
Total	19	68	6239	6326

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TABLE V
PRIORITY LEVEL OF INCIDENT REPORTED (EXPECTED) FREQUENCIES

	High	Moderate	Low	Totals
Female	13.1	46.9	4306	4366
Male	5.9	21.1	1933	1960
Total	19	68	6239	6326

E. Gender and Reading Knowledge Articles

There is no significant relationship between gender and reading knowledge articles, $\chi 2$ (df1, N = 1145) = 1.288, p = 0.256 Meaning this has happened by chance.

The findings from this study are contrary to the findings of [13] which postulates that female employees perceive knowledge sharing culture differently than their male counterparts. This research showed that there is no significant relationship between gender and reading knowledge articles. The observed and expected frequencies are presented in Tables VI and VII, respectively.

TABLE VI
READING KNOWLEDGE ARTICLES (OBSERVED) FREQUENCIES

	No	Yes	Totals
Female	508	233	741
Male	290	114	404
Total	798	347	1145

TABLE VII
READING KNOWLEDGE ARTICLES (EXPECTED) FREQUENCIES

	No	Yes	Totals
Female	516.43	224.57	741
Male	281.57	122.43	404
Total	798	347	1145

F. Gender and Reporting ICT Incidents Related to Knowledge Articles

There is no significant relationship between gender and reporting an ICT incident related to the knowledge article read, $\chi 2$ (df1, N = 2728) = 3.704, p = 0.054. Meaning this has happened by chance.

The findings from the analysis found that there was no significant relationship between gender and reporting an ICT incident related to the knowledge article read. These findings are congruent with [14] on determining the key factors affecting KMS usage in IT. Their study found that despite having more male than female participants in their study, there was no significant difference between male and female KMS usage. Both male and female staff at SMG are equally likely to report an ICT incident that is related to the knowledge articles read. The observed and expected frequencies are shown in Tables VIII and IX, respectively.

TABLE VIII
REPORTING ICT INCIDENTS RELATED TO KNOWLEDGE ARTICLES (OBSERVED) FREQUENCIES

	Observed	Expected	Totals
Female	508	233	741
Male	290	114	404
Total	798	347	1145

TABLE IX
REPORTING ICT INCIDENTS RELATED TO KNOWLEDGE ARTICLES (EXPECTED) FREQUENCIES

	Observed	Expected	Totals
Female	516.43	224.57	741
Male	281.57	122.43	404
Total	798	347	1145

G. Summary of Hypotheses

Table X presents a summary of all the hypotheses that were advanced in the current study.

TABLE X
SUMMARY OF HYPOTHESES

Hypothesis	Observed	Results
(H1)	7.872	Supported
(H2)	12.630	Supported
(H3)	1.288	Not Supported
(H4)	3.704	Not Supported

V. IMPLICATION FOR ICT SERVICE DESK MANAGERS

The findings in the current research present implications for a variety of approaches to support non-ICT SMG staff and the use of KMS. Comprehending KMS usage among SMG staff and the reporting of ICT related incidents will help to inform improvements to ICT service desk practice. These improvements include providing interventions to reduce the digital divide experienced by non-ICT SMG staff.

Prior to investing in the development of the KMS solution, it is important for management to investigate KMS usage among SMG staff and the reporting of ICT related incidents processes. If staff rejects the KMS offering, they will not utilize it to seek and exchange information. Thus, the rejection of the KMS will result in a wasted budgetary expense.

VI. LIMITATIONS

There is a disparity between the actual number of staff in this research and the number of staff reported in SMG's gender pay gap report. This is because it is acknowledged there is a possibility that both contract staff and volunteer staff form part of the sample group in this study whereas they have been excluded from SMG's gender pay gap report.

This study did not investigate which departments in SMG have the proclivity to report ICT service desk incidents and read knowledge articles. This knowledge would be insightful as it could potentially be used to diagnose ICT training needs and capabilities within specific departments in order to create targeted, context specific learning interventions.

This study only focused on seekers of knowledge and not contributors in the evaluation.

VII. CONCLUSION

This study sought to use statistical inference to analyse the data from tools available to SMG staff that are used for just-in-time knowledge acquisition and the tools used for reporting ICT incidents. The findings revealed that gender does not play a role in an individual's proclivity to read the knowledge articles for

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Just-in-time knowledge acquisition which is contrary to [20]. Additionally, there was no significant relationship between gender and reporting an ICT incident related to the knowledge article read. However, according to the findings of the current study, gender does play a role in an individual's tendency to report an ICT incident to service desk. Female staff at SMG are more likely than male staff to report ICT incidents across three of the four categories. Men are more likely than women to report a high priority incident to the Service desk.

Future research may include a qualitative approach that investigates staff perceptions of knowledge sharing in SMG. This study did not focus on the perceptions of knowledge sharing.

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