
UNDERSTANDING VOTING SECURITY AND TECHNOLOGY: WORKSHOP

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ABSTRACT

Democracy is based on education, Socrates (470-390 B.C.) Will education over-ride propaganda, fake news, and emotional thinking? The purpose of this presentation is to educate people on election security and election technology to increase trust of an election. When there is a lack of education, election problems develop. The 2020 presidential election has raised questions of being rigged. Through election technology & security education, such questions can be resolved. The presentation is composed of two parts. Part A covers “**Preventing & detecting voter fraud.**” Topics covered are: 1) Data protection, 2) Rigged Software (How it is done, hide it, prove in court) and Swap memory cards, and 3) Dead voters (Why exist, prove in court). For Part B, “**Mis-leading numbers,**” topics covered are: 4) Statistical manipulation (random selection vs selection criteria), and 5) Bedford's Law (Voter fraud vs Accounting fraud). After the presentation, there will be discussion.

INTRODUCTION

There has been a decline in trust in government. The average U.S.A. public trust of the government from 1958 to 1968 was 69%. From 2011 to 2021, the average U.S.A. public trust was 20% (Pew, 2021). In the 2020 U.S. general election, only 65% of voters trusted the initial findings (Mercur & Neumann, 2021; Laughlin & Shelburne, 2021) with less than 25% of Republicans trusting (Coleman, 2020). Election distrust is a political weapon that undermines confidence in elections . (Fried & Harris, 2020).

The solution to election distrust is education. When there is a lack of education, election problems develop. Through election technology & security education, such questions can be address and resolved. Socrates (470 – 399 BC) stated democracy is based on education (Life, 2017). When you are educated, you can talk from a position of knowledge when in a discussion on voter fraud. The belief is that as more people are informed, the better off society will be when issues arise (Socrates, 470 – 399 BC). When there is a lack of education, election problems develop as stated by Socrates and Plato of ancient Greece (Life, 2017; Montmorency, 2020). Trust in the election system decreases.

OVERVIEW

The objective of this presentation is to provide knowledge to make an informed decision on elections. With this knowledge, trust in elections may increase. Activities include presentation, discussions, and questions/answers.

REFERENCES

Coleman, J. (Dec. 2020). Poll: Less than one-quarter of Republicans trust election results. *The Hill*, Dec. 9, 2020. (Accessed on 8/31/21)
<https://thehill.com/homenews/campaign/529476-fewer-than-one-quarter-of-republicans-trust-election-results-poll>.

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- Fried, A., & Harris, D. B. (2020). In Suspense: Donald Trump's Efforts to Undermine Public Trust in Democracy. *Society*, 57(5), 527-533. <http://dx.doi.org/10.1007/s12115-020-00526-y>.
- Laughlin, N. & Shelburne, P. (2021). How Voters' Trust in Elections Shifted in Response to Biden's Victory. *Morning Consult*, Jan. 27, 2021. (Access 8/31/21) (on-line) <https://morningconsult.com/form/tracking-voter-trust-in-elections/>.
- Life, T. S. (2017, July 18). Why Socrates Hated Democracy. *World History Encyclopedia*. Retrieved on 6/22/2021 from <https://www.worldhistory.org/video/1223/why-socrates-hated-democracy/>.
- Mercur, R.T.i & Neumann, P.G. (June 2021). The Risks of Election Believability (or Lack Thereof). *Viewpoints: Communications of The ACM*, 64(6), 24-30. DOI:10.1145/3461464.
- Montmorency, R. (July 10, 2020). Why Socrates Hated Democracy. *Nspirement*. Retrieved on 6/22/2021 from <https://www.nspirement.com/2020/07/10/why-socrates-hated-democracy.html>
- Pew (2021). Public Trust in Government: 1958-2021. *Pew Research Center*, May 17, 2021. (Accessed 8/31/2021, online) <https://www.pewresearch.org/politics/2021/05/17/public-trust-in-government-1958-2021/>.

THE IMPACT OF PSYCHOPATHIC MANAGERS AND THE AGILE METHODOLOGY

PANEL

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ABSTRACT

Prevailing research indicates that the incidence of psychopaths in the general population is about 1%. If this assertion is true in the workplace, could psychopathic managers purposely sabotage Agile teams to prevent others from achieving success? During the 2022 ACIS Conference, panelists will discuss the psychopathy framework, and how psychopathic managers could deliberately sabotage Agile teams to prevent success.

While psychopaths have roamed the earth since biblical times (Kielh et al. 2011), the study of psychopathy has been shed in controversies. From psychopathy not being a diagnosed disease (DSM or ICD), to the incidence of psychopaths in the workplace evaluated at 4% by Babiak et al. (2010), psychopathy is a very sensitive subject that triggers strong emotions or reactions. The Psychopathy Checklist Revised (PCL-R) checklist (Hare et al. 2010) provides a framework for the evaluation of psychopathy. In IT, the Standish Group (since 1995) has studied the Agile methodology and documented its successes and failures. To work, a team need to be self-empowered. This means that many managers are left without power as teams produce deliverables that normal teams struggle to deliver. Could psychopathic managers deliberately sabotage those teams to ensure no one is successful without them.

This panel will seek to elevate attendant's awareness of the risk that some managers may seek to sabotage Agile for their personal gain. As a suggestion for future research, the authors suggest that research should be conducted to test if coworkers to accurately evaluate their colleagues for psychopathy using PCL-R. The authors also suggest that such study may be very important in environments of high level of trust

REFERENCES

- Babiak P, Neumann C, Hare R (2010), *Corporate psychopathy: Talking the walk*.
- Hare R, Harpur T, Hakstian A, Forth A, Hart S, Newman J (1990), The revised Psychopathy Checklist: Reliability and factor structure. *Psychological Assessment: A Journal of Consulting and Clinical Psychology*, 2(3), 338–341.
- Kiehl K, Hoffman M (2011), The criminal psychopath: history, neuroscience, treatment and Economics, *Jurimetrics*, Summer; 51, 355–397.
- The Standish group (1995), the CHAOS study, Retrieved from <https://www.csus.edu/indiv/v/velianitis/161/chaosreport.pdf>

SOCIAL DESIRABILITY BIAS IN CYBERBULLYING RESEARCH

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EXTENDED ABSTRACT

Social desirability (SD) bias makes the respondents look good by overreporting positive behaviors and underreporting negative behaviors. SD has been important in research using self-report surveys because it can distort the validity of the causal inferences (Kwan et al., 2010; Kwak et al., 2019). As a result, significant efforts have been made to assess and control SD bias in various disciplines. However, despite much research on SD bias, there are several opportunities to contribute to SD bias in IS research.

First, the most popular way to assess SD bias is to examine the correlation between the SD scale and study variables. A non-significant correlation between them implies a lack of SD bias (Hart et al., 2015; Paulhus, 1991). In particular, prior IS research noted that SD bias was not problematic when the correlations between the SD scale and study variables were low. For example, Chan and Lai (2011) found a significantly negative correlation between the MC scale and software piracy attitude ($r = -.21, p < .01$). However, even if there are low correlations between SD scales and study variables, they might threaten the validity of causal inferences (Paunonen & LeBell, 2012). Thus, a clear guideline on interpreting the correlation in evaluating the significance of SD bias is needed.

Second, Kwak et al. (2021) found that when both independent and dependent variables are contaminated by SD bias, the path coefficients and their statistical significance are inflated, resulting in a false-positive interpretation. Especially, they showed that the statistical significance of the relationship between mobile Internet addiction and mobile-loading intention is changed from significant ($p < .05$) to non-significant ($p = ns$) after controlling for SD bias. Despite their findings, we are unsure if SD bias can deflate the path coefficients and their statistical significance, resulting in false-negative interpretation.

Based on the research gap, the purposes of this study are (1) to provide a guidelines of how to evaluate the correlation in assessing the significance of SD bias and (2) to examine the possibility of false-negative interpretation. To achieve the research purposes, we collected 314 data from cyberbullying victims through Amazon Mechanical Turks. To assess SD bias, this study used the 16 items of the balanced inventory of desirable responding (BIDR-16) consisting of the self-deception enhancement scale (SDE) and the impression management (IM) scale (Hart et al., 2015).

REFERENCES

- Chan, R. Y., & Lai, J. W. (2011). Does ethical ideology affect software piracy attitude and behaviour? An empirical investigation of computer users in China. *European journal of information systems*, 20(6), 659-673.
- Hart, C. M., Ritchie, T. D., Hepper, E. G., & Gebauer, J. E. (2015). The balanced inventory of desirable responding short form. *SAGE Open*, 5(4), 1-9.
- Kwak, D.-H., Holtkamp, P., & Kim, S. S. (2019). Measuring and controlling social desirability bias: Applications in information systems research. *Journal of the Association for Information Systems*, 20(4), 317-345.
- Kwak, D.-H., Ma, X., & Kim, S. (2021). When does social desirability become a problem? Detection and reduction of social desirability bias in information systems research. *Information and Management*, 58(7), 103500.
- Kwan, S. S., So, M. K., & Tam, K. Y. (2010). Applying the randomized response technique to elicit truthful responses to sensitive questions in IS research: The case of software piracy behavior. *Information Systems Research*, 21(4), 941-959.
- Paulhus, D. L., & Reid, D. B. (1991). Enhancement and denial in socially desirable responding. *Journal of Personality and Social Psychology*, 60(2), 307-317.
- Paunonen, S. V., & LeBel, E. P. (2012). Socially desirable responding and its elusive effects on the validity of personality assessments. *Journal of Personality and Social Psychology*, 103(1), 158-175.

TOWARDS A COST/BENEFIT ANALYSIS OF TRADE SECRET PROTECTIONS FOR SMALL BUSINESS

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EXTENDED ABSTRACT

PURPOSE OF THE STUDY

U.S. law protects four specific types of intellectual property (IP): copyright, trademark, patent, and trade secrets. This abstract proposes a new line of scholarly inquiry into the methods, objectives, and current state of trade secret protection.

BASIS OF THE STUDY

The IP ecosystem has changed drastically over the past decade. First, court cases such as *Bilski vs. Kappos* (2010) complicated elements of patent protection prompting lawyers and businesses to reconsider the relative merits of various IP approaches (Halligan, 2010). Second, the primary technologies deployed by today's largest companies, databases, and algorithms, are difficult to protect with patents and copyright (Sandeem, 2005). Finally, legislative bodies around the world have produced new statutes such as the U.S. Defend Trade Secrets Act of 2016. As a result of these complex changes, the benefits and costs of various IP protection strategies have become more challenging to discern. In this environment, trade secret protections have the potential to play a more important role in the management of IP (Lemley et al., 2011; Lie, 2016). Therefore, we pursue the cost-benefit analysis of IP strategies with a focus on cases in the United States (U.S.) relevant to small business.

METHODOLOGY

The study reviewed statistical approaches to modeling trade secrets to discover input variables useful for a cost-benefit analysis. After a preliminary literature review, we identified the most common variables documented in the research. Finally, a gap analysis was performed to identify the variables not readily present but necessary for a robust cost-benefit analysis.

FINDINGS

In our preliminary literature review, we focused on empirical studies that constructed models of trade secrets based on cybersecurity audits and case law (Table 1).

Table 1: Research Studies Addressing Firm-level Trade Secrets Data

Study	n	Years	Jurisdictions	Notes
Almeling et al., 2009	394	1950-2008	U.S. Federal Court	Analyzed decisions of trial courts
Almeling et al., 2010	358	1995-2009	U.S. State Courts	Analyzed state appellate court decisions
Rowe, 2017	157	2000-2014	U.S. Federal Courts	Analyzed jury verdict reports
Levine & Seaman, 2018	486	2016-2017	U.S. DTSA	Analyzed misappropriation under DTSA
Jaros et al., 2019	83	1985-2017	Federal - DoD Cases	Analyzed perpetrators
Searle & Vivian, 2021	103	1996-2020	U.S. Federal Courts	Analyzed documents for trade secret events

The studies highlighted many variables (Table 2) suitable for a cost-benefit analysis.

Table 2: Select Variables for a Cost-Benefit Analysis of Trade Secret Protections

Variable	Description	Source	Citation
damages	compensatory or punitive	case law	Rowe, 2017
injunctive relief	preliminary or permanent	case law	Rowe, 2017
ex parte seizure	benefit to plaintiff	DTSA case law	Rowe, 2017
type of trial	bench vs. jury	case law	Rowe, 2017
type of trade secret	technical vs. business information	case law	Levine & Seaman, 2018
form of trade secret	digital asset vs. physical asset	case law	Levine & Seaman, 2018
type of misappropriation	use vs. acquisition	case law	Rowe, 2017
NDA	Was there an NDA in effect among parties?	case law	Levine & Seaman, 2018
NOS code	Nature of Suit code. No NOS codes for DTSA.	DTSA case law	Levine & Seaman, 2018
civil/criminal action	Was the case pursued as civil, criminal, or both?	case/documents	Searle & Vivian, 2021

While the studies considered here contribute much to our approach, we recognize that gaps remain to achieving a cost-benefit analysis based on these variables alone. First, the overwhelming majority of the data points derive from court cases which are often not representative of the full range of experiences in the world. Second, the essence of cost-benefit analysis requires a full accounting of the trade-offs among multiple alternatives. In order to achieve this, we need to include research on the IP alternatives to trade secrets, namely, patents and copyright. Finally, the literature in the field of IP is vast and rapidly expanding. We believe that many other relevant studies must exist in the overlapping fields addressing this topic.

FUTURE STUDY

We propose three specific activities as next steps in our research regarding trade secrets as an effective method of protecting information systems-related IP. First, a comprehensive, rigorous literature review would significantly aid the body of knowledge in this area by synthesizing and summarizing case and statutory law with existing scholarly research already completed. Following that review, we propose to develop an analytical model to apply the variables identified in this abstract, to quantify the cost/benefit of using trade secrets as protection of IP. Once developed, we will test the model with data from specific jurisdictions to validate its accuracy and utility.

REFERENCES

- Almeling, D. S., Snyder, D. W., Sapoznikow, M., McCollum, W. E., & Weader, J. (2009). A Statistical Analysis of Trade Secret Litigation in Federal Courts. *Gonzaga Law Review*, 45.
- Almeling, D. S., Snyder, D. W., Sapoznikow, M., McCollum, W. E., & Weader, J. (2010). A Statistical Analysis of Trade Secret Litigation in State Courts. *Gonzaga Law Review*, 46.
- Bilski vs. Kappos, 561 U.S. 593 (2010).

- Halligan, R. (2010). Trade Secrets v. Patents: The New Calculus. *Landslide*.
- Jaros, S. L., Rhyner, K. J., McGrath, S. M., & Gregory, E. R. (2019). *The Resource Exfiltration Project: Findings from DoD Cases, 1985-2017*.
- Lemley, M. A., Risch, M., Sichelman, T., & Wagner, R. P. (2011). Life After *Bilski*. *Stanford Law Review*, 63(6), 1315.
- Levine, D. S., & Seaman, C. B. (2018). The DTSA at One: An Empirical Study of the First Year of Litigation Under the Defend Trade Secrets Act. *Wake Forest Law Review*, 53.
- Lie, H. T. (2016). Introduction to Current Trade Secret Management Research. *SSRN Electronic Journal*.
- Rowe, E. A. (2017). Unpacking Trade Secret Damages. *Houston Law Review*, 55(1).
- Sandeen, S. K. (2005). A Contract by Any Other Name is Still a Contract: Examining the Effectiveness of Trade Secret Clauses to Protect Databases. *IDEA: The Journal of Law and Technology*, 45(119).
- Searle, N., & Vivian, A. (2021). *Surprisingly Small: The Effect of Trade Secret Breaches on Firm Performance*. Workshop on the Economics of Information Security (WEIS).

CAN FRAGILE STATES MAINTAIN CYBERSECURITY?

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ABSTRACT

Each year, *Foreign Policy* publishes the Fragile States Index, which ranks nation-states' sustainability in terms of political, economic, and social systems, as well as internal cohesion and the existence of external intervention. Sustainability and cybersecurity are topics of current interest, but they are rarely discussed together. It is pertinent to investigate whether the fragile states can maintain cybersecurity during an era of disruptive technologies and as their economies experience digital transformation. In our global society, cybersecurity is an increasing concern. Our study compares the countries on the 2021 Fragile States Index with rankings on the National Cyber Power Index published by the Belfer Center for Science and International Affairs at Harvard University. The most fragile states are not well prepared in the realm of cybersecurity. We identify how various indicators on the Fragile States relate to cybersecurity capacity building. This introductory paper is the first in a series.

Keywords: Cybersecurity, Sustainability

INTRODUCTION

A nation's political, economic, and social systems' sustainability is critical to maintaining its status as an independent entity in the world order. Key definitions are provided, followed by a brief discussion of the United Nation's Sustainable Development Goals. We then introduce the concept of cybersecurity and the important role it plays in a nation's sustainability. The methodology section explains where and how the data is gathered. The results section describes the findings.

Definitons. Albertson and Andrews (2017) describe a fragile state as one that has lost control of its territory or one that cannot provide basic services to its citizens. Typically, fragile states do not have governments with legitimate authority or practice collective decision making. For a variety of reasons, fragile states may not be able to interact with other states in the global community. A fragile state may experience corruption and criminal behavior in its ruling body and inequality amongst demographic groups.

The Fund for Peace has identified five groups of key factors that can provide insight to a state's fragility or sustainability. The groups are Cohesion, Economic, Political, Social, and Cross-cutting indicators. As an example, Table 1 shows the connections between Cohesion indicators and cybersecurity.

Table 1: Cohesion Indicators and Cybersecurity

Indicator	Connection to Cybersecurity
Security apparatus	1) Cyberwarfare 2) Cyberterrorism 3) Cyber crime 4) Cyber espionage against citizens
Factionalized elites	1) Disinformation and Misinformation 2) Cyber bullying against minorities, e.g., religious or ethnic groups
Group Grievance	1) Propaganda

The second key factor in measuring fragility is a states’ economy. Table 2 shows the cybersecurity issues that are related to economic indicators. These indicators are related to the cybersecurity readiness and capacity of a state.

Table 2: Economic Indicators and Cybersecurity

Indicator	Connection to Cybersecurity
Economic Decline and Poverty	1) Cyber crime 2) Decline of Cybersecurity Startups 3) Closure of Cybersecurity Businesses 4) Enrollment Decline in Cybersecurity Programs at Undergraduate and Graduate Levels
Uneven Development	1) Lack of Diversity in Cybersecurity Programs at Undergraduate and Graduate Levels 2) Lack of Diversity in Cybersecurity Workforce
Human Flight and Brain Drain	1) Skilled Cybersecurity Workforce Leaving the Country 2) Students Attending Undergraduate and Graduate Programs in Other Countries

The political environment of a state plays a key role in determining its fragility, and also its cybersecurity posture. Table 3 identifies some connections between political indicators and cybersecurity. Issues such as election security, which is a current topic, impact the fragility of a state

Table 3: Political Indicators and Cybersecurity

Indicator	Connection to Cybersecurity
State Legitimacy	1) Cyber Tampering in Elections 2) Social Media Attacks Against the Government
Public Services	1) Equal Access to the Internet 2) Cybersecurity Programs Accessible to All Interested Students
Human Rights and Rule of Law	1) Cyber Bullying 2) Freedom of Speech and Freedom of Religion not Censored on Social Media or the Internet 3) Media Free from Government Influence 4) Equal Access to the Internet and Information

Fragility of a state can be assessed via several social indicators. Table 4 connects two social indicators with cybersecurity issues.

Table 4: Social Indicators and Cybersecurity

Indicator	Connection to Cybersecurity
Demographic Pressures	1) Internet Sustainability—support growth in terms of people accessing the infrastructure
Refugees and Internally Displaced Persons (IDPs)	1) Internet Access 2) Cyber Bullying 3) Disinformation and Misinformation

Finally, the cross-cutting indicator of external interventions is related to cybersecurity in terms of cyberwarfare, as indicated in Table 5.

Table 5: Cross-Cutting Indicators and Cybersecurity

Indicator	Connection to Cybersecurity
External Intervention	1) Cyber Warfare 2) Cyber Espionage 3) Disinformation and Misinformation 4) Propaganda

METHODOLOGY

As this is an introductory exploratory study, we obtained the Fragile States Index and the National Cyber Power Index. We connected the indicators on the Fragile States Index to cybersecurity issues based on our expertise in the cybersecurity profession and current topics that are receiving media attention, e.g., election security and human rights. Then we investigated the relationship between a nation’s ranking on the National Cyber Power Index and the Fragile States Index. We next plan to review the literature on each indicator and cybersecurity issue. The analysis phase will attempt to define a relationship between a nation’s ranking on the Fragile States Index and the National Cyber Power Index.

RESULTS

The National Cyber Power Index published by the Belfer Center for Science and International Affairs at Harvard University ranks cyber-powerful counties based on a multitude of indicators, including several that are considered in the Fragile States Index. These include a states’ capacity to: surveil and monitor domestic groups, control and manipulate the information environment, and collect foreign intelligence for its own national security. Being a player in establishing technical standards gives countries power, as does developing a thriving and robust cybersecurity industry. Cyber power is viewed from both defensive and offensive postures.

Table 6 lists the ten most cyber-powerful countries and their ranking on the Fragile States Index. It is interesting to note that the top countries in cyber power rank fairly low on the Fragile States Index.

Table 6: Comparison of Rankings

Ranking per National Cyber Power Index	Ranking per Fragile States Index
1) United States	143 rd
1) China	95 th
1) UK	150 th
1) Russia	74 th
1) Netherlands	168 th
1) France	159 th
1) Germany	167 th
1) Canada	171 st
1) Japan	161 st
1) Australia	170 th

DISCUSSION AND FUTURE RESEARCH

The 2021 Fragile States Index ranks Yemen as the most fragile state among the 179 countries it measures (Fund for Peace, 2021). The civil war has created humanitarian and infrastructure problems. Lingaas (2018) reported that cyberwarfare is an important component of combat there. When the opposition gained physical control of Sanaa, Yemen's capital of Sanaa, they took kinetic control of the country's internet backbone turning it in to YemenNet. Experts say vulnerabilities exist because the hardware and firmware is manufactured in China. The existing government countered by establishing AdenNet, its own Internet Service Provider (ISP). Researchers at Recorded Future and VirusTotal have found increases in viruses and malware on this network (Lingaas, 2018).

The Fragile States Index also highlights countries with the largest changes in their fragility in both positive and negative directions. For example, in 2021, the United States saw the largest year-to-year worsening in its fragility. Analysts speculate police violence, election insecurity, and the impacts of the Covid-19 pandemic were major contributors to the decrease. We acknowledge cyber threats against United States systems are increasing in number and severity, and discuss the role important cybersecurity topics, such as disinformation and misinformation, has on the nation's rankings.

Future research is needed to validate the assumptions we have made regarding the cybersecurity implications of the indicators. Additionally, we plan to identify correlations among a nations' rankings on both Indices. We believe that nations with high ranks on the Cyber Power Index will be ranked low on the Fragile States Index, and vice versa.

REFERENCES

- Albertson, A. and Moran, A. (2017). *Untangling the Complexity of Fragile States*. Truman Center. <https://www.strausscenter.org/wp-content/uploads/Untangling-the-Complexity-of-Fragile-States-2017.pdf>
- Caramancion, K. M., Li, Y., Dubois, E., & Jung, E. S. (2022). The Missing Case of Disinformation from the Cybersecurity Risk Continuum: A Comparative Assessment of Disinformation with Other Cyber Threats. *Data*, 7(4), 49.
- Dawson, M., Tabona, O., & Maupong, T. (Eds.). (2022). *Cybersecurity Capabilities in Developing Nations and Its Impact on Global Security*. IGI Global.
- Fund for Peace. (2021). Fragile States Index. <https://fragilestatesindex.org/global-data/>
- Lingaas, S. (2018, 28 November). How Cyberwarfare is Playing into Yemen's Civil War. *Cyberscoop*. <https://www.cyberscoop.com/yemen-civil-war-cyberwarfare-recorded-future-cyberwarcon/>
- Messner, J. J. (2020). Fragile States Index Annual Report 2020.
- Shackelford, S., Raymond, A., McCrory, M. A., & Bonime-Blanc, A. (2022). Cyber Silent Spring: Leveraging ESG+ T Frameworks and Trustmarks to Better Inform Investors and Consumers about the Sustainability, Cybersecurity, and Privacy of Internet-Connected Devices. *Cybersecurity, and Privacy of Internet-Connected Devices (January 7, 2022)*.
- Tijerina, W. (2022). Industrial policy and governments' cybersecurity capacity: a tale of two developments?. *Journal of Cyber Policy*, 1-19.

Voo, J., Hemani, I., Jones, S., DeSombre, W., Cassidy, D., & Schwarzenbach, A. (2020).
National Cyber Power Index 2020. *Belfer Center for Science and International Affairs,
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EXPLORING IOT SECURITY RESEARCH DIRECTIONS

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EXTENDED ABSTRACT

DESCRIPTION OF THE STUDY

The purpose of this proposed study is to explore and prioritize research directions on security issues for IoT (Internet of Things). IoT devices are widely used in various industries and our daily lives and are increasingly contributing to the advancement of technologies and services ranging from smart cities, smart homes, smart health to smart data collection and process automation. It is estimated that there will be over 20 billion IoT device connections by 2022 and the IoT business revenue will grow from less than \$9 billion in 2018 to \$4 trillion by 2025 (Hassija et al., 2019; Sarkar et al., 2022). However, expansion of interconnected systems and devices with sensitive data is vulnerable to increasing cyber threats and attacks. Therefore, the security of IoT networks has become a challenging but essential and significant topic for further research to seek solutions and maintain steady and healthy growth of the IoT industry (Imran et al., 2021; Lee & Lee, 2021; Rajmohan, Nguyen, & Ferry, 2022). This study plans to review relevant research literature of the last 10 years and conduct interviews of selected IoT security experts to identify and characterize the major security challenges, vulnerabilities, and risks at different IoT network layers and prioritize the challenges based on the metrics of security goals. The outcome of the study will be a valuable contribution of taxonomy with significant research issues and directions for IoT security researchers.

BASIS OF THE STUDY

Comprehensive and effective metrics are essential to identifying and prioritizing security challenges and risks for IoT networks. This study plans to adopt the metrics for security challenges and requirements proposed by Dabbagh and Rayes (2017) for identifying, evaluating, and prioritizing IoT security issues for research. Their proposed metrics or variables for recognizing various IoT security challenges are: (1) Multiple Technologies – a combination of RFID, wireless sensor networks, cloud computing and virtualization; (2) Multiple Verticals – various IoT applications such as eHealth, smart homes, smart cities, etc. with various security challenges; (3) Scalability or capacity for connection expansion; (4) Big Data with large streams of data to secure; (5) Availability or 100% operational; (6) Resource Limitations that can be an easy vulnerability for DoS attacks; (7) Remote Locations for IoT sensors may present physical security challenges; (8) Mobility for smart objects presents extra challenge for developing dynamic and efficient protection mechanisms; and (9) Delay-Sensitive Service may be another vulnerability for DoS type attacks. To assess and prioritize the security vulnerabilities and risks of IoT networks, the following metrics for IoT security requirements are used for this study: (1) Confidentiality – only known to the intended entities; (2) Integrity – no tampering; (3) Authentication – intended entities are who they claim to be and free from impersonation attacks; (4) Availability – no disruption of operation or service; (5) Authorization – with permission to perform requested operation; (6)

Freshness – data is fresh and without old data for replay attacks; (7) Non-repudiation – an entity cannot deny a performed action; (8) Forward Secrecy – an object leaving the network will not understand communications after its departure; and (9) Backward Secrecy – new objects will not understand prior communications (Dabbagh & Rayes, 2017).

CONCLUSIONS AND IMPLICATIONS

This proposed study will use comprehensive metrics to identify and prioritize IoT security issues for research consideration. The security issues will include major vulnerabilities and risks at different layers of IoT networks, including Application Layer, Middleware or Support Layer, Network or Data Communication Layer, and Sensing Layer. The taxonomy of the identified IoT security challenges will include descriptions and analysis of the security vulnerabilities, threats, and attacks with suggested countermeasures and methods for risk assessment and management. The interviews and the taxonomy of the study will contribute valuable research reference and expert insights on the significant issues of IoT security.

REFERENCES

- Hassija, V., Chamola, V., Saxena, V., Jain, D., Goyal, P., & Sikdar, B. (2019). A survey on IoT security: Application areas, security threats, and solution architectures. *IEEE Access*, 7:82721 – 82743, 2019.
- Imran, Ali, S.M., Alam, M.M., & Su'ud, M.M. (2021). A survey of IoT security issues – From past to future trends. *Journal of Computer Science*, 17(11), 1031 – 1045.
- Lee, J.Y., & Lee, J. (2021). Current research trends in IoT security: A systematic mapping study. *Mobile Information Systems, 2021* (Article ID 8847099), 1-25.
DOI: <https://doi.org/10.1155/2021/8847099>
- Rajmohan, T., Nguyen, P.H., & Ferry, N. (2022). A decade of research on patterns and architectures for IoT security. *Cybersecurity*, (2022) 5:2, 1-29.
DOI: <https://doi.org/10.1186/s42400-021-00104-7>
- Dabbagh, M. & Rayes, A. (2017). Internet of Things security and privacy. In A. Rayes & S. Salam (Eds.). *Internet of Things – From hype to reality* (pp. 195–222). Springer International Publishing AG.
- Sarker, I.H., Khan, A.I., Abushark, Y.B., & Alsolami, F. (2022, March 14). Internet of Things (IoT) security intelligence: A comprehensive overview, machine learning solutions and research directions. *Mobile Networks and Applications* (2022).
DOI: <https://doi.org/10.1007/s11036-022-01937-3>

THE ADVANTAGES OF VIRTUAL MEETINGS IN ENGINEERING ENVIRONMENT

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EXTENDED ABSTRACT**PROPOSED STUDY**

With the emergence of the COVID pandemic, organizations across the globe were forced to transition from traditional face-to-face meeting structures to virtual (e.g., Webex, Zoom, Skype, etc.) forms. In an earlier study, we examined this shift from a dramaturgical point of view (Nugent & Montague, 2020). While this highlighted some interesting aspects of front-stage versus back-stage realities as well as new forms of embarrassing social gaffs, the study did not consider the impact this shift may have on productivity and performance. Therefore, this study explores some of the most critical activities and skills in engineering environments and considers how the shift to virtual may impact performance – both positively and negatively.

The researcher is a participant observer who has compiled ethnographic field notes on system development practices in the defense contracting industry for over two decades. This has included the authoring of requirements specifications, design/architecture documents, as well as test cases. Ethnographic methods were used in the collection and analysis of the data (Lofland & Lofland, 1984; Strauss & Corbin, 1990). True to grounded theory research philosophies, there is no specific theory or hypothesis driving the data gathering and analysis, rather the ethnographer utilizes codes to allow key themes and patterns to emerge (Belgrave & Seide, 2019).

BASIS OF STUDY

Communication has been identified as a critical, if not the most critical, skill in engineering environments (Bucciarelli, 1996); Collin, 2005; Jonassen et. al. 2006; Moaveni, 2020; Nugent & Montague, 2017; Sheppard, S., Colby et. al, 2006; Trevelyan, 2007; Vincenti, 1990; Vinck, 2003. Engineering expertise is highly specialized and distributed unevenly across teams and organizational departments. For example, according to (Anderson, et. al., 2010),

Engineers identify a nuanced set of communication and coordination skills as the most important skills within their work...Within the increasingly complex and distributed nature of many engineering projects, engineers must not only rely on traditional communication skills of writing, speaking, and listening, but they must also understand how to effectively use organizational structures and sometimes subtle channels of communication. [p. 169]

The technical, political, and social information required to perform one's task is never incomplete and always open to revision compelling both formal and informal (impromptu) meetings. In traditional face-to-face meetings participants gather in a specific location and the meeting leader projects content (documents, spreadsheets, slides, etc.) onto a screen. The presenter and the participants discuss the topics/statuses directly in the face-to-face environment. While this is

productive in many ways, the shift to virtual introduces changes to these dynamics that may impact productivity (Wolff, 2005).

Somewhat obviously, virtual meetings by definition mean that the participants do not need to be physically present at a specific place. This overcomes many practical and logistical challenges of co-location. The virtual meeting application also provides a listing of the participants that are currently on line which facilitates identification of attendees and the preparation of meeting minutes where applicable.

Perhaps more importantly, virtual meeting applications make it possible for all participants, not just the main presenter, to easily share their screens and exhibit content. In engineering environments, this flexibility is extremely effective in sharing ideas and solving problems. Each participant has, at his or her fingertips, the totality of electronics documents they have access to both locally on their computer and on the organization's network. During working meetings, it is very common for participants other than the main presenter to request that they share their screen in order to communicate information relevant to the task or problem at hand. This is also quite common in impromptu meetings between two engineers - and these meetings are often initiated from online chat sessions.

Virtual meeting applications also provide a "side chat" feature that introduces a parallel communication channel that does not exist in any meaningful way in traditional meetings. In the side chat, participants often ask questions when they do not want to interrupt the main dialogue. It is also a popular means to share links to files that participants may want, or have requested, in the main meeting. It is also the preferred method of injecting humor into the meeting. There are times in most meetings in which the materials being presented/discussed are not directly relevant to a participant. During those times, the participant may shift his or her attention to other tasks while still listening to the meeting. This is particularly common and enabled when they are not currently sharing their video or audio.

Another potential benefit of virtual meetings is the capability to record the meeting. While not often used in engineering meetings, it is potentially useful when some workers are unable to attend the live meeting and are then able to view the recording at a later time.

Therefore, the shift to virtual introduces new modalities of communication and new communication channels that improve engineering productivity. However, as many of you have experienced in virtual meetings, there are also disadvantages. The primary issue is the lack of full face-to-face communications – especially when none of, or only a small handful of, the participants share their video. Gestures, cues, physical appearance, demeanor, deference, etc. that often communicate important social information is lacking. This dilutes the building of social bonds between individuals and self-identity. Furthermore, most if not all of the virtual meeting applications do not allow concurrent audio transmissions rendering the natural flow of dialogue choppy and potentially prone to abuse by those who want to control the information channels. Finally, some participants may be marginalized when the application is configured to only show a subset of the participants on the screen and will bring into focus those that are speaking or are have higher levels of participation.

IMPLICATIONS OF THE STUDY

The shift to online/virtual conferencing is novel to many and represents a change in the taken-for-granted modalities and channels of communication. It is clear from the themes identified in this abstract that some of the most critical features of engineering work relating to information sharing and real-time dialogue may be enhanced by virtual media. These themes are applicable to other professions and occupations as well; however, they are particularly germane to the demands of engineering or other highly technical modes of work. Scholars and practitioners should be alert to the potential for this shift to disadvantage some participants in certain situations as well and use this awareness to take steps to minimize these impacts.

REFERENCES

- Anderson, K, Courterb, S, & McGlamery, T. (2010). Understanding engineering work and identity: a cross-case analysis of engineers within six firms. *Engineering Studies*, 2(3), 153–174.
- Belgrave, L. L., & Seide, K. (2019). Grounded theory methodology: Principles and practices. In Liamputtong, P. (Ed.), *Handbook of research methods in health social sciences*. Springer. https://doi.org.ezproxy.lib.vt.edu/10.1007/978-981-10-2779-6_84-2.
- Bucciarelli, L. (1996). *Designing Engineers*. Cambridge, MA: The MIT Press.
- Collin, K. (2005). *Experience and Shared Practice: Design Engineers' Learning at Work*. Jyvaskyla : University of Jyvaskyla.
- Jonassen, D, Johannes S., & Lee, C. (2006). Everyday Problem Solving in Engineering: Lessons for Engineering Educators. *Journal of Engineering Education*, 95(2), 139–51.
- Lofland, J & Lofland L. (1984). *Analyzing Social Settings*. Wadsworth Inc.
- Moaveni, S. (2020). *Engineering Fundamentals: An Introduction to Engineering*. Cengage Learning.
- Nugent, P. D. & Montague, R. D. (2020). *Leveraging Dramaturgical Analysis to Understand the Transition from Face-to-Face to Virtual Environments*. International Association for Computer Information Systems, Nashville (online), Tennessee.
- Nugent, P. D. & Montague, R. (2017). *The Review Function in Organizations and its Implications for Organization Theory, Cybernetics, and Ethnography*. Complexity, Informatics, and Cybernetics: IMCIC 2017, Orlando, Florida.
- Sheppard, S., Colby, A., Macatangay, K, & Sullivan, W. (2006). What Is Engineering Practice?. *International Journal of Engineering Education*, 22(3), 429–438.
- Strauss, A. & Corbin, J. (1990). *Basics of Qualitative Research: Grounded Theory Procedures and Techniques*. Sage Publications.
- Trevelyan, J. (2007). Technical Coordination in Engineering Practice. *Journal of Engineering Education*, 96(3), 191–204.
- Trevelyan, J. (2008). The Intertwined Threads of Work. *Engineers Australia*, 80(2), 38–9.
- Vincenti, W. (1990). *What Engineers Know and How They Know It*. Baltimore, MD: Johns Hopkins University Press.
- Vinck, D., ed. (2003). *Everyday Engineering: An Ethnography of Design and Innovation*. Cambridge, MA: The MIT Press.
- Wolff, R., D. J. Roberts, A. Steed & O. Otto. I (2005). A Review of Tele-Collaboration Technologies with Respect to Closely Coupled Collaboration. *International Journal of Computer Applications in Technology*, 29(1), 11–26.

PREDICTING 30+ DAY LATE MORTGAGE PAYMENTS

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ABSTRACT

Currently across the United States the mortgage market is booming, creating a flood of available mortgages on the secondary market. With the influx of available mortgages for investors to purchase the space has become highly competitive and companies are looking for competitive advantages with limited time and resources to invest in the mortgages. The purpose of this study is to show how the use of machine learning and neural networks can help predict mortgages that will have 30+ day late payments. These mortgages can be identified using predictive analytics with machine learning and neural networks. By quickly identify these mortgages investors can spend time on more profitable loans to invest in or adjust their pricing models to accommodate the lower return they would expect for loans that might become delinquent.

Keywords: Machine Learning, Neural Network, Predictive Analytics, Secondary Mortgage Market

INTRODUCTION

Congress created the secondary mortgage market in 1938 with the formation of Fannie Mae, which purchased FHA mortgages. Most mortgages sold on the secondary market today end up in a mortgage-backed security (MBS). The first MBS was issued in 1968. Thereafter, the MBS market grew rapidly with outstanding issuances exceeding \$9 trillion by 2010.

Investment firm now days focus on trying to purchase as many high performing mortgages as they can because the return made on those loans is substantially more than low performing mortgages. A high-performing mortgage is a mortgage that stays current on all payments. A low-performing mortgage is a mortgage that has one or more payments that are 30+ days past the due date. The purchasing of mortgages on the secondary market by an investment group is an important process and one that requires the use of both loan-level data and current secondary market rates. Secondary market rates are built on basis points such as 103 basis points meaning that the buyer or investor will pay a dollar and three cents for every dollar. An example would be if a mortgage was taken out for \$100,000 the buyer would pay \$103,000 for that mortgage. This paper is going to focus on one aspect of the process and that is the loan-level data and looking to predict if a loan will have a late payment of 30 or more days late during the life of the mortgage.

Artificial intelligence has started to have a major influence on mortgages and the lending process. Farris, Chelsey (2021) talks about all the ways that AI is currently shaping the mortgage industry and the lending process. Two of the main topics Farris talks about are the use of Optical Character Recognition (OCR) being used to scrape data out of non-uniform documentation used across the industry to streamline the process and the ability to automate data validation. Sadok, Hicham & Sakka, Fadi & Maknouzi, Mohammed. (2022) talk about how AI opens up the door for more data

points that can now be used in the credit process that before would not have been possible, and how with the addition of the new data sources new unforeseen biases could arise.

LITERATURE REVIEW

In the mortgage industry, the diligence and underwriting process is a detailed assessment of the borrower's overall economic and financial position, in the case of an investor purchasing a mortgage on the secondary market, it is a review of the origination data and documents to confirm that the mortgage and borrower data is correct, while also allowing the investor to validate the data points they have deemed important for evaluating the profitability and overall value of a mortgage. Once the data is verified, it is then reviewed to see if the data meets a specific data standard or mortgage guideline. The guideline standards can vary depending on the focus of the investor or their appetite for risk, but the data points they are reviewing are standard across the industry. Those data points include but are not limited to Loan to Value (LTV), Debt to Income (DTI) and the borrower Credit Scores.

According to the Oxford dictionary, machine learning is the use and development of computer systems that can learn and adapt without following explicit instructions, by using algorithms and statistical models to analyze and draw inferences from patterns in the data. Fabian Pedregosa et al. (2018) talk about what machine learning is and then the python module of scikit-learn. The paper focuses on how scikit-learn provides state of the art machine learning algorithms to non-specialist using python.

Pillai, Sivakumar (2019) looked at building a machine learning model that assess the credit risk of mortgage related exposures to financial institutions. The goal was to build a model to help identify mortgages that would eventually default. The overall results of the project were successful in that they were able to accurately predict loans that would default with just over an eight five percent accuracy. However, this research project did not account for a large set of loans that for a time become delinquent but eventually catch up and become current.

Gupta, Navin (2017) focused on 5 ways that recent advances in data sciences will have a major impact on the mortgage industry. First, Gupta touches on how machine learning can help with several aspects throughout the whole industry. Another topic in the article is how there are underlying bias in the credit evaluation process and how many institutions do not even know these biases exist. Lastly, Gupta mentions how AI can look to help extract data from the loans and using Natural Language Processing and Neural Networks to enable machines to 'read' the documents.

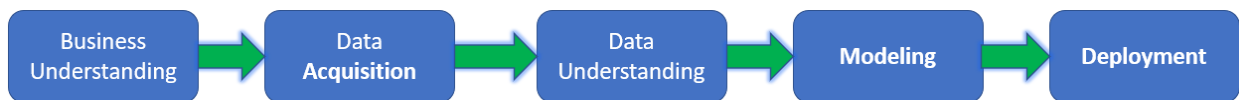
Handzic, Meliha (2003) looked at how the use of neural networks could help to identify good loan applications from bad loan applications. The goal was to compare the efficiency and accuracy of identifying good loan applications from bad applications using three different models: Multi-Layer Perceptron, Ensemble Averaging, and Boosting by Filtering. They were able to show how the 3 various models could improve identifying good loans from bad loans, but they noted that more trust is going to be needed before models like their neural networks can gain a larger acceptance in the business world. Again, they focused on identify loans that would be paid off and loans that would default.

Albanesi, Stefania, and Domonkos, Vamossy (2019) focused on using deep learning to predict consumer default. The model they built provides favorable credit risk assessment to young borrowers relative to standard credit scoring models, while accurately tracking variations in systemic risk. Again, this model focuses on identifying defaults to help with risk but does not look to identify credit risk associated with late payments.

RESEARCH METHOD

DATA SCIENCE PROCESS

In building our model, we followed the Data Science process, which follows a flow of gaining business understanding, gathering the data, and understanding it, modeling the data, and deploying a model.



Business understanding: We reached out to a mortgage aggregator, and spoke with members of the data team, accounting team, and financing team. While we understood the business process of purchasing mortgages and the criteria used to evaluate mortgages for purchasing, we interviewed several members on the various teams to see their side of the mortgage purchasing process. The ultimate criteria we discussed was figuring out the best way to identify mortgages that will be considered high-performing mortgages. To be considered high performing, it must have no later payments of 60 days or more throughout the life of the mortgage. Another explored data point could be identifying mortgages that become reperforming again, which means the borrower gets caught back on payments and is back on their monthly payments schedule. These criteria fell out of scope due to a lack of available data and resources to work through to find what was defined as reperforming loans.

Data Acquisition: For the data acquisition and understanding, we were able to go out to Fannie Mae’s website¹ where they have 20+ years of mortgage data and a data dictionary for their available datasets. You can download as little as one financial quarter worth of data up to the complete data set over 20 years’ worth of data. The downloads are broken into comma-separated values (csv) files, one for each quarter of each year. The files range in size from as small as 1 gigabyte up to 38 gigabytes. The data set in each file consists of millions of rows with 108 features. At first, we thought each file was a snapshot of all mortgages from that quarter, but as we looked closer, we realized it was mortgages originated in that quarter. Then each row was a snapshot of the mortgage from Origination month and year to current day or the last updated payment on the mortgage. Once we had the data downloaded and started our analysis, we quickly realized that with our current time and resources we were not going to be able to use all the data provided, from there we narrowed our choice of data down to 2018 first quarter through 2020 second quarter. Now that we had a good data set to work with, the next step was to start analysis and gain an understanding of the data.

Data Understanding: We quickly noticed that many fields were primarily null, so we eliminate those fields right away as a possible point of bias within the data if we were to keep the columns with no reasonable way to solve for the missing values. Our next step was to aggregate several

features to condense the multiple rows for each mortgage down to one entry per mortgage. Once we had narrowed down our dataset to one entry per mortgage, we then worked on some more data cleaning. Some of the items we looked at were outliers within the dataset and for any missing values. For the missing values we use a couple different techniques to provide a value. For current unpaid balance and remaining months, we were able to use the latest value or find public records to help get those values. For credit scores we were able to use 0 in place of the missing values. This is because it is common for some borrowers to not have a credit score, so it was reasonable that the value was 0. Once we felt confident the data was cleaned, we now needed to go, and dummy encode the categorical columns. As we were going through the categorical features, we were able to begin eliminating several more. We removed the address fields as we were not bringing in any secondary data that would make this data valuable to the model, and to encode the column would have made the dataset too wide. Some of the categorical features we did encode were Purpose, Property Type, and Borrower Occupancy Status. Once we finished cleaning and encoding our data files, we were down to 45 features from the original 108 features. Now, it was time to split our data into training, validation, and testing sets. In doing this, we quickly noticed our data was skewed in terms of the number of mortgages with late payments and number of mortgages without late payments (table 1). To solve this, we ended up taking the same random number of mortgages with late payments as the same random number of mortgages without late payments. Our final dataset was 817,650 mortgages with 45 features after encoding the categorical features.

Table 1: Loan counts

	2020Q 2	2020 Q1	2019 Q4	2019 Q3	2019 Q2	2019 Q1	2018 Q4	2018 Q3	2018 Q2	2018 Q1
Delq	15149	39957	46686	50625	33228	31904	41233	50600	48155	51287
Not Delq	12206 18	64378 5	64333 2	62303 7	37416 1	30996 1	37980 7	44941 8	40642 6	40754 3
Total	12357 67	68374 2	69001 8	67366 2	40738 9	34186 5	42104 0	50001 8	45458 1	45883 0

Modeling: The first model we built was a logistic regression model using backward propagation. We created multiple models using all 45 features and a second model to compare using backward propagation. We did this to focus on not overfitting the model so that it was not fit specifically to our data set and could be used across multiple mortgage data sets. The various models we tried to build were all classification based machine learning models and one artificial neural network (ANN). The last thing we did was to take the z-code from the ANN third activation layer and run it through several machine learning models to boost the results. The main machine learning models we ended up using were logistic regression models, decision tree models, and random forest models due to our dataset being so large and having limited resources. In using the random forest model, we had to set the hyperparameter of how many trees to use in the forest for this ensemble model. To do this, we used the elbow method to select the ideal number of trees to use in our random forest without overtraining the model because the more trees you use the better the performance will be (figure 1). Each tree you add will increase the model’s overall accuracy, but at a cost and at a specific point the cost outweighs the gain. It will cause the model to be overfitted to your particular dataset, meaning you have set the model to match your specific data set and it is

not reusable for a new similar dataset. The elbow method allows us to run the model using various hyperparameters and then plot the misclassification results to find the point in our graph (the elbow) where the cost outweighs the reward for adding more trees to our model.

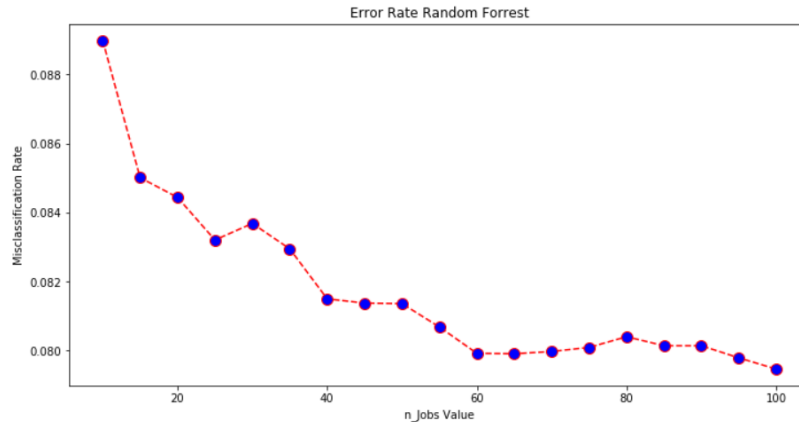


Figure 1: Elbow point

Deployment: Once we had our findings and our results, we needed to deploy the model or models. It is essential to know we could have a fantastic model that is very arcuate, however, if it cannot be deployed the model will never provide any value to the customer. The things to consider in a model and model deployment are model stability, reliability, and scalability. It is also best to consider what technology and resources the customer has readily available.

In our case we would need to deploy this on a mortgage aggregator or mortgage originators infrastructure so, that they could take our model and apply it to the mortgages, they are buying to improve the quality of those loans. The real-world application of the model might be in the pricing model to define what they will pay for a mortgage, or in a decision process for deciding to buy a mortgage.

RESULTS

We ended up running multiple models using various machine learning algorithms, one neural network, and several more machine learning algorithms using the z-code output from the 3rd activation layer of our neural network.

Of the machine learning models we ran using our cleaned dataset, the best performing model was the Random Forest Model we ran using 60 trees as our hyperparameter. This model returned an accuracy of just over 92 percent.

The neural network we used was a PatternNet model with three hidden layers which resulted in an accuracy of 94 percent (Figure 2). The model used Scaled Conjugated Gradient training and Cross-Entropy for performance. (See Figure 3 for Confusion Matrix)

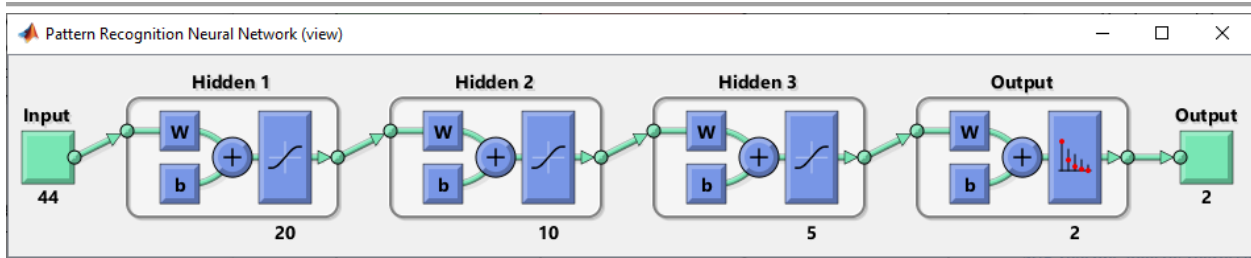


Figure 2: Pattern Recognition Neural Network

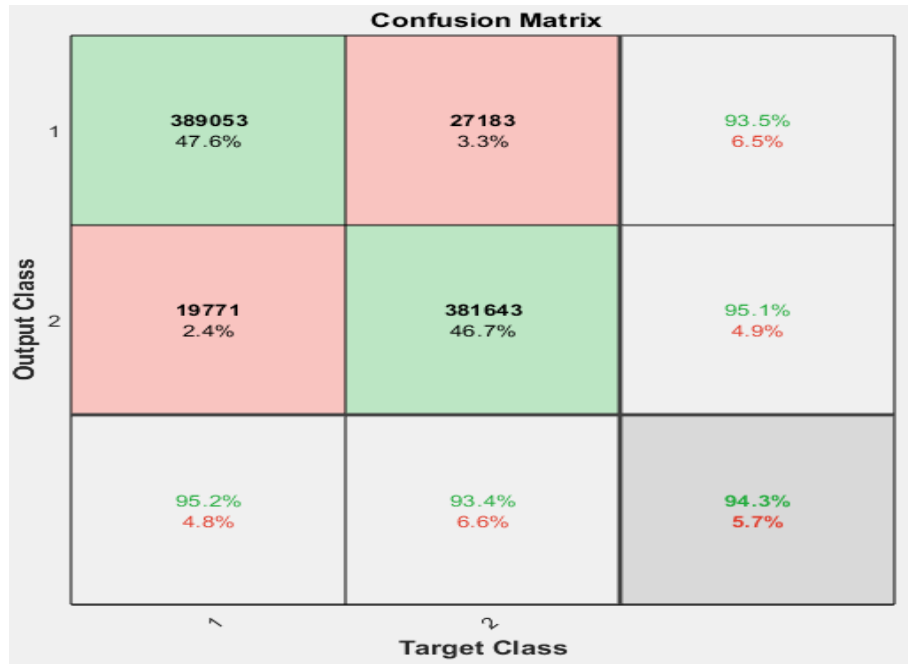


Figure 3: Confusion Matrix from neural network

The last models we ran used the Z-Code from the 3rd activation or hidden layer in our neural network; because we pulled the code at the 3rd level, we ended up with only three features. This result made our data much less complex and allowed us to run some additional machine learning algorithms that we were not able to run on the larger data set with 44 features, including various Support Vector Machine algorithms and even a nearest neighbor model. Using the Z-code, we were able to improve the results with some algorithms but decrease the performance on others. The best performance was using a 10-degree polynomial model and the worst ended up being a support vector machine using the sigmoid training model.

CONCLUSION

The results of using AI and machines learning techniques on loan data shows promising results in helping companies to distinguish between mortgages that will stay current and mortgages that will experience late payments at some point during the life of the amortization period. This information can be used to help mortgage aggregators to focus their resources more efficiently on the loans they want to purchase. Not only can it help with that it can also be used to improve their programs they use to buy loans as well as improve their pricing models in what they will pay for a loan using the standard data used across the industry.

We agree with (Gupta, Navin.) in that AI and machines learning are just getting started in the Mortgage industry in helping companies improve their risk management and continue to build on the studies that have already been done using loan level data. We believe soon we will start to see even more complex models that wont just be using the vast amounts of loan level data but will also start to incorporate additional data sources like census data to pair with the loan data.

REFERENCES

- Handzic, Meliha, et al. “How Neural Networks Can Help Loan Officers to Make Better Informed Application Decisions.” *Proceedings of the 2003 InSITE Conference*, 2003, <https://doi.org/10.28945/2602>.
- Gupta, Navin. (2017). “5 Ways AI and Machine Learning Will Revolutionize the Mortgage Industry.” *LinkedIn*, LinkedIn, 9 Feb. 2021, <https://www.linkedin.com/pulse/5-ways-ai-machine-learning-revolutionize-mortgage-industry-gupta>.
- Pillai, Sivakumar G., et al. “Machine Learning Analysis of Mortgage Credit Risk.” *Advances in Intelligent Systems and Computing*, 2019, pp. 107–123., https://doi.org/10.1007/978-3-030-32520-6_10.
- Albanesi, Stefania, and Domonkos Vamossy. “Predicting Consumer Default: A Deep Learning Approach.” 2019, <https://doi.org/10.3386/w26165>.
- Farris, Chelsey. (2021) “The Future of AI in Mortgage.” *Capacity*, 12 Oct. 2021, <https://capacity.com/ai-and-automation-in-mortgage/the-future-of-ai-in-mortgage/>.
- Sadok, Hicham & Sakka, Fadi & Maknouzi, Mohammed. (2022). Artificial intelligence and bank credit analysis: A review. *Cogent Economics & Finance*. 10. 10.1080/23322039.2021.2023262.
- Fabian Pedregosa, Gaël Varoquaux, Alexandre Gramfort, Vincent Michel, Bertrand Thirion, Olivier Grisel, Mathieu Blondel, Andreas Müller, Joel Nothman, Gilles Louppe, Peter Prettenhofer, Ron Weiss, Vincent Dubourg, Jake Vanderplas, Alexandre Passos, David Cournapeau, Matthieu Brucher, Matthieu Perrot, Édouard Duchesnay. (2018, June 05). *Scikit-Learn: Machine learning in Python*. Retrieved April 11, 2022, from <https://arxiv.org/abs/1201.0490>

STRATEGIES FOR FACILITATING UNIVERSITY STUDENT ENGAGEMENT IN ONLINE INFORMATION SYSTEMS COURSES

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ABSTRACT

For a host of reasons, university students are participating in online courses (i.e., a single course through complete programs). As such faculty, have refined strategies and techniques for facilitating instructor-to-student(s) and student-to-student engagement in online courses. Thus, the purpose of this presentation is twofold: (1) to share examples of techniques for facilitating instructor-to-student(s) engagement and (2) to share strategies for facilitating student-to-student engagement in information systems courses. Samples of instructor-to-student(s) engagement techniques in discussion forums and in feedback portals will be shared. Instances of student-to-student engagement strategies will be put forward. Illustrations of how content links, rubrics, videos, and other tools to facilitate engagement will be highlighted throughout the presentation.

Keywords: discussion forum, feedback, online courses, student engagement

**STRATEGIES FOR STREAMLING STUDENT LEARNING OUTCOME
ASSESSMENTS FOR BOTH EXTERNAL AND INTERNAL AUDIENCES IN AN
INFORMATION SYSTEMS AND OPERATIONS MANAGEMENT DEPARTMENT**

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ABSTRACT

The importance of documenting student learning outcomes and subsequent continuous improvement activities is engrained in the very fabric of higher education. The purpose of this presentation is to share an evolving framework for streamlining assessment activities within an information systems and operations department. Specifically, three distinct external and internal audiences are served: (1) external regional university accrediting body; (2) external college accrediting body; and (3) internal university core curriculum sub-committee. Individual departmental baccalaureate degree programs (e.g., Business Analytics, Computer Information Systems, and Logistics and Supply Chain Management) are assessed by the external regional accrediting body. All bachelor degree programs are assessed by an international external accrediting agency. Selected courses offered by the information systems and operations department are included in the university core curriculum framework serving both departmental and college programs. A framework illustrating the interrelatedness of assessments and continuous improvement activities for streamlining the process will be highlighted during this presentation.

Keywords: accreditation, assessment, continuous improvement, external and internal audiences

IS EDUCATION IN SAP'S ERP SOFTWARE "RELEVANT"?

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EXTENDED ABSTRACT

INTRODUCTION

This paper is based on the author's experience with teaching enterprise resource planning (ERP) to IS and business students over the years. The ERP systems used were SAP R/3, ERP, and S/4HANA. By "relevant" we mean, does learning how to handle SAP's software matter with regard to student understanding of ERP and ERP systems. Taking into account that in their future business life, students will most likely come in contact with an ERP system, the question is whether an SAP course does provide them with a level of competence that will enable them to effectively use, introduce, or perhaps select an ERP system.

A common approach to teaching SAP's ERP systems is executing typical business processes (such as order-to-cash, sourcing, quality assurance) in class, following a case study based on a model company. Model company means that the "company" – including business background, organizational structures, data structures, business rules, and business processes – is already implemented. In this way, an effective starting point for working with the ERP system is available. The model company mostly used today is *Global Bike International, Inc. (GBI)*, a midsize multinational manufacturer and vendor of high-end touring and racing bikes [Magal et al., 2021]. Locations are in the US, Germany, and a few other countries.

CRITERIA AND ARGUMENTS

Based on two decades of teaching ERP courses with SAP software, we identified four primary reasons why these courses do *not* provide students with a substantial knowledge of enterprise resource planning.

1) *Abstraction gap*: Operational terms are different from the terminology and concepts students learn in their business classes. For example, in a production or operations management course, students may have become familiar with terms like production strategy, service level quality, and operations performance. When executing a real-world production process, they need to handle things like purchase requisitions, goods issue postings, or routings. These terms are on a rather low abstraction level, and new to most students. Furthermore, many case-study instructions are of the type: "click on xxx, then click on xxy, and in the subsequent screen enter the value yy in field xyz". Since these clicking sequences are on a low abstraction level, students tend to lose track of the higher-level business process (Kurbel 2014).

2) *Unknown business concepts*: When configuring or executing a process with an SAP ERP system, decisions must be made relating to business concepts. In an ERP form, this may show up as a checkbox to be marked, a button to be clicked, or a link to be followed. These choices often refer to business methods that may be selected or that need to be configured. SAP's software incorporates quite advanced methods, but what if the student does not them? An example is a

screen where parameters of forecast methods can be set. Unless students have a background in advanced forecasting methods, they will hardly know, for example, what the effect of setting a “gamma factor” in exponential smoothing is. Hence, they cannot reasonably stipulate the parameter.

3) *Non SAP systems*: Although the probability that the student will later be exposed to an SAP system is significant, the majority of students will work with other ERP systems. Many of these systems differ substantially from an SAP system. SAP is the global ERP market leader in terms of revenue, but SAP is not the only vendor. Hundreds of other ERP systems do exist, very many with market shares below 1 %. Most studies (e.g. Pang et al., 2021) show around 2/3 of the vendors belonging to the “Others” group (typically systems with < 5 % market share). SAP's customer base are primarily large companies. Most companies worldwide, however, are small or midsize (99.4 % of German companies are "Mittelstand" (Rudnicka, 2022), 97.5 % of US companies have fewer than 20 employees (US 2022)). These companies typically employ one of the “other” systems. Knowledge of SAP systems is not relevant.

4) *Industry-specific solutions*: Many ERP vendors offer specialized ERP systems, fulfilling the needs of a certain industry or market niche. The majority of ERP systems are of this type. An industry-specific system differs significantly from a general ERP system such as SAP ERP or S/4HANA. As an example, consider an ERP system for diemakers, a subsegment of the mold industry. End products are, for example, folding boxes and stand-up displays. Diemakers use basically one type of machinery, allowing them to cut all types of dies. The entire ERP system is arranged around this simple production process.

5) *High uncertainty in planning*: In many industries, make-to-order is the dominating production type, with product specifications provided by the customer. A vitally important task is to create reasonable quotations based on a reliable cost calculation, yet for products that have never been built before. This means that the data needed for a calculation (bills of materials, routings, utilization of equipment, etc.) are not available. A general ERP system such as SAP ERP or S/4HANA cannot handle this situation. However, there are industry-specific solutions for make-to-order manufacturers that do provide a certain level of support. For example, mERPio, an ERP system for the mold industry (<https://www.meusburger.com>), has features for making a rough, experience-based calculation first, and later – when more data is available – to substitute the rough calculation with a refined one.

CONCLUSION

The answer to the initial question "does SAP education matter?" is: "to some extent". In our experience, students do not really gain an understanding of ERP, but through the work with an SAP ERP system, they learn what “real-world” business processes and business objects are like. Without an ERP course, they are likely to miss out on objects like quotations, order headers, bills of materials, delivery call-offs, or ATP (available-to-promise) quantities, because these objects are below the level of abstraction used in their other study courses.

Case-study based teaching of SAP ERP systems is useful, but it is by far not sufficient to provide students with substantial competence and insights in ERP. At least two extensions are required:

1. The business concepts supported by the ERP software need to be explained *before* students start with an SAP course. For example, if the focus is on production, students should have taken a course teaching them what master production scheduling, routings, forecast methods, lotsizing, and lead-time scheduling are about.
2. Students should get to know other ERP systems, too, in order to recognize the diversity of real-world enterprise resource planning. It is highly beneficial if they get a chance to work with an industry-specific ERP system and/or a customer-oriented system for one-off production.

REFERENCES

- Magal, S., Weidner, S., Word, J.: Global Bike Group – Background and overview of Global Bike strategy and operations, ver. 4.0; SAP University Alliances, SAP UCC Magdeburg, Germany, Sep 2021.
- Kurbel, K.E.: Reengineering the teaching of SAP SCM – How to make students understand what they are clicking in supply network planning; in: Proceedings of CENTERIS 2014, Troia, Portugal.
- Pang, A., Markovski, M., Micik, A.: Top 10 ERP Software Vendors, Market Size and Market Forecast 2020-2025; <https://www.appsruntheworld.com/top-10-erp-software-vendors-and-market-forecast>, Dec 24, 2021 (accessed May 11, 2022).
- U.S. Diplomatic Mission to Germany: About the US – U.S. Economy – Small Business; <https://usa.usembassy.de/economy-small.htm> (accessed May 11, 2022).

BLOCKCHAIN TECHNOLOGY FOR RENEWABLE ENERGY: FEATURES, APPLICATIONS & FORECASTS

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ABSTRACT

Blockchains, or distributed ledgers, are innovative information and communication technology (ICT) solutions that are emerging within various sectors and industries across the globe. This decentralized ledger is already widespread in various sectors, but mainly in the banking industry, often through corresponding banking, or syndicating and peer-to-peer (P2P) loans. Importantly, Blockchain technology enhances transparency and authenticity of processes throughout the whole supply chain and thus, auditability of all of the transactions recorded and updated every 10 minutes. Moreover, it ensures the anonymity and privacy of all of the network participants. Another significant benefit that Blockchain technology provides, mainly coming from its transparent and decentralized nature, is the capability to decrease the information asymmetries among the collaborating partners. Through e.g. the digitalization of the transactional mechanisms, decentralization of authority, Internet of Things (IoT) and asset management enabling as well as smart contracting, the improvement of the business day-to-day operations is firmly forecasted. Importantly, the digitalization of the energy sector will cause major alteration in current structures, and thus, it will require business model innovation.

Importantly, blockchain application is systematically growing across different industries, for instance in healthcare, voting systems, manufacturing, supply chain management, or luxury goods. It has also gained the attention of the energy industry, where digitalization is already visible in solutions such as smart meters and smart grids, electric e-mobility, vehicle-to-grid (V2G), energy cryptocurrencies and tokens, etc. This has resulted in the introduction of a novel concept of the Internet of Energy (IoE) in the academic literature.

In this study, the level of know-how, as well as major benefits and barriers associated with Blockchain technology implementation, are investigated through semi-structured interviews with the renewable energy industry experts. This methodology, together with the specific target groups selected, makes this study an insightful and unparalleled information provider. The analysis serves to determine the prospects of blockchain diffusion in the Finnish renewable energy sector and to develop a roadmap for blockchain integration, considering the multi-level contribution required to improve the current state of affairs. This curiosity study provides numerous theoretical and managerial implications that can foster the widespread blockchain technology diffusion in the Finnish, European, and global energy systems.

Keywords: Blockchain; Technology Diffusion; Digital Innovation; Internet of Energy (IoE); Peer-to-Peer Energy Trading; Energy Prosumers; Renewable Energy; Circular Economy

REFERENCES

- Andoni, M., Robu, V., Flynn, D., Abram, S., Geach, D., Jenkins, D., ... & Peacock, A. (2019). Blockchain technology in the energy sector: A systematic review of challenges and opportunities. *Renewable and Sustainable Energy Reviews*, *100*, 143-174.
- Bürer, M. J., de Lapparent, M., Pallotta, V., Capezzali, M., & Carpita, M. (2019). Use cases for blockchain in the energy industry opportunities of emerging business models and related risks. *Computers & Industrial Engineering*, *137*, 106002.
<https://doi.org/10.1016/j.cie.2019.106002>
- Hafeez, S., Juszczuk, O., & Takala, J. (2021). A Roadmap for successful IoT implementation: empirical evidence from the energy industry. *Issues in Information Systems*, *22(1)*, 92-113. https://doi.org/10.48009/1_iis_2021_92-113
- Hwang, J., Choi, M. I., Lee, T., Jeon, S., Kim, S., Park, S., & Park, S. (2017). Energy prosumer business model using blockchain system to ensure transparency and safety. *Energy Procedia*, *141*, 194-198. <https://doi.org/10.1016/j.egypro.2017.11.037>
- Juszczuk, O. (2020). Blockchain for Renewable Energy - Features and Applications - IACIS Europe Virtual Conference 2020, <https://youtu.be/l-Y2fIenM6M>
- Juszczuk, O.; Shahzad, K. Blockchain Technology for Renewable Energy: Principles, Applications and Prospects. *Energies* **2022**, *15*, 4603.
<https://doi.org/10.3390/en15134603>
- Nord, J. H., Koohang, A., & Paliszkievicz, J. (2019). The Internet of Things: Review and theoretical framework. *Expert Systems with Applications*.
- Shahzad, K. (2020). Blockchain and Organizational Characteristics: Towards Business Model Innovation. In: Markopoulos, E., Goonetilleke, R., Ho, A., Luximon, Y. (eds) *Advances in Creativity, Innovation, Entrepreneurship and Communication of Design*. AHFE 2020. *Advances in Intelligent Systems and Computing*, *1218*. Springer, Cham.
https://doi.org/10.1007/978-3-030-51626-0_9
- Teufel, B., Sentic, A., & Barmet, M. (2020). Blockchain energy: Blockchain in future energy systems. *Journal of Electronic Science and Technology*, 100011.
- Wang, Q., & Su, M. (2020). Integrating blockchain technology into the energy sector—from theory of blockchain to research and application of energy blockchain. *Computer Science Review*, *37*, 100275.
- Upadhyay, A., Mukhuty, S., Kumar, V., & Kazancoglu, Y. (2021). Blockchain technology and the circular economy: Implications for sustainability and social responsibility. *Journal of Cleaner Production*, 126130.

ACTUALIZING GENDER AND RACIAL DIVERSITY INCLUSION IN COMPUTING FIELDS

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EXTENDED ABSTRACT

PROPOSED STUDY

Women represent less than 28% of the science, technology, engineering, and mathematics (STEM) profession (American Association of University Women [AAUW], 2020). Racially diverse representatives make up less than 37% of STEM professions (Fry et al., 2021). Both gender and racially diverse professionals exit STEM fields at a disproportionate rate compared to their Caucasian male counterparts (Fry et al., 2021).

As diverse professionals leave the field, little research has been conducted to identify the rationale for their exit to inform methods of retention for organizations. With an increasing focus on diversity and inclusion within our field, it often seems as if many companies are “talking the talk” but not fulfilling their promises with action. This research will focus on why diverse employees have considered leaving or have left their respective STEM fields with garnered feedback utilized to provide leadership strategies for an improved work experience for diverse professionals.

PROPOSED RESEARCH METHODOLOGY

This research will provide a summary of the existing data representing diverse STEM professionals alongside a survey that will gather information from diverse representatives on their work experience. Representation will come from targeted survey responses from participants of all ages, with all levels of professional experience, and from female participants of all racial representations and males of diverse representation. This survey will also gather insight into the employee’s rationale for if they were to leave – or have left – the STEM field. The survey will be conducted via SurveyMonkey’s Audience feature to reach a large target audience for a broader range of responses. Once collected, qualitative analysis will be conducted to identify patterns and similarities between responses alongside survey participant recommendations for improved work conditions.

Based on initial research, the data analysis following survey completion should show significant dissatisfaction within the STEM field from diverse candidates. Participants may identify initial apprehension to beginning a career in STEM and subsequent consideration of leaving the field. Analysis should also show concerns of pay discrimination, having to be overqualified for the same role, and lack of promotion opportunities (Grossman & Porche, 2013).

EXPECTED IMPLICATIONS

The expected survey findings will assist in informing challenges faced by diverse professionals alongside their rationale for leaving or the consideration of leaving the field. While many organizations have been vocal regarding diversity initiatives, existing diversity programs have been found to be unsuccessful (Hurtado et al., 2010). Initiatives such as mandatory diversity

training, focus on the number of diverse hires, and grievance systems are often unsupported by leadership and organizational culture and are unmeasured for internal success (Hurtado et al., 2010). Through this research, we will identify root causes of diversity challenges alongside opportunities for improvement that can be implemented within organizations. The implementation of these enhancements will increase diversity hiring, maintain employee retention, and build an environment that fosters growth of diverse professionals.

SUMMARY

STEM leaders must put an emphasis on hiring, fostering, and protecting diverse employees in STEM fields. Through this research, we will identify challenges faced by diverse professionals with opportunities for improvement to mitigate employee loss. Our research will include the current state of diversity employment in STEM fields, a survey to gather diverse professional perception, and an analysis of our findings that include improved measures for both gender and racially diverse employee retention.

REFERENCES

- Casad, B. J., Oyler, D. L., Sullivan, E. T., McClellan, E. M., Tierney, D. N., Anderson, D. A., Greeley, P. A., Fague, M. A., & Flammang, B. J. (2018). Wise psychological interventions to improve gender and racial equality in stem. *Group Processes & Intergroup Relations*, 21(5), 767–787. <https://doi.org/10.1177/1368430218767034>
- Fry, R., Kennedy, B., & Funk, C. (2021, April 1). Stem jobs see uneven progress in increasing gender, racial and ethnic diversity. Pew Research Center Science & Society. <https://www.pewresearch.org/science/2021/04/01/stem-jobs-see-uneven-progress-in-increasing-gender-racial-and-ethnic-diversity/>.
- Grossman, J. M., & Porche, M. V. (2013). Perceived gender and racial/ethnic barriers to stem success. *Urban Education*, 49(6), 698–727. <https://doi.org/10.1177/0042085913481364>
- Hurtado, S., Newman, C. B., Tran, M. C., & Chang, M. J. (2010). Improving the rate of success for underrepresented racial minorities in stem fields: Insights from a national project. *New Directions for Institutional Research*, 2010(148), 5–15. <https://doi.org/10.1002/ir.357>
- Hutton, C. (2019). Using Role Models to Increase Diversity in STEM. *Technology and Engineering Teacher*, 79(3), 16–19.
- SurveyMonkey Audience. SurveyMonkey. (2022). Retrieved June 1, 2022, from <https://www.surveymonkey.com/market-research/solutions/audience-panel/>
- The STEM gap: Women and girls in science, technology, engineering, and math. AAUW. (2020, October 5). <https://www.aauw.org/resources/research/the-stem-gap/>.

ENGAGING K-12 STUDENTS IN DISTANCE LEARNING THROUGH GAMIFICATION

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EXTENDED ABSTRACT

The world was hit with one of its largest health crises since 2020. The health crises caused many changes in day to day to life. Both teachers and students were forced adjusting to distance learning. One of the key problems associated with such transition was how to keep the students engaged while being online. Gamification has been one of the approaches adopted by many teachers. However, many teachers just used games that were the available at hand. How well are the games in achieving the engagement purpose? This paper reports a preliminary study on the use of gamification in online classes at elementary level by conducting a product review. This report concludes with a research proposal and a preliminary design for a game Time Maintenance that will hopefully engage the student in different learning techniques.

Keywords: Gamification, Distance Learning, Game Design, HCI

INTRODUCTION

The Covid pandemic forced K-12 school closures in 2020 to protect the well-beings of the society. As the result, school districts were forced to move their instructions online (Reich, et al., 2020). With limited time to prepare, teachers were scrambling to convert their class materials to an online environment (Fagell, 2020). Many teachers used whatever tools they could find, or whatever tool they had at hand, to help engage students. Among them, gamification was one of the strategies teachers utilized in their classrooms. What are different gamification tools/games used in elementary school classrooms? How well are the games in achieving the engagement purpose? What kind of features may help improve student engagement? As part of the effort to address these research questions, a qualitative study design was applied which involves gaming platforms review based on the conversations with elementary school teachers. This paper reports preliminary findings of this pilot study. A proposal on a game design that will help engage students in different learning techniques is presented at the end.

LITERATURE REVIEW

Teaching and Learning

Learners come in all different shapes and size with a wide range of different abilities. Teaching does not have a one size fits all solution however there have been universal suggestions on how to cater to the diverse range of learners in today's world. CAST, an education research and development organization created and published the Universal Design for Learning Framework and Guidelines. The UDL guidelines notes that educators should provide learners with multiple means of engagement, representation, action, and expression (CAST, 2021).

The National Academies of Sciences noted in 2018 that one of the critical elements of effective learning strategies is the learners “Curiosity and willingness to explore what one does not know” (National Academies of Sciences, 2018). Obtaining and maintaining learner’s engagement in lessons requires the educators to spark interest in the students and allow some type of control over their learning experience for the lesson while also presenting the learner with a challenge. Allowing learners to have control of how they learn allows the learner to feel empowered and motivated to participate in the lesson (National Academies of Sciences, 2018). Interest can be sparked within students by allowing the learner to make choices, relaying the importance and value of the lesson material, and to avoid student’s distractions where possible (CAST, 2021). Students should be allowed to make choices on difficulty, visual aspects, and types of activities when possible.

The National Academies of Sciences provides three instructional approaches for engaging learners. These three approaches are problem and project-based learning, collaborative learning, and providing feedback. Problem and project-based learning places more emphasis on how the learning outcome is achieved versus what the learning outcome is. According to CAST, educators should relate lessons to real life or socially appropriate scenarios so that students can understand the value of the lesson. Real world association is a key component of the project-based learning approach (National Academies of Sciences, 2018). Collaborative Learning provides students with the opportunity to understand power and labor and develop skills on how to work with others. It is important to allow students to collaborate with other students and teachers involved in the lesson. Benefits of collaborative learning provided by The National Academies of Sciences include positive social acceptance among peers, greater task orientation, and greater psychological health. Teachers should provide feedback to students to allow students to gain an interest in how they can improve on concepts within the lesson (CAST, 2021). Feedback can provide learners with guidance on how to improve for specific concepts within the lesson (National Academies of Sciences, 2018). Within the lessons or activity learners should also be provided with the opportunity of self-reflection and assessment. Self-assessment and reflection allow the learner the opportunity for engagement with self in connection to the lesson.

Technology in Education

Technology has been used widely in promoting engagement amongst students within their lessons. Technology has allowed educators to broaden and expand the types of activities and media used in their lessons. The eight key affordances of learning technologies provided by the National Academies of Sciences are adaptivity, feedback, choice, nonlinear access, linked representations, open ended learner input, communication with other people and interactivity. Some of these key affordances that are essential to classroom engagement are feedback, choice, open ended learner input, communication with other people, and interactivity. Two engaging models of learning with technology are learning through repetition and collaborative and cooperative learning (National Academies of Sciences, 2018). Learning through repetition requires the learner to continuously repeat components and concepts presented within the lesson. Collaborative and cooperative learning requires learners to work together to come up with solutions and plans to execute a task.

Gamification in Education

The use of gamification in education utilizes gaming elements to enhance students' motivation and promote learning (Kalogiannakis M, 2021) A study conducted in 2020 found that gamification had a greater impact on the retention rates of students than students who did not learn through gamification in the exercise (Putza, Hofbauera, & Treib, 2020). Gamification can promote motivation in the learner and access their interest in the topic of the lesson. The benefits of gamification in education include improvement in student engagement, increases memory retention, practice with problem-solving, allows other life and cognitive skills to be acquired and practiced while participating in the lesson, compatible with multiple learning styles, and promotes collaboration. (Zirawaga, Olusanya, Maduku, & Faculty of Applied Science, 2017). Gamification also offers an opportunity for educators to keep students engaged in distance learning settings. (National Academies of Sciences, 2018) Although learning through gamification poses many benefits there are disadvantages to consider as well. These disadvantages include access to distractions while students have access to the games, potential health hazards due to long term computer interaction, and students lack access to technologies used to access the games (Zirawaga, Olusanya, Maduku, & Faculty of Applied Science, 2017). Certain aspects of the game have to be implemented carefully or there is a risk that gamification could have the adverse effect on the learner's motivation (Putza, Hofbauera, & Treib, 2020).

In 1980 Malone conducted a study to understand what makes gaming fun in education. Within this study he was able to identify the characteristics of the most popular games that made them popular. He found that the most popular games were goal oriented, scored, and had high amounts of graphics and audio. Three elements of game play have been noted by Malone. These three elements are challenge, fantasy, and curiosity. The challenge of the game can be determined by allowing the player to have access to choose the difficulty of the game and having different goals for different levels. Fantasy is defined by Malone as mental images or sensory triggers that are not present within one's reality. These fantasy elements can include role-playing and storytelling (National Academies of Sciences, 2018). Fantasy elements within educational games tie into the requirement noted by both CAST and the National Academies of Sciences for educators to relate lessons to the real world. Fantasy allows players to identify and associate skills from the lesson that can be used in their reality (Malone, 1981). Malone also argues that it is best to incorporate an element of intrinsic fantasy in the game as it the skill relies on the fantasy and vice versa allowing the player to be more engaged in the game. To engage the player's curiosity the game should appropriately fit the skill level of the player. The player should feel challenged but should not be discouraged by the challenge (Malone, 1981).

Game Design

The National Academies of Sciences notes a few of Mayer's Principles to Guide Multimedia learning. These principles can be considered when designing games for education. The twelve principles are the coherence principle, signaling principle, spatial contiguity principle, temporal contiguity principle, segmenting principle, pretraining principle, modality principle, multimedia principle, redundancy principle, personalization principle, voice principle, and image principle (National Academies of Sciences, 2018). The coherence principle is the notion that learners can learn better when only the important information including graphics and sounds are included in

the lesson. The signaling principle states that learners can learn better when they are directed to the information that they should focus on. The spatial contiguity principle explains that learners have a better understanding of content when additional media is placed right next to the words or information that they should focus on. The segmenting principle acknowledges that the user should be able to control the pace of how information is relayed to them. The multimedia principle states that learners gain a better understanding of content when media is combined vs when media is delivered alone. The personalization principle refers to the user's ability to learn better when the style is customized to fit them.

Four questions that should be considered when designing games for education are who the players will be, what are the goals for the players, what process is used to meet these goals, and how will goal assessment be met (Zirawaga, Olusanya, Maduku, & Faculty of Applied Science, 2017). A team of researchers from Massachusetts Institute of Technology propose that the best framework to apply to game design in learning includes three models that require identification and assessment of student's skills used in lessons. These three models are the content model, evidence model, and task model. The content model identifies what the student already knows and their skill levels in relation to the lesson. The evidence model test's the students' abilities of the lesson. The task model identifies what specific attributes of the student should be targeted to allow them to reach a lesson goal. These three models are said to give the game a balanced design (Groff, Clarke-Midura, Owen, Rosenheck, & Beall, 2015).

Based on the review above, it is important to consider the range of learners when designing games and narrowing the scope to target a specific audience so that design elements can appropriately fit the audience. Once the target audience is identified the goal of the game and process should be identified. The approach for the game can then be focused on. One of the best two approaches two choose from would be project-based or collaborative for gamification. Next the implementation of the three elements of game play can be considered. Based on the target audience the level of challenge, type of fantasy, and the method to keep the student curious can be determined. Each of Mayer's Principles should be evaluated against the game design and applied.

RESEARCH METHODOLOGY

This research attempts to address the following main research questions:

1. *What are different gamification tools/games used in elementary school classrooms?*
2. *How well are the games in achieving the engagement purpose?*
3. *What kind of features may help improve student engagement?*

Before addressing how well the games perform in the classroom, we need to know which tools are used so far in elementary school classrooms. This research involves mostly qualitative research methods. The following steps were involved:

- Conduct interviews with elementary school teachers, especially those who were forced to make the transition during pandemic. This allows us to collect information regarding different tools used and the elements of the games utilized in the elementary schools.
- Conduct product reviews. The reviews would allow us to learn more about the different features provided and compare them with the design guidelines in the literature.

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- Perform a gamification design for the elementary schools to help improve student engagement
 - Conduct an experiment to evaluate the new design in terms of the effectiveness of the student engagement improvement.

As a pilot study, we had the purpose of testing the research instrument while exploring the research questions. Therefore, we limited our scope to some elementary schools in mid-Atlantic area. Interviews were conducted with ten elementary school teachers. Based on the information collected during the interviews, classroom tools used, and key elements of games were identified. A product review was then conducted to learn more detail about the games. Based on the reviews, a game design was proposed. Details of the interview process and the product review are provided in the preliminary results section below.

PRELIMINARY RESULTS

Interviews

Participants were recruited either through Tutor Doctor or through personal connections. Interviews were conducted via telephone or Zoom. No in-person meeting was conducted due to the pandemic. Each interview lasted between 30 and 45 minutes. During the interview each participant was asked 7 questions to gather information on how students are engaged in the classroom and online. The range of grade levels taught by participants is between Pre-K and fourth grade. Participants also taught a variety of subjects including math, language arts, science, and history. The experience level of all participants varied greatly. The years of experience for participants ranged from 2 years to 15 years. All participants had experience with in-person instruction previously and had conducted instruction online due to pandemic. For the purposes of discussion findings and results from interviews have been separated into four groups: sparking interest through gamification, classroom tools, evaluation rewards and feedback, and virtual tools.

Sparking Interest through gamification

Some interview participants had experience with multiple grade levels. It was expressed by these participants that the methods in sparking interest had to be different depending on the student's grade level. For all grade levels gamification was a common method used to spark the interest of students. One of the participants of the study is required to follow a school district curriculum and program. The curriculum used by this district is called "Learn through Play" where students are engaging in playful activities that allow them to acquire multiple types of academic, cognitive, and developmental skills. A common process for implementing game play found across participants were to show the students how to play the game, play together in a group environment until the students understand how to play, the rewards associated with the activities, and allowing students to play individually. Listed below in Table 1 are games shared by participants that are played in the classroom to keep students engaged as well as their instructions and benefits.

Table 1: Games Used in Classrooms

Name of Game	How to play	Benefits of the Game
I have, Who has?	The student says, “I have” and describes an object and then asks “Who has” and states an object with and adjective	<ul style="list-style-type: none"> • Builds Vocabulary • Learn Parts of Speech
Bingo	Bingo Cards are filled with content related material (i.e., Vocab words, Historical figures, math terms). Teacher randomly draws terms or definitions for students to match	<ul style="list-style-type: none"> • Builds Vocabulary • Enhances math concepts • Memorization of terms
Hangman	Student or teacher selects a content related term and allows other students to guess letters to fill in the term. If needed hints can be requested by students and given using the related definitions or information provided during the lesson.	<ul style="list-style-type: none"> • Builds Vocabulary • Memorization of terms
All around the world	All students sit in a circle. One student is selected to go around the circle student-by-student and compete to correctly answer a problem. The objective is to make it all around the circle without any mistakes.	<ul style="list-style-type: none"> • Enhances math skills
Fly Swat	The instructor places out a list of answers or terms related to the lesson. The students are provided with fly swatters. Students compete in a one-on-one fashion to swat the correct answer based on the description provided by the instructor.	<ul style="list-style-type: none"> • Vocabulary Builder • Concept enhancement • Memorize Terms
Head bands	Students are provided terms and divided into two teams. One player is selected from the team to place the term on the head while the rest of the team gives them hints to guess the term	<ul style="list-style-type: none"> • Vocabulary Builder • Concept enhancement • Memorize Terms
Role Playing	Students act out different scenarios from the lessons.	<ul style="list-style-type: none"> • Concept enhancement

Classroom Tools

Tools used in the classroom also vary based on grade level and subject matter. Common tools shared were manipulatives, magnetic letters, flash cards, word cubes, white boards, and visual aids. Manipulatives are commonly used in the classroom for mathematical operations to allow students to move, group, and perform mathematical operations on the manipulatives. Magnetic letters help students move and rearrange letters to form words and identify sounds. Flash cards allow students to review materials in a random and repetitive manner. Word cubes allow students to form sentences and identify different parts of speech. White boards allow students to write out answers to math problems or to spell different words. Visual aids include graphic organizers and pictures that organize and deliver information in a visual manner through graphics.

Evaluation, Feedback, and Rewards

During the interviews multiple methods of providing feedback were identified. These methods included small group reflection and discussion, individual feedback, and pair-and-share with other peers. During small group reflection and discussion students were allowed to reflect on the activity and share their experience. Within small group reflection and discussion sessions students could be asked to share something new they learned, enjoyed, or found interesting. Individual feedback could come in different forms. One form of individual feedback was short verbal praises after a student achieves a goal during an activity such as answering a question right. Another form of individual feedback was sitting down with students and providing them information on how they can improve their skills that will allow them to master the concept of the lesson. Pair and share allowed students to interact with another student. The students might share what they had learned. In addition, they might inform the other student something that they might not have learned during the activity. Two categories of rewards were provided during interviews. These two categories were tangible and non-tangible rewards. Tangible rewards refer to physical rewards students could hold. Examples of these tangible rewards were candy, stickers, classroom supplies, and stuffed animals. Non-tangible rewards refer to rewards students could not touch or that were not physically present. Examples of non-tangible rewards included verbal praise, out of uniform days, no homework passes, and having the title of the winner.

Virtual Tools

Participants shared different virtual tools that were already in use in their classrooms. A few of the shared virtual tools include *name wheels*, *virtual dice*, *phonics man*, *google slides*, *google jam board*, *Money Math*, *Read Aloud*, *Storyline.net*, *Kahoot*, and *Quizlet*. Zoom and Google Classroom were the most common two platforms to allow students and instructors to interact virtually. These platforms efficiently allowed delivery of the tools mentioned previously. Google slides and Google Jam Board allowed for teachers to customize and recreate in person games to be used in virtual settings. The Name Wheel allowed instructors to customize the wheel according to the students in the class and allowed students to take turns and be selected based on the wheel. Read Aloud and storyline.net allowed students to see and hear words as the story was being read aloud to improve word and sound recognition. Kahoot and Quizlet allowed for individual and team review in a competitive manner. Strengths of the virtual tools shared include the ability to customize to the needs of the class and instructor, brightly colored, highly interactive, and the ability to track student progress and to share student progress with instructor. Some weaknesses of the tools include poor functionality, poor instructions, language barriers, poor hybrid classroom functionality. Poor functionality and poor instructions made the program to be complicated to use; language barriers were experienced when the instructions and information were only provided in one language; poor hybrid classroom functionality made it complicated for certain age groups. Participants also provided suggestions for the virtual tools that they use. The most common suggestions were to improve instructions to make them clear for all users, to make them easier and clearer to navigate, and to be cost effective.

Interview Summary and Reflection

The interviews provided important insights to the types of elements that are essential to include in educational games from an educator standpoint. Prior to use and design of the game it is important to identify the goal and benefits of the game as it relates to the lesson and content. There should

be variety in the types of games played and how they are played. Games can be played individually or in a collaborative manner (i.e groups and teams). Visual aids and tools should be considered to determine how the student will accomplish goal of the game. Potential classroom tools that can be transformed into virtual tools are manipulatives, flash cards, whiteboards, and magnetic letters. When creating games, it is important to spend time creating clear and straightforward instructions that can be easily followed by all users. It is also important to ensure that the game is appropriately colored based on the theme and target audience. The price of the game should be cost effective so that all students can access full versions of the product.

Product Review

Five products were reviewed and evaluated for this report. The five products reviewed were *Quizlet Live*, *Quizlet Match*, *Quizlet Gravity*, *Kahoot* and *Adventure Academy*. These five products were selected because they were common across responses from interview participants. Six factors were examined for each game: *the quality of instructions*, *the appeal of the design*, *challenge*, *fantasy*, *tools used in and for gameplay*, and *the cost of the game*. Quality of instructions of each product were measured as either *well written* or *needs improvement*. Well written indicates that the instructions were explicit and gives clear instruction on what the players should do to achieve the goal or objective of the game. Needs improvement indicates that instructions were available but did not clearly present the objective of the game and/or how the player should achieve the objective. The appeal of design variables was based on the ages that design will appeal to. The two possible values included in this review were All Ages and Elementary-Middle school. Challenge was determined based on the class skill level or level chosen by player. When the challenge was based on class skill level, it means that the challenge of the game was determined by the competition offered by other classmates. When the level was chosen by the player, they could typically choose from easy, medium, and hard. The fantasy element was described based on the fantasy elements included in the game. Rewards described the types of rewards players receive for achieving game objectives. Cost described the price of each game. Table 2 describes the attributes observed for each game.

Quizlet Live allows students to compete as teams or in a head-to-head manner to answer questions based on lesson content. The faster that the player answers the question correctly the more points they get and they higher they are ranked on the leader board. Quizlet match has the player match terms and definitions in the shortest amount of time possible. Quizlet Gravity has players type in terms to match definitions on asteroids before they hit the planet. Kahoot is like Quizlet Live in the style of competition for students. Adventure Academy is a multiplayer virtual world that contains puzzles and quests that require students to use math and English skills to explore the virtual world.

Table 2: Summary of Product Reviewed

Product	Quality of instructions	Appeal of the Design	Challenge	Fantasy	Rewards	Cost
Quizlet Live	Well written	All Ages	Based on class skill level	No Fantasy Elements	Live Leaderboard Recognition	4.99/month
Quizlet Match	Needs Improvement	All Ages	Level Chosen by the player	No Fantasy Elements	Leaderboard Recognition	Free
Quizlet Gravity	Needs Improvement	Elementary – Middle School	Level Chosen by the player	Space Fantasy Elements	Leaderboard Recognition	Free
Kahoot	Well Written	All Ages	Based on class skill level	No Fantasy Elements	Live Leaderboard Recognition and Medals	Free 39/month 59/month
Adventure Academy	Well Written	Elementary – Middle School	Level chosen by the player	Role Playing Fantasy Elements	Coins for in game purchases	12.99/month

Quality of Instruction

The game with the best quality of instruction was Adventure Academy because the instructions clearly identified what a user needed to do to complete a game task. The instructions were also appropriately labeled with arrows to indicate what to select. The game that needed the most improvement with instructions was Quizlet Match. The instructions briefly stated the objective of the game in one sentence. The user must figure out how to achieve the objective of the game.

Appeal of Design & Fantasy

The two games observed with fantasy elements were Quizlet Gravity and Adventure Academy. These two games were also most appealing to children. The interfaces were brightly colored and easy to navigate.

Challenge

Quizlet Live and Kahoot were group-based games. The challenge for each player was determined based on their peers’ abilities to answer questions quickly and correctly. In Quizlet Match the challenge was based upon the student’s ability to answer questions quickly. Quizlet Gravity and Adventure Academy allowed the players to choose their level difficulty.

Rewards

Quizlet Live and Kahoot allowed students and their peers to see where they rank live after the game. Quizlet Match and Quizlet Gravity placed the player on a leaderboard to compare against others in their group. Adventure Academy awarded players with coins to make upgrade and accessory purchases.

Review

Brightly colored and easy to navigate designs seemed appeal to youth. It is better in individual gameplay to allow players the choice of their challenge and difficulty. Clear, concise, and appropriately labeled instructions should be included in the game play opening. Players should receive rewards in the game that provide them with morale and can also offer them the opportunity to obtain items that they would like.

GAME PROPOSAL

Overview

This section presents a game proposal based on our review above. We use a game titled **Time Maintenance** as an example to showcase how the gamification can be applied. The goal of the game is to allow players to utilize and enhance math and language skills while engaging in historical lessons. Players will have an option to participate in a multiplayer mode or an individual player mode. The multiplayer mode will allow the players to determine whether they would like to work together or compete against each other. Throughout the course of the game, players will be asked to complete mathematical challenges or grammar, spelling, and vocabulary puzzles to make it to the end of the story. Players complete all the challenges in the shortest amount of time receive their medal and a space on the leader board.

There will be hints available to students to help them solve a puzzle when they are having a challenging completing the puzzle. A puzzle can include identifying the correct part speech, anagrams, hangman, or fill in the bank. Mathematical challenges will consist of a series of 15-20 grade level appropriate math problems to be completed in under 5 minutes. Other mathematical challenges will include using virtual money to make purchase in the game and setting clocks to go back and forth in time.

Challenge

All players will have the opportunity to select their grade level. Each grade level will be programmed with dozens of different puzzles of three different difficulties. The players during individual game play will have the opportunity to select the level of puzzles that they would like to have included in their storyline. The difficulty levels can be easy, medium, and difficult. The easy level will allow at least 7 minutes to complete each puzzle with simpler puzzles and challenges to solve. The medium level will allow at least 5 minutes to complete each puzzle with slightly more challenging puzzles than easy. The difficult level will allow at least 3 minutes to complete difficult puzzles and challenges.

Fantasy

Players will be required to complete missions as agents of the Council League of Clock Keepers AKA CLOCK. As agents they will have the ability to travel through time to different time periods using their Zap Watches. The missions will require players to defeat the antics of Dr. Dateless who has scrambled multiple parts of history.

Dr. Dateless is angry at every one in time because he does not have a birthday. As a result of his anger, he goes back in time and scrambles the dates and events of different historical dates. For the players to correct Dr. Dateless's scrambles they must complete math problems and language puzzles to defeat Dr. Dateless. Between each challenge there will be a short cut away scene of Dr. Dateless taunting the player.

Rewards and Feedback

During the puzzles and challenges players will receive quick and brief audio and text praises when a math problem or puzzle is answered correctly. Players will also receive points for each puzzle or problem completed correctly. If the student answers the questions incorrectly short encouraging messages will be given to the student through text and audio. At the end of the puzzles and challenges students will receive feedback with the problems that they got incorrect and their correct answers. If the student got 70% right, they would receive bronze a medal. If the student got 80% right, they would receive a silver medal. If the student got 90% right, they would receive a gold medal. If the student is in the top 10 scorers, they will receive a spot on the leader board. At the end of the storyline players will receive a medal for successful completion. The player will also receive place on the leaderboard based on their completion time for the story.

Instructions

The instructions will be well labeled and available through audio and text. Each puzzle and challenge will have the instructions clearly stated and labeled before the start of the game. The location of the instructions will be clearly marked with a symbol that is easy to identify.

Design

The game will be available through web browsers and designed for game play on PC computers. The two forms of tools for input will be the computer mouse, touch screen, and keyboard. There will be visual and auditory output. The visual design will be brightly colored with a red and yellow color them. Figures 1-8 are examples of draft designs.



Figure 1: The home screen of the video game

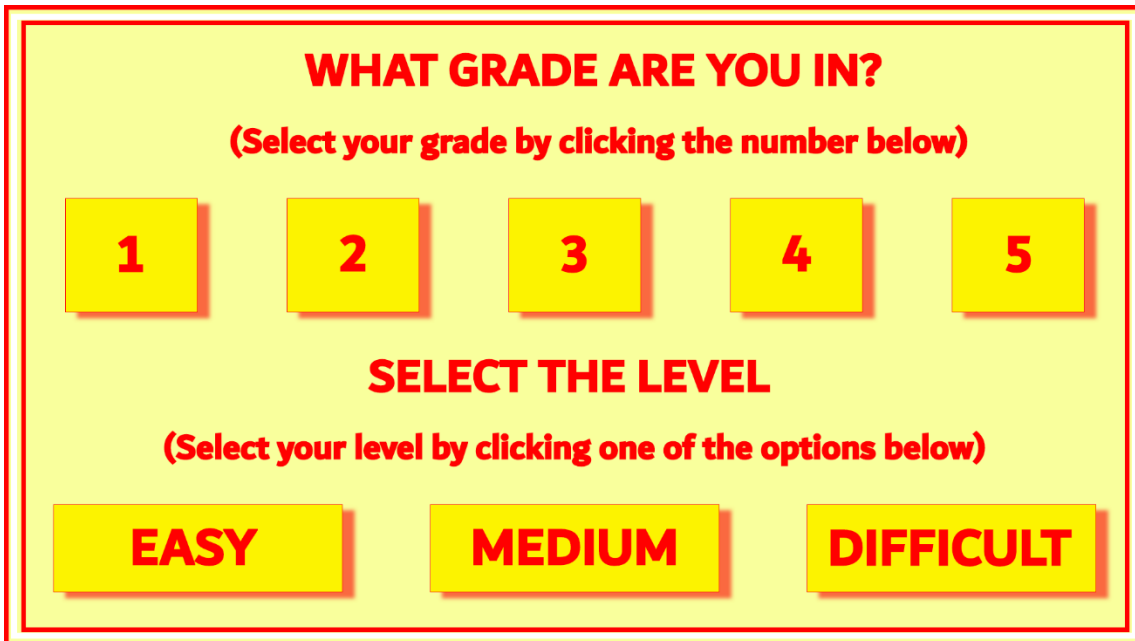


Figure 2: The difficulty selection screen

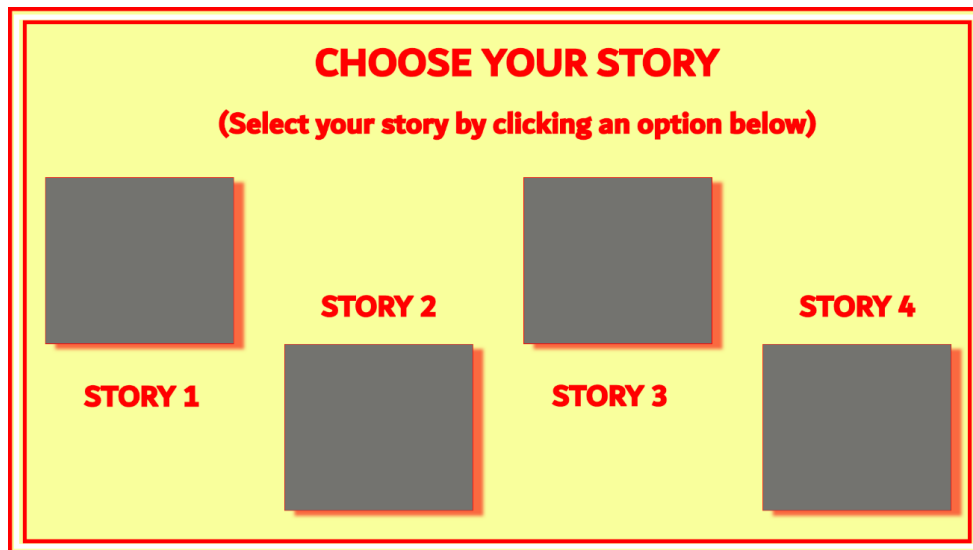


Figure 3: The screen where players can have the choice of story that they would like to play

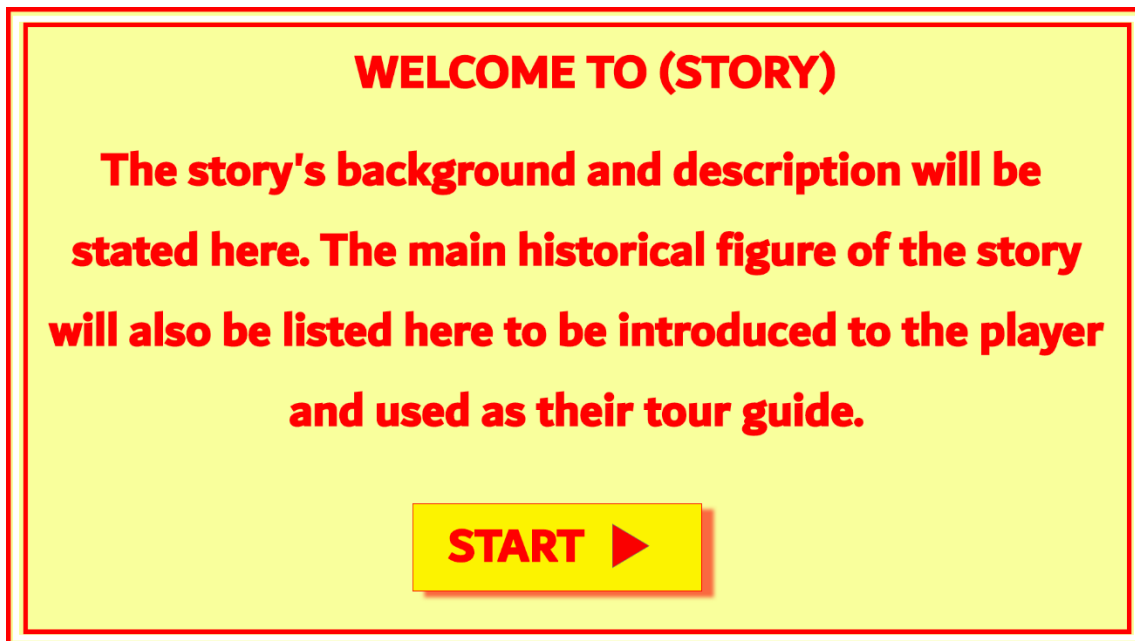


Figure 4: Story Welcome Screen

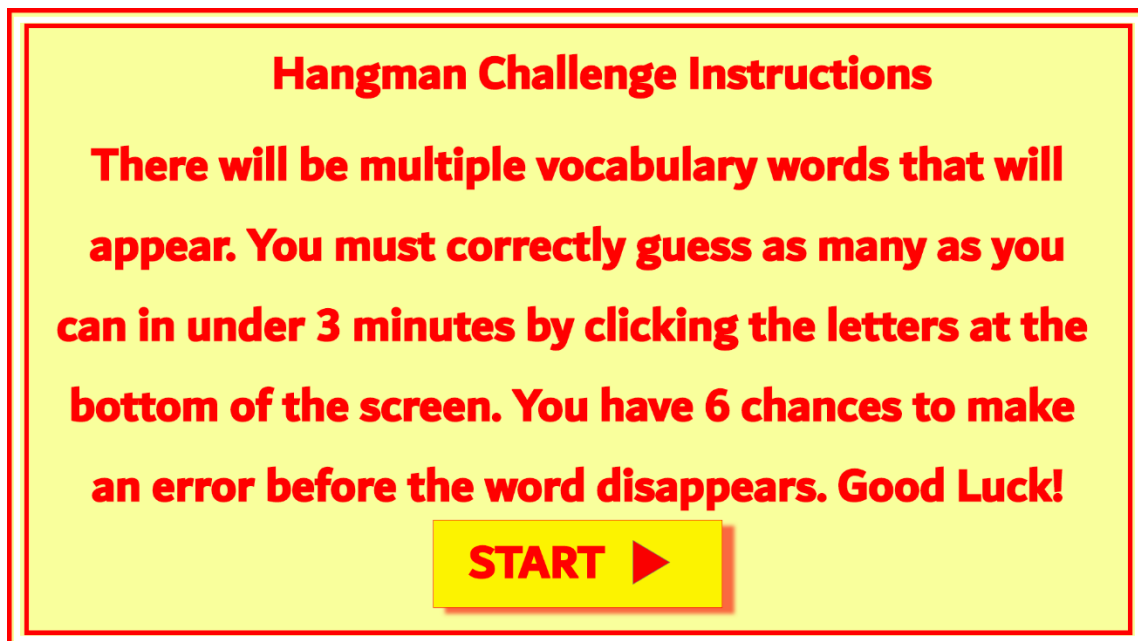


Figure 5: A sample of the challenge instructions

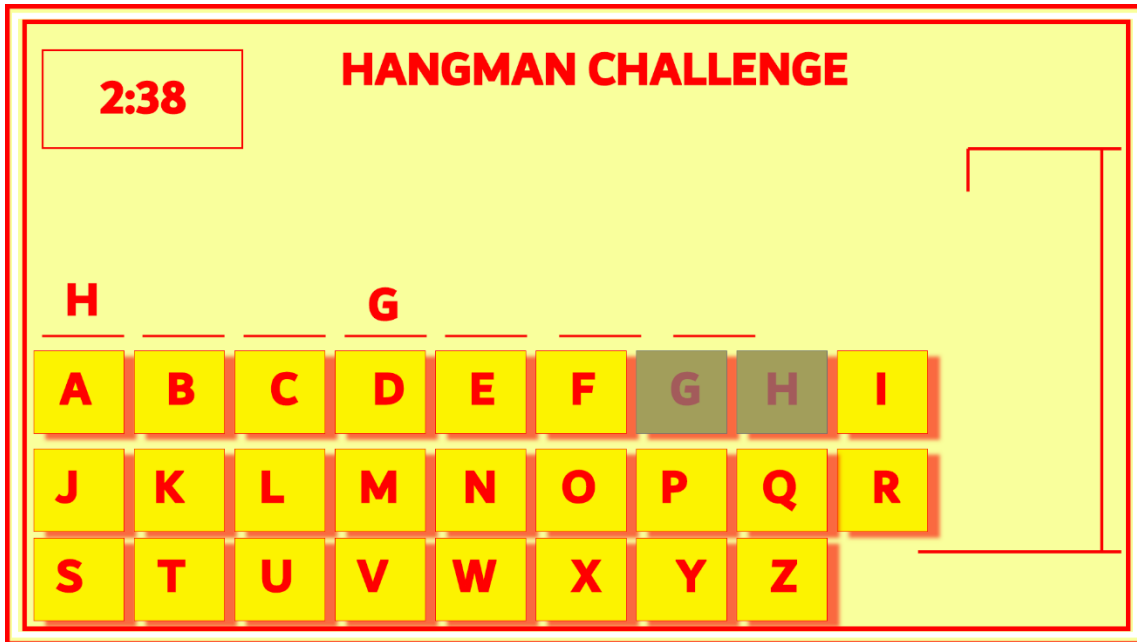


Figure 6: A sample Hangman Challenge



Figure 7: Sample congratulations screen that awards the player a medal

LEADERBOARD		
NAME	SCORE	TIME
PLAYER 1	100	1:30
PLAYER 2	100	1:50
PLAYER 3	100	2:00
PLAYER 4	95	1:30
PLAYER 5	90	1:35
PLAYER 6	90	1:50
PLAYER 7	85	1:30

Figure 8: Sample leaderboard screen

DISCUSSION AND CONCLUSION

The preliminary result of this pilot study attempted to test the research instruments while exploring the potential answers to the research questions:

What are different gamification tools/games used in elementary school classrooms? Various games/strategies were utilized in the elementary school classroom environment. However, the tools that were used when the classrooms were forced to be moved online were relatively limited. With the limited time available in the transition, teachers were forced to utilize the tools they had at hand, and the games they play previously in-person with little edits. Popular games were identified for further review based on their quality of instructions, the appeal of the design, challenge, fantasy, tools used in and for gameplay, and the cost of the game.

How well are the games in achieving the engagement purpose? The data collected so far cannot address this question formally. With the gaming elements implemented, it may potentially achieve the engagement purpose. However, more research needs to be done to address this question.

What kind of features may help improve student engagement? Similar to last research question, this also needs to be further investigated. With the brief proposal of a game design presented as the result of the pilot study, an experiment may be conducted to test the effectiveness of the features implemented.

Although due to the limited scope of the study, the result cannot be easily generalized, it does indicate further research is needed in this area. In addition, it did show that the general research design presented in the research methodology could potentially work for a formal research study. A more comprehensive study will be designed and conducted in the future to formally address the research questions stated earlier.

REFERENCES

- CAST. (2021, April 9). *The UDL Guidelines*. Retrieved from UDL:
<https://udlguidelines.cast.org/>
- Fagell, P. L. (2020). Career Confidential: Teacher wonders how to help students during coronavirus shutdown. *101*(8), 67-68. doi:<https://doi.org/10.1177/0031721720923799>
- Groff, J., Clarke-Midura, J., Owen, V. E., Rosenheck, L., & Beall, M. (2015). Better Learning in Games: A Balanced Design Lens for a New Generation of Learning Games. *Learning Games Network*, 1-29.
- Kalogiannakis M, P. S.-I. (2021). Gamification in Science Education. A Systematic Review of the Literature. *Education Sciences* <https://doi.org/10.3390/educsci11010022>, 11(1). doi:<https://doi.org/10.3390/educsci11010022>
- Malone, T. W. (1981). What Makes Things Fun To Learn? A Study of Intrinsically Motivating Games. *Cognitive and Instructional Sciences Series*, 1-95.
- National Academies of Sciences, E. a. (2018). *How People Learn II : Learners, Contexts, and Cultures*. Washington, DC: National Academies Press.
- Putza, L.-M., Hofbauera, F., & Treib, H. (2020). Can gamification help to improve education? Findings from a longitudinal study. *Computers in Human Behavior* , 1-12.
- Reich, J., Buttimer, C., Fang, A., Hillaire, G., Hirsch, K., Larke, L., & Slama, R. (2020). *Remote learning guidance from state education agencies during the covid-19 pandemic: A first look*. Retrieved from osf.io/k6zxy
- Zirawaga, V. S., Olusanya, A. I., Maduku, T., & Faculty of Applied Science, C. I. (2017). Gaming in Education: Using Games as a Support Tool to Teach History. *Journal of Education and Practice*, 55-65.

COVID-19 PANDEMIC IMPACT ON THE FRESHMAN SUPPLY CHAIN

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EXTENDED ABSTRACT

INTRODUCTION

According to a recent National Student Clearinghouse Center report there are more than one million fewer students enrolled in US institutions of higher education now as compared to 2019 prior to the emergence of the Covid-19 pandemic. Further, college enrollment is down by nearly 3 million in the past 10 years. This is a significant enrollment decline with the highest declines being in Freshmen enrollment. Per the National Student Clearinghouse Research Center Freshman enrollment went down by 2.7% from Fall 2020 to Fall 2021 for a total decline of 13.9% since Fall 2019 pre-pandemic. This in turn will have an immediate and significant impact on university enrollment, revenue and operations for the next four to six years.

While there may be some variation in classification and reporting, as far as freshman enrollment goes, those born after 1996 are considered Gen Z. Unlike the Millennials or Gen Y preceding them Gen Z was growing up in a robust economy with low unemployment. However, all that changed with the onset of the Covid-19 pandemic in early 2020. With the pandemic moving into the third year a once rosy future is increasingly uncertain. As a result of the pandemic more than half of the older Gen Z population either lost income or belong to a household that lost income. This, with ever increasing cost of attendance and inflation, has had a direct negative impact on college affordability.

BASIS OF THE STUDY

The National Student Clearinghouse Research Center research shows that there has been an “unprecedented” decline in college enrollment among high school graduates and especially so for the most underserved population of students. The percentage of 2020 high school graduates who immediately enrolled in college dropped by almost 7% during Fall 2020 at the height of the Covid-19 pandemic, a decrease that was four times greater than the pre-pandemic decrease rate of 1.5% in Fall 2019. In general, there has been a decline in the number of students graduating high school and those that do may not seek college or university enrollment. For example, in Texas, for several years since 2002 and pre-pandemic about half the high school graduates enroll as freshman in a college or university. This trend has a direct negative impact on the freshman supply chain to US Colleges and Universities.

This decline in enrollment was further exacerbated by a decline in international enrollment. Per data released by the Institute of International Education the number of foreign students studying in the United States fell sharply during the 2020-21 academic year. International student enrollment at U.S. universities fell 15% in the 2020-21 school year. Fewer than 1 million foreign students enrolled for either online or in-person classes at U.S. universities in the 2020-21 school year, comprising 4.6% of total enrollment at American higher educational institutions. That not only marks a 15% year-over-year decrease from the 2019-20 school year, but also marks the first

time since 2014-15 that fewer than a million international students have enrolled at U.S. institutions. The overall decrease in the number of foreign students in the U.S. in 2020-21 was driven by sizable reductions in first-time students coming from abroad – in many cases due to border closings, flight cancellations or other challenges caused by the COVID-19 pandemic.

IMPLICATIONS

While Gen Z is still on track to be the best-educated generation in the US they are increasingly questioning the value of a college education. The Gen Z population is adept at using technology and Internet resources for independent learning and are all about the pursuit of knowledge freely available online. In contrast, public universities are perpetually behind the curve and constantly playing catch-up with emerging cutting-edge technology. This shortcoming was magnified when colleges and universities scrambled to switch to an online modality during Spring 2020. Most did not have the technology to cater to student and faculty needs and several faculty members were ill prepared to teach online. Two years later things are not much better, and, debarring a few better resourced or funded public institutions most are still struggling. The situation is further exacerbated for traditionally resource starved minority serving institutions such as HBCUs.

Case in point is Lincoln College, an HBCU, located in Illinois. In May 2022 the College shut its doors and closed after 157 years in operation. The primary reason for the closure was an unsuccessful effort to raise millions of dollars to help recover from low student enrollment during the Covid-19 pandemic combined with a devastating cyberattack. Per University officials Lincoln College “experienced record-breaking student enrollment in Fall 2019, with residence halls at maximum capacity. Unfortunately, the coronavirus pandemic dramatically impacted recruitment and fundraising efforts, sporting events, and all campus life activities.” A ransomware attack was the final nail in the coffin. In a farewell statement it was noted that “Lincoln College has survived many difficult and challenging times – the economic crisis of 1887, a major campus fire in 1912, the Spanish flu of 1918, the Great Depression, World War II, the 2008 global financial crisis, and more, but this is different.” Unfortunately, the College was unable to survive the current enrollment and technology challenges.

CONCLUSIONS

The question then is what can be done and what needs to be done to survive and succeed moving forward? How can institutions of higher education stay relevant and adapt to the needs of the Gen Z freshman population? Unless institutions of higher education move rapidly in the right direction, we will continue to see a perilous decline in the Freshman Supply Chain. This can and will have a far-reaching impact on University budgets and viability. We are already hearing about mega-universities that can serve a vast number of students via a digital online modality and can do so at a more economical cost. While faculty are familiar with the phrase “publish or perish” the new concern for faculty and institutions of higher education should probably be “adapt or perish”. If we are not able to adapt to the needs of our students and stakeholders rapidly, we will face an existential crisis.

REFERENCES

- Inside Higher Ed. (2022, January 7). Fewer high school graduates enroll in college.
<https://www.insidehighered.com/news/2022/01/07/fewer-high-school-graduates-enroll-college>
- Jordan, A. (2022, May 10). HBCU Lincoln College Closing Due to CyberAttack, COVID-19-Induced Burdens. Black Enterprise.
<https://www.blackenterprise.com/illinois-lincoln-college-is-closing-its-doors-due-to-cyberattack-covid-19-induced-burdens/>
- NPR News & NPR News. (2022, January 13). More than 1 million fewer students are in college, the lowest enrollment numbers in 50 years – Nation & World News. NPR.
<https://www.wuft.org/nation-world/2022/01/13/more-than-1-million-fewer-students-are-in-college-the-lowest-enrollment-numbers-in-50-years/>
- Quillen, A. (2022, March 28). College Enrollment Is Down, But Experts Say There Could Be Silver Lining. NBC 5 Dallas-Fort Worth.
<https://www.nbcdfw.com/news/local/college-enrollment-is-down-but-experts-say-there-could-be-silver-lining/2925922/>
- Silver, L. (2021, December 9). Amid pandemic, international student enrollment at U.S. universities fell 15% in the 2020–21 school year. Pew Research Center.
<https://www.pewresearch.org/fact-tank/2021/12/06/amid-pandemic-international-student-enrollment-at-u-s-universities-fell-15-in-the-2020-21-school-year/>

THE CIRCULAR ECONOMY AND DISRUPTIVE TECHNOLOGY

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ABSTRACT

A circular economy is an economic system of production and consumption. The system mandates sharing, using, restoring, and reusing existing materials and products as long as possible (Europarl, 2022). The circular economy has gained tremendous attention among scholars in many fields, including natural sciences, technology, and management. In this presentation, we aim to present 1) various definitions of circular economy, 2) its current state of the research and how it is trending, and 3) focus on digital and disruptive technology research, i.e., artificial intelligence, blockchain, 3D printing, IoT, digitalization, etc., and their influence on circular economy. We will conclude this presentation by discussing some future directions for research.

Keywords: Circular economy, digital technology, disruptive technology

REFERENCE

Europarl (2022). Circular economy: definition, importance, and benefits. Retrieved from <https://www.europarl.europa.eu/news/en/headlines/economy/20151201STO05603/circular-economy-definition-importance-and-benefits>

PANEL
TOOLS, TECHNOLOGY, AND DESIGN FOR ONLINE TEACHING: FROM
RECORDING TO SOCIAL MEDIA MANAGEMENT

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ABSTRACT

This panel session will provide an overview of the use of various recording and editing software, discuss the content development and recording process, and provide an overview of instructor social media management (YouTube and Instagram) as it relates to online teaching. It will also discuss online course design concepts from Quality Matters and provide actionable ways to incorporate them into your courses. Panel participants will listen to an overview of topics and then be given time to develop a lesson plan for a video lecture or demo to apply in an online course. Objective: Participants leave with tools and techniques for recording and producing material for online classes, as well as a guide to promoting and managing online course content on social media.

THE EDITORS PANEL

Prashant Palvia, pcpalvia@uncg.edu, University of North Carolina Greensboro, USA
Alex Koohang, alex.koohang@mga.edu, Middle Georgia State University, USA
Joanna Paliszkievicz, joanna_paliszkiewicz@sggw.edu.pl, Warsaw University of Life Sciences,
Poland

The Editors Panel will discuss what it takes to publish in a high-quality journal. Topics include: the paper topic, the research question, the paper anatomy, methodology, and navigating the review process. Three editors from reputed journals representing six journals will provide advice on these topics. Much of the time will be devoted to answering the attendees' questions. The qualifications of the three editors are provided below.

Prashant Palvia, is the Editor-in-Chief of the *Journal of Global Information Technology Management (JGITM)*, an international journal in Information Systems and in its 20th year. *JGITM* has the highest impact factor among all IS journals focused on publishing international IS research. Prashant is also Associate Editor for *Information & Management*, a top tier IS journal.

Alex Koohang is the Editor-in-Chief of the *Journal of Computer Information Systems (JCIS)*. Going on 6 years, the journal is one of the oldest MIS/IT/IS journals. *JCIS* aims to publish manuscripts that explore information systems and technology research.

Joanna Paliszkievicz is the Deputy Editor-in-Chief of *Management and Production Engineering Review* – a multidisciplinary journal covering a variety of topics in production engineering and management. She is also the Associate Editor of the *Journal of Computer Information Systems*, *Expert Systems with Applications*, and *Intelligent Systems with Applications*.

AN INVESTIGATION OF MUNICIPALITIES SOCIAL MEDIA DEPLOYMENT IN THE PROCESS OF PUBLIC RELATIONS

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Prashant Palvia, University of North Carolina Greensboro, pcpalvia@uncg.edu

EXTENDED ABSTRACT

As digitalization increases, social media usage among public institutions has also increased. Since the interaction and communication have been enhanced with the advent of social media, it is being increasingly used by organizations for building relationships with its various constituents. In this light, public relations (PR) is an area where social media is being used by various municipalities. “A municipality is a single administrative division having corporate status and powers of self-government and jurisdiction as granted by national or regional laws to which it is subordinate” (Wikipedia - <https://en.wikipedia.org/wiki/Municipality>). The Internet and social media enable municipalities to directly send the content of their messages, without gatekeepers and editors. This has radicalized the meaning and purpose of communication among peers. Municipalities have significant importance in developed nations and besides regional development, they assist the advancement of democracy in their region. However, studies investigating social media deployment by municipalities, its advantages and disadvantages, and the variety of obstacles in the process are quite limited.

Social Media is one of the emerging topics in Information Systems research and this study illuminates one of the most important social media usage practices in local administration in view of public relationship management. Techniques used in the process of public relations (PR) have vital importance in the final success of these activities. Recent technological advances that we have experienced have caused immense change and influence in local governments and their management practices. With this study, we aim to examine various social media practices used by municipalities to further their mission, especially in their PR efforts. We also hope to unravel the variety of different social media cultures prevailing among municipalities.

THE BASIS OF THE STUDY

We use multiple methodologies to conduct this study. By administering (1) a survey instrument, and (2) a content analysis of the web sites of different municipalities, we identify and assess the social media deployment levels and characteristics of municipalities investigated. Our study is primarily descriptive in nature in which we try to outline the extent and manner of usage of different social media tools by municipal authorities. The study is conducted in Turkey and the municipalities are selected from Sakarya, a Turkey governance district. There are sixteen different municipalities in the Sakarya province and all of them are included in the study. The data was processed by using SPSS v20.

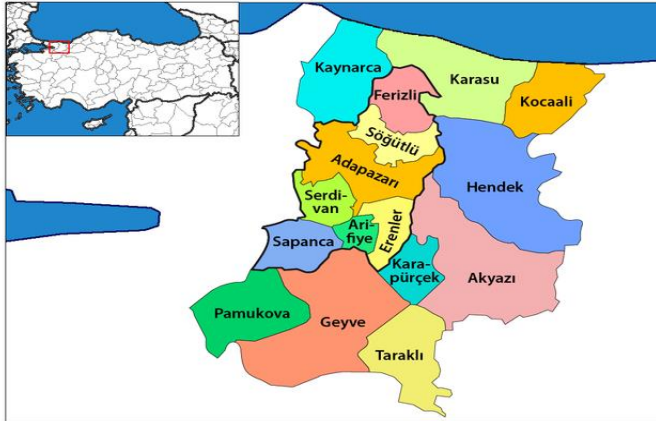
IMPLICATIONS

Social media has tremendous effect and use today in all organizations, including municipalities. Social media adoption by Turkish municipalities, especially in rural areas are continuously

increasing. This transforms the relationships among citizens of small Turkish cities in rural areas and their respective municipalities. Our primary findings reveal that surprisingly almost all Sakarya’s sixteen district municipalities, regardless of how small they are, have adopted and are using at least one social media platform to communicate with their citizens.

PRELIMINARY FINDINGS AND CONCLUSIONS

Sakarya is located in northwest Turkey. It is about 120 km east of Istanbul and has sixteen municipalities as seen in Figure 1 below.



Almost all district municipalities of the Sakarya Province have at least one social media account, except the Karapürçek municipality. Karapürçek is so small and remote that probably the mayor and his aides never felt a strong need to have any social media account.

Figure 1: Districts of Sakarya

Based on the survey responses from 16 district municipalities of Sakarya province except Karapürçek, all other municipalities have Facebook accounts. Similarly, except again Karapürçek, all Sakarya municipalities have Twitter account and Instagram account. Interestingly, regarding YouTube account, some municipalities have it, yet some other municipalities do not have it. Closer investigation reveals that a YouTube Account ownership does not depend on the size of the municipalities. For example, some big Sakarya district municipalities such as Sapanca, Erenler and Arifiye have reported that they do not have a YouTube account.

Each municipality’s number of followers seems to be directly a function of the population of the municipality. Some of the municipalities did not provide their total number of social media followers. Probably the responsible person did not have the current numbers. In general, the number of social media followers in different Sakarya municipalities is relatively small considering the total population of the province (2 million people). Hence, we could easily argue that the municipalities in Sakarya still have a long way to go in terms of social media diffusion and presence of their activities and services.

It seems Adapazarı, Erenler, Karasu and Sapanca municipalities have strong and continuous interaction among their followers on social media and they are doing a good job in managing their social media accounts. On the contrary, large central municipalities like Serdivan and Arifiye are not doing a good job in management of their social media accounts, as evidenced by the number of likes for their social media accounts. The success of social media account management seems to depend on how much importance it is given by the mayor and his or her administrative team.

The final question in our survey was about the percentage use of different social media activities by the municipalities. We identified four different major activities as: corporate activities; social and cultural activities; announcement and disclosure activities; and condolence, commemoration and celebration activities. There is a balanced usage of social media among these four different activities, except that the municipalities seem to make a slightly higher use of social media for announcement and disclosure activities.

In summary, different social media platforms seem to be becoming one of the major ways of communication for Sakarya's district municipalities in Turkey. In a developed country context, it has important and significant implications. Our study informs other local governments in the appropriate deployment of social media for their PR and other efforts.

A LOW-CODE/NO-CODE APPROACH TO THE SYSTEMS ANALYSIS AND DESIGN COURSE

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EXTENDED ABSTRACT

INTRODUCTION

The Systems Analysis and Design (SA&D) course has been one of the foundation pieces of the undergraduate MIS degree curriculum. The courses that appear in these programs typically focus on topics like the System Development Life Cycle, tools and techniques for analysis and design and a variety of other topics. These courses are often limited to focusing on the design process and are constrained by the difficulty of implementing the systems that are designed. The emergence of low-code/no-code software development tools offer MIS educators the opportunity to design a course which allows students to engage in the full range of SA&D activities.

DESCRIPTION OF THE STUDY

This paper examines the status of the SA&D course in Information Systems curricula and proposes a course structure which takes advantage of advances in low-code/no-code platforms as well as offering students experience in Agile and Scrum development processes. A sample of 37 of the top undergraduate MIS programs (College Factual.com, 2022; US News and World Report Best Colleges Rankings, 2022) was examined to determine which programs have SA&D courses and to ascertain the focus of these courses. Of the 37 programs, 31 feature SA&D courses. Of these 16 are titled SA&D with the remainder using other variations of this theme. An examination of the course descriptions shows that only 15 of these courses require an analysis and/or development project. Of these 15, only 8 require an actual project implementation. Of these, none of the specifically address using low-code/no-code platforms to develop a working information system in the context of a term project. The most commonly occurring terms found in the course descriptions are SDLC, Object-Oriented Programming and CASE tools.

A LOW-CODE/NO-CODE IMPLEMENTATION

This study proposes a Systems Analysis and Design course structured around Agile and Scrum Development and requires students to design and implement an information system using a low-code/no-code platform. The first half of the semester is spent addressing analysis and development topics such as Information Gathering Methods, Data Flow Diagrams, Process Specifications, Designing Databases, and Human-Computer Interaction and UX Design. The second half of the semester is spent exclusively on the term project. Students are required to use the Mendix Low-Code Platform which is structured around the Agile/Scrum development methodology. Students form teams, appoint team members to Scrum roles, develop a project backlog, and complete several (typically 5) sprints. Each sprint culminates in a stand-up which the team presents to the entire class. This process culminates in the delivery of a working information system for an internal or external client.

IMPLICATIONS AND CONCLUSIONS

Gartner estimates that by 2024, low-code application development will be responsible for more than 65% of application development activity. The literature search for this study revealed only two papers which proposed a low-code approach to the SA&D course (Wang, S., & Wang, H., 2021) and Wang, H., & Wang, S., 2022). Since industry is moving rapidly toward using low-code/no-code platforms for information systems development projects, it is incumbent for universities which offer MIS or IS programs to provide relevant experience for their students using these platforms in the context of a real-world project based on Agile and Scrum methodologies. It appears that, currently, the top MIS/IS programs are not doing so. This represents a tremendous opportunity for specific MIS/IS programs to become the most relevant in this area.

REFERENCES

- College Factual.com, *2022 Best MIS Bachelor's Degree Schools*, Retrieved May 20, 2022.
- US News and World Report Best Colleges Rankings, *2022 Best Undergraduate Business Management Information Systems Programs*, Retrieved May 20, 2022.
- Wang, H., & Wang, S. (2022). Improving student performance by introducing a no-code approach: A course unit of decision support systems. *Journal of Information Systems Education*, 33(2), 127-134.
- Wang, S., & Wang, H. (2021). Teaching tip: A teaching module of no-code business app development. *Journal of Information Systems Education*, 32(1), 1-8.

BIG DATA TOOLS FOR ANALYTICS IN IS RESEARCH

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EXTENDED ABSTRACT

A growing amount of data is stored in a digital form. The authors commenced a research project with 63,000,000 tweets and proceeded to analyze the big data. We searched for the top open-source big data analytics tools to manage and analyze our data set. We describe Apache Hadoop, Apache Cassandra, KNIME, and RapidMiner, and we explain our rationale for choosing one big data analytics software platform to manage and analyze our data set. Given the use of big data in government and business, it is imperative that students in IS programs are taught big data analytics. The software of one big data analytics tool, KNIME, facilitated easy storage and management of big data. However, we found Python code easier to implement for the analysis portion compared to this one big data analytics software platform. Hence, it is essential for students in Business Analytics programs to learn Python code to be competitive in the job market.

Keywords: big data, data analytics, analytics software

INTRODUCTION

Pervasive digitization is ever-present. A growing amount of data is stored in a digital form. The wide-spread use of the web, social media, mobile devices, and sensor network and the falling costs for storage and computing resources have resulted in almost ubiquitous and growing digital record of computer mediated actions and communications termed big data (Müller et al., 2016). Big data is voluminous, but it may have other characteristics such as velocity and variety (McAfee & Brynjolfsson, 2012). Government and private companies have big data (Müller et al., 2016). Major corporations have various platforms utilizing big data (Parupudi, 2018). Big data analytics are applied to big data resulting in new information flows and improvements in firm performance (Parupudi, 2018; McAfee & Brynjolfsson, 2012). Thus, big data has prominence in Information Systems (IS) research. There are various big data tools. As such, we describe and evaluate select tools for research purposes.

We now have big data available for business and research purposes. Traditional software tools are inadequate for managing and analyzing this data. We commenced a research project with 63,000,000 tweets and proceeded to analyze the big data. The goal of the research project was to find if sentiments conveyed in the tweets impacted economic indicators such as stock market indicators and unemployment numbers during the COVID-19 pandemic in 2020.

As such, we searched for top open-source big data analytics tools to manage and analyze our data set. We chose open-source tools because of limited funding--a common issue among academics. We explored several open-source big data tools available for analytics in business and personal research use.

BIG DATA ANALYTICS TOOLS

Apache Hadoop

Apache Hadoop is an open-source software framework (Pol, 2016; Ratan, 2017). It is used for the distributed storage and parallel processing of voluminous amounts of data. Its core consists of HDFS (Hadoop Distributed File System). HDFS uses the MapReduce programming model (Ratan, 2017). It consists of computer clusters built to run on hardware based on open standards--commodity hardware (Ratan, 2017). Data is processed in parallel, in multiple CPUs. According to Trivedi et al., “Hadoop HDFS became more popular amongst all the big data tools as it is open source with flexible scalability, less total cost of ownership[,] [and] [it] allows data stores of any form without the need to have data types or schemas defined” (Trivedi et al., 2019). As noted, “Hadoop MapReduce is a programming model and software framework for writing applications that rapidly process vast amounts of data in parallel on large clusters of compute nodes” (Trivedi et al., 2019). Trivedi et al. explained its popularity. “It is designed to scale up from a single server to thousands of machines, with a very high degree of fault tolerance.”

Large Fortune 500 companies use Apache Hadoop. Hadoop is designed for scalability. Hence, it requires investment as well as resources to run. Thus, we found it unsuitable for personal research use.

Apache Cassandra

Apache Cassandra is an open-source distributed NoSQL database management system. It can handle large amounts of data across many different commodity servers. Thus, it provides high availability with no single point of failure (Ratan, 2017). “In case one node goes down, another node takes its responsibility, till the time failed node is not up” (Pedamkar, 2022). Cassandra does not handle images. It can handle structured, semi-structured, and unstructured data. While Hadoop is preferred for batch processing of data, Cassandra is for real time processing. It uses Cassandra query language.

Mid-size companies use Apache Cassandra. It requires resources to run. Therefore, we found it unsuitable for personal research use.

KNIME

Konstanz Information Miner (KNIME) is an open-source, data analytics, integration, and reporting platform (Berthold et al., 2012). The software's modular environment integrates different components for data mining and machine learning through a data pipeline concept (Berthold et al., 2012). The graphical user interface facilitates the assembly of nodes for data pre-processing such as extraction, transformation and loading, modelling, visualization, and analysis (Berthold et al., 2012). Users can create data flows and selectively execute some or all of them.

KNIME is used in small and medium sized businesses. The open-source tool can be installed and used without substantial investment or resources. It appeared to be the most adequate for our personal research use.

RapidMiner

RapidMiner is a data science software platform with an open-source core (RapidMiner, 2022). It is used for business and commercial applications. It is also used for education, research, rapid prototyping, training, and application development (Ratan, 2017). RapidMiner supports end-to-end data science processes including the steps for machine learning processes such as data preparation, model building and validation, results visualization, and optimization (RapidMiner, 2022). This software solution provides various machine learning and data mining procedures including data loading and transformation, predictive analytics and statistical modelling, data pre-processing and visualization, evaluation, and deployment.

Small, medium-sized, and large companies use RapidMiner. Professors and non-funded researchers are eligible for educational licenses of RapidMiner Studio. Like KNIME, RapidMiner can be downloaded and installed for use immediately. However, RapidMiner is a data science software platform. According to Springboard India, “Data analytics focuses more on viewing the historical data in context while data science focuses more on machine learning and predictive modeling” (Springboard India, 2019.) As stated by Springboard India, “Data science is a multi-disciplinary blend that involves algorithm development, data inference, and predictive modeling to solve analytically complex business problems” (Springboard India, 2019). KNIME is a data analytics software platform. As we were searching for big data analytics software, not data science platforms, KNIME appeared to be more suitable for our personal research use compared to RapidMiner. We chose KNIME to proceed with our data set. It only required installation.

SPSS Modeler

SPSS is a statistical software suite. It is readily available for use to academics through universities. SPSS requires a special module, SPSS Modeler, for big data analytics. The SPSS Modeler is a data mining and text analytics software platform. We explored SPSS Modeler to analyze the data set. However, the cost of this special module prohibited use.

We selected the open-source tool, KNIME, to manage, organize, and analyze the data set. We successfully opened the data set in KNIME and merged our additional extracted Twitter data. We also successfully merged our stock market and unemployment data. When we started to analyze the data, we found that KNIME was difficult to use. We were attempting regression. KNIME required us to build workflows using nodes to create a statistical procedure. We found this to be cumbersome. After using KNIME to manage and organize the data set, we used Python code to run analytics: LASSO regression for one subproject and spectral cluster analysis for another subproject. KNIME can be used for data analytics; however, we found this to be more difficult to accomplish than through Python code. We did not need to code in Python from scratch. We used SciKit-Learn, a machine learning platform in Python for both analyses. It is a machine-learning library for the Python programming language. It is an open-source software. Also, the Python library provides a simple and efficient tool for big data analytics. Knowledge of Python code was still needed to prepare data for analysis. Traditional tools proved inadequate in handling big data.

DISCUSSION AND CONCLUSION

We show how we accomplished big data analytics in our research project with 63,000,000 tweets. The implications are beyond such research projects. Due to big data use and analytics in

government and business, several courses on big data analytics are now offered to students in IS educational programs.

Business analytics programs tend to focus on data analytics software platforms to teach big data analytics to students. Our research experience has informed otherwise. Python code is relatively easier to implement and is needed when big data analytics software platforms prove difficult for analyzing big data. Stanton and Stanton (2019) also point to the importance of programming skills in analytics jobs. They conducted a survey of job postings in analytics. They concluded that both programming and quantitative skills are required to address problems along with expertise in the domain.

REFERENCES

- Berthold, M. R., Cebren, N., Dill, F., Gabriel, T. R., Kötter, T., Meinl, T., ... & Wiswedel, B. (2009). KNIME-- the Konstanz Information Miner: Version 2.0 and beyond. *ACM SIGKDD explorations Newsletter*, 11(1), 26-31.
- Hofmann, M., & Klinkenberg, R. (Eds.). (2016). *RapidMiner: Data mining use cases and business analytics applications*. CRC Press.
- McAfee, A., & Brynjolfsson, E. (2012). Big data: The management revolution. *Harvard Business Review*, 90(10), 60-68.
- Müller, O., Junglas, I., Brocke, J., & Debortoli, S. (2016). Utilizing big data analytics for information systems research: Challenges, promises and guidelines. *European Journal of Information Systems* 25(4), 289–302. <https://doi.org/10.1057/ejis.2016.2>.
- Parupudi, A. V. K. (2018, May 28). *The use of big data analytics in information systems research*. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3185883.
- Pedamkar, P. (2022). *Hadoop vs. Cassandra*. <https://www.educba.com/hadoop-vs-cassandra/>
- Pol, U. R. (2016). Big data analysis: Comparison of Hadoop MapReduce and Apache Spark. *International Journal of Engineering Science*, 6389.
- Prekopcsak, Z., Makrai, G., Henk, T., & Gaspar-Papanek, C. (2011, June). Hadoop: Analyzing big data with RapidMiner and Hadoop. In *Proceedings of the 2nd RapidMiner community meeting and conference (RCOMM 2011)* (pp. 1-12).
- RapidMiner. (2022). <https://rapidminer.com/blog/the-core-of-rapidminer-is-open-source/>.
- Ratan, V. (2017, September 12). *Top 4 open source tools you can use to handle big data*. <https://www.opensourceforu.com/2017/09/open-source-tools-you-can-use-to-handle-big-data/>.
- Springboard India (August 12, 2019). *Data science vs data analytics – How to decide which one is right for you?* https://medium.com/@springboard_ind/data-science-vs-data-analytics-how-to-decide-which-one-is-right-for-you-41e7bdec080e.
- Stanton, A. D., & Stanton, W. W. (2019). Skills employers seek in analytics-focused hires: Implications for business schools. *Allied Academies International Internet Conference*, 18(2), 78-79.
- Trivedi, K., Kumari, S., & Jain, S. (2019). Big data processing with Hadoop. *International Journal of Business & Engineering Research*, 12, 1-3.

BARRIERS FOR USING BLOCKCHAIN IN SUPPLY CHAINS: A LITERATURE REVIEW

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ABSTRACT

Most private permissioned blockchains in business enterprises are still in the sandbox stage, with troubles of interoperability and resource limits looming large. This work reports a current inventory of barriers to blockchain use, categorized by the largest sources of friction. In a review of 1,166 recent articles, filtering for those specifically reporting on the challenges of blockchain use in supply chains left 76 for detailed analysis. The challenges reported clustered around four themes: (1) technical, (2) financial, (3) business ecosystem, and (4) social/cultural/regulatory, with the last two themes as prevalent as technical and financial ones. We discuss why not all industries, organizations, and locales may be ripe for blockchain use, with successful projects limited to specific circumstances, most notably regulator requirement for a chain of custody, reducing waste for perishable goods, and avoiding trademark infringements. These specific circumstances may increase the value of chained data, helping to nudge participant, industry, and regulator coordination, critical for successful blockchain use. This unusual level of coordination may trigger the “cooperative advantage” of blockchain in supply chain. A questionnaire mapped to the barriers provides a way to prompt discussion about whether this technology is a fit for an organization.

Key words: blockchain, supply chain, cooperative advantage, distributed ledger, digital ledger, collective advantage

A CLUSTER ANALYSIS OF GRADE SCHOOL STUDENTS' STANDARDIZED MATH TEST SCORES: INSIGHTS FROM TABLEAU

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EXTENDED ABSTRACT

PROPOSED STUDY

Education in America is a topic greatly explored to determine its impact and effectiveness on students. This study investigates the standardized math test scores of third through eighth grade students from the state of New York to detect the trends within each grade and race each school year. We use an unsupervised data mining approach to examine potential disparities in scores among Asian, white, black, and Hispanic students. K-means analysis and subsequent data visualization analysis reveal patterns among groups of students. Based on results, we discuss the possible causes for the results and suggest additional review of the education system.

BASIS OF THE STUDY

To explore differences in math achievement scores by race, related data was obtained from Data.gov that reported scores on the mandated New York State Mathematics Test from several districts (NYC Open Data, 2021). This dataset reported mean test scores and percentages by grade level (3-8) and race (white, Asian, Hispanic, and black) between 2006 and 2011. The scores were also reported in terms of ranges, such that scores in Range 1 were the lowest range and scores in Range 4 were the highest. Combined mean scores for Ranges 3 and 4 were also reported. A total of 2,565,624 scores were reported in the dataset across districts, grade levels, and races.

K-means cluster analysis will be used to determine whether or not there are statistically significant groups of individuals in the data based on test scores. K-means cluster analysis is a machine learning approach to grouping records into clusters based on similarities across various factors in a model (Clark et al., 2021). Data visualization will then be used to visualize patterns in the clusters according to race and grade level.

IMPLICATIONS OF THE STUDY

There are several theoretical explanations proposed for variations in achievement levels of students of different races. Some research suggests that teachers' racial biases affect student achievement and are lower in counties in the United States with larger proportions of minority students (Chin et al., 2020). Other research suggests that differences in discipline across races and gender impacts math achievement (Ibrahim & Johnson, 2020). Additional work has focused on differences in students and teachers with a "growth" rather than a "fixed" mindset as proposed by Carol Dweck, in which a "growth" mindset views mathematical skill as something that can be improved upon through effort, while a "fixed" mindset regards it as something that is fixed at birth (2014). One such study found that teachers with a fixed mindset had racial achievement gaps twice as large as teachers with a growth mindset (Canning et al., 2019).

Our study will take an exploratory unsupervised data mining approach to achievement in grade school students of different races. Thus, we do not motivate our analysis with a theory a priori, but rather will probe for statistical patterns in the data and suggest further routes of investigation related to our findings.

REFERENCES

- Canning, E. A., Muenks, K., Green, D. J., & Murphy, M. C. (2019). STEM faculty who believe ability is fixed have larger racial achievement gaps and inspire less student motivation in their classes. *Science Advances*, 5(2), 1-7. <https://www.science.org/doi/epdf/10.1126/sciadv.aau4734>.
- Chin, M. J., Quinn, D. M., Dhaliwal, T. K., & Lovison, V. S. (2020). Bias in the Air: A Nationwide Exploration of Teachers' Implicit Racial Attitudes, Aggregate Bias, and Student Outcomes. *Educational Researcher*, 49(8), 566-578. <https://doi.org/10.3102/0013189X20937240>
- Clark, A. Y., Blumenfeld, N., Lal, E., Darbari, S., Northwood, S., & Wadpey, A. (2021). Using k-means cluster analysis and decision trees to highlight significant factors leading to homelessness. *Mathematics*, 9(17), 2045.
- Dweck, C. S. (2014). Mindsets and math/science achievement.
- Ibrahim, H., Johnson, O. (2020). School discipline, race–gender and STEM readiness: A hierarchical analysis of the impact of school discipline on math achievement in high school. *Urban Rev* 52, 75-99. <https://doi.org/10.1007/s11256-019-00513-6>.
- NYC Open Data. (2021). 2006 - 2011 NYS Math Test Results by Grade—Citywide—by Race-Ethnicity. City of New York. [Data.gov](https://data.cityofnewyork.org/).

A STUDY OF FEMALE CYBERSECURITY PROFESSIONALS

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EXTENDED ABSTRACT

DESCRIPTION OF THE STUDY

There's a significant underrepresentation of females in the cybersecurity workforce which contributes to the growing overall shortage of workers in the field. This problem needs to be further understood as the demand for cybersecurity professionals' increase. According to the 2016 United States Bureau of Labor Statistics, the cybersecurity field is experiencing a growing shortage of personnel with over a quarter-million positions remain unfilled in the United States alone and expecting to increase by 18% from 2014 to 2024. The 2015 ISC2 Global Information security workforce study documented the profession is growing but falling increasingly behind the demand (Suby, 2015a). The current workforce is 90% male, even though women are consistently graduating with the highest concentration of advanced degrees (Suby, 2015a, 2015b). Recent reports from Cyberseek.org reports in one year, the demand for cybersecurity-related skills increased from 534K to over 750K unfilled cybersecurity jobs in Spring 2022 (cyberseek.org). In 2017, only 11% of cyber professionals are female and continue to be underrepresented in the cybersecurity field (Bagchi-Sen, Rao, Upadhyaya, & Chi, 2010; LeClair, Shih, & Abraham, 2014; Suby, 2015a, 2015b). ISC2 recently revealed there are roughly 24% of women in the cybersecurity field, however, the criteria for determining the result has been modified to include all IT skills if over 25% of the job tasks, not just cybersecurity skills job tasks (ISC2, 2021). According to this report, the representation of women in cybersecurity is slowly increasing, but the salary compared to their male counterparts is not. These disparities contributes to the growing overall shortage of workers in the field.

BASIS OF THE STUDY

The purpose of this study is to investigate of the reasons why few qualified females are not entering the cybersecurity workforce and determine what can be done to increase their numbers. This study utilized a grounded theory approach to interview twelve female cybersecurity professionals to discover their perceptions of the cybersecurity field. The impact of this research gives women a voice in recommending strategies to encourage other females to pursue the cybersecurity field. The research also aids in demystifying the complexity of the factors by organizing and categorizing them in a logical sense in order to present a theoretical model that will provide holistic insight to academicians and practitioners in developing future cybersecurity professionals and formulating effective cybersecurity curriculum (Smith, Koohang & Behling, 2010). This study utilized a grounded theory approach to identify the structure of experiences as described by the research participants The source of data are from interviews of 12 female cybersecurity professionals recruited from two professional organizations, ISC2 and Armed Forces Communications and Electronics Association (AFCEA). The interviews were recorded, professionally transcribe, and analyzed utilizing qualitative data analysis techniques and QDA software, Quirkos. The data analysis used a streamlined code-to-theory model for qualitative inquiry.

CONCLUSIONS AND IMPLICATIONS

The findings of this study identified four factors of engagement and one unexpected co-factor that are perceived to have an impact on decisions to pursue the cybersecurity field. The four factors identified were awareness, support, intrinsic and extrinsic values. The interesting find of the cybersecurity mindset profile factor that is perceived to enhance the success of career trajectory and warrants additional research to discover the impacts on the decision to pursue the cybersecurity field. The participants revealed strategies that could encourage females to pursue the cybersecurity field. This study provides holistic insight to academicians and practitioners in developing future cybersecurity professionals. Moreover, it adds to the body of knowledge by answering the call for that additional qualitative approaches in methodology by bringing data richness and to generate new theoretical frameworks in cybersecurity research. These findings contributed notably to the body of knowledge, and have several implications for providing other researchers and practitioners insight into the perceptions of female cybersecurity professionals and strategies to encourage them to pursue the field. The results make it evident, through the beliefs of 12 women, that women can do cybersecurity and well. Generating an interest early in a girls' life can bring more women to the field, therefore, reducing the overall shortages in the United States and worldwide. Moreover, the results can be utilized to reduce the gender disparity in the cybersecurity field. This study may also have implications in other male dominated career fields, as well, where the theoretical model can be applied to increase the female participation rates. Another contribution is the discovery of an emerging theoretical framework to aid in this mission. Building on prior research, this study answered the calls to extend gender research with qualitative methods to understand the nuances of the field. This study also answered the call to understand and demystify the complex factors of increasing female participant rates in cybersecurity.

Keywords: Cybersecurity, Engagement Factors, Gender, Mindset factors, Cybersecurity Profile

REFERENCES

- Bagchi-Sen, S., Rao, H. R., Upadhyaya, S. J., & Chai, S. (2010). Women in cybersecurity: A study of career advancement. *IT professional*, 12, 24–31. doi:10.1109/MITP.2010.39.
- Cyberseek US. (2022). HeatMap. Retrieved from www.cyberseek.org/heatmap.html
- (ISC)² Cybersecurity Workforce Study (2021). <https://www.isc2.org/Research/Workforce-Study>
- LeClair, J., Shih, L., & Abraham, S. (2014, February). Women in STEM and cybersecurity fields. In *Proceedings of the 2014 Conference for Industry and Education Collaboration* (pp. 5–7). Washington, DC: American Society for Engineering Education.
- Smith, T., Koohang, A., & Behling, R. (2010). Formulating an effective cybersecurity curriculum. *Issues in Information Systems*, 11(1), 410–416. Retrieved from <http://www.iacis.org/iis/iis.php>
- Suby, M. (2015a). The 2015 (ISC)² Global information security workforce study [White paper]. Retrieved from <https://www.boozallen.com/content/dam/boozallen/documents/Viewpoints/2015/04/frostsullivan-ISC2-global-information-security-workforce-2015.pdf>
- Suby, M. (2015b). Women in security: Wisely positioned for the future of InfoSec study [White paper]. Retrieved from <https://iamcybersafe.org/wp-content/uploads/2017/01/2015-Women-In-Security-Study.pdf>

DIGITAL TRANSFORMATION USING CLOUD COMPUTING: A MANAGERIAL PERSPECTIVE

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EXTENDED ABSTRACT

New digital technologies are not trends, fads, or only relevant to companies in the technology industry. Social media, cloud computing, and mobility are seismic shifts in the technology ecosystem and are as significant today as the introduction of the PC and internet were over the past two decades. Cloud computing is a network model of on-demand access for sharing configurable computing resource pools (Zou et al., 2022). Cloud computing is essentially the outsourcing of computing services to an external location, and it is typically used by accessing these services over the internet either as software as a service (SaaS), utility computing, platform as a service, service commerce platforms and more. The paper identifies a range of research questions that arise from the analysis.

Keywords: cloud computing, digital transformation, information technology, implications for theory and practice,

BASIS OF THE STUDY

A review of the literature shows that cloud computing can enhance productivity and create value for organizations. It may lead to disintermediation of complex software infrastructures, increased company agility, enhanced data security and systems reliability, and cost savings compared to an in-house solution. While cloud computing provides many benefits, it also has a few challenges, including latency on the network, reliability, sustainability, new security challenges in secure service management and control, privacy protection, data integrity protection in distributed databases, data backup, and synchronization (Zou et al., 2022; Buyya et al., 2009). Cloud computing has a ripple effect of moving technology to a 'greener' agenda by cutting down on greenhouse gas emissions (GHG), data centers powered by renewable energy, and reducing energy consumption (McManus, 2021). Data centers, also known as server farms, use a mechanical process that refrigerates the gaseous medium of air to keep heat away from computers. The cloud burns carbon and is included in the 0.3 percent of overall carbon emissions produced by data centers (Monserrate, 2022).

IMPLICATIONS FOR RESEARCH AND FUTURE RESEARCH DIRECTIONS

As firms prioritize as a service provider over traditional vendors, accelerate digital transformation projects, and enable the new normal of work following the COVID-19 pandemic, (Dignan 2021). Understanding green cloud computing, edge computing, cloud cryptography, and load balancing is vital. "Enterprises are looking to virtual desktop infrastructure to make secure remote work possible, hopefully without sacrificing productivity, cost, and security"(Linthicum, 2022). The future of cloud computing could offer instantaneous computing, a more reliable connection, and additional ways to access this resource. Future research could explore the following questions:

- What are the best and next practices to overcome implementation challenges of cloud computing?
- Can we, as consumers, expect the cloud computing industry to naturally evolve towards the right standards on its own?
- What are the specific problems and opportunities for cloud computing service providers and consumers, and the implications, both positive and negative, of government-instituted standards?
 - * As a consumer or provider of cloud computing services, what specific types of standards would be beneficial to our enterprise today?

IMPLICATIONS AND RECOMMENDATIONS FOR MANAGERS

Managers need to research which cloud computing companies are the best solution for their organization. Cloud computing has a significantly higher impact on the level of profitability of small firms and firms in manufacturing industries in comparison to big firms and firms in service industries (Chen, et al., 2022). According to Cloud industry forum (n.d.), when researching providers, the following checklist can be helpful for managers to consider: (1) Provider's certification and standards that adhere to the industry best practices and standards, (2) Provider's platform and preferred technologies align with the client firm's cloud objectives and ask providers their goals in innovation and growth over time, (3) Ask how cloud computing providers regulate their data and keep it safe, especially supporting security policies and processes, (4) Ensure that provider's products support other vendors already that the company may have, (5) Understand providers' contracts to know what services they will be getting before signing the contract, (6) Find out about reliability and performance of the provider, (7) Check how cloud providers support the customer in an emergency, and (8) Investigate the provider's overall business profile and health. Additionally, with new regulation, managers will need to be up to date with how that could affect their businesses.

CONCLUSION

Cloud computing makes it more accessible due to server-less computing for organizations to convert their data to knowledge to achieve their business strategies. Cloud computing will revolutionize the economy, such as new job opportunities in quantum computing, artificial intelligence in cloud computing, and the growth of cloud infrastructure as a service. In the cloud computing domain, we may see continued emergence of a core set of beneficial cloud computing standards to be promoted through a wide range of consumer and industry consensus standards-setting bodies. Overall, cloud computing can be a very valuable resource and companies should analyze their business infrastructure to better understand how these services can cater to their needs.

REFERENCES

- Buyya, R., Srirama, S., Casale, G., Calheiros, R., Simmhan, Y., Varghese, B., Shen, H. (2019). A Manifesto for Future Generation Cloud Computing. *ACM Computing Surveys*, 51(5), 1-38.
- Buyya, R., Yeo, C.S., Venugopal, S., Broberg, J. and Brandic, I. (2009) 'Cloud computing and emerging IT platforms: vision, hype, and reality for delivering computing as the 5th

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- utility', *Future Generation Computer Systems*, Vol. 25, No. 6, pp.599–616. ISSN 0167-739X, <https://doi.org/10.1016/j.future.2008.12.001>.
- Cloud industry forum (n.d.), 8 criteria to ensure you select the Right Cloud Service Provider. 8 criteria to ensure you select the right cloud service provider, Retrieved from <https://www.cloudindustryforum.org/content/8-criteria-ensure-you-select-right-cloud-service-provider>
- Chen, Xi., Guo, M., & Shanngguan, W. (2022). Estimating the impact of cloud computing on firm performance: An empirical investigation of listed firms. *Elsevier Journal*, 1-15.
- Dignan, L. (2021, December 22). Top cloud providers: AWS, Microsoft Azure, and Google Cloud, hybrid, SaaS players. *ZDNet*. <https://www.zdnet.com/article/the-top-cloud-providers-of-2021-aws-microsoft-azure-google-cloud-hybrid-saas/>
- McManus, I. (2021). Top 5 environmental benefits of cloud computing, *Lateral*, July 4, Retrieved, from <https://getlateral.com/blog/top-5-environmental-benefits-of-cloud-computing-today#:~:text=It%20Reduces%20Greenhouse%20Gas%20Emissions&text=A%20survey%20conducted%20by%20Accenture,by%20switching%20to%20cloud%20computing.>
- Monserrate, S. G. (2022). The Cloud Is Material: On the Environmental Impacts of Computation and Data Storage, *MIT Case Studies in Social and Ethical Responsibilities of Computing*, Winter 2022 (January). [tps://doi.org/10.21428/2c646de5.031d4553](https://doi.org/10.21428/2c646de5.031d4553).
- Zou, J., He, D., Zeadally, S., Kumar, N., Wang, H., & Choo, K. R. (2022). Integrated Blockchain and Cloud Computing Systems: A Systematic Survey, Solutions, and Challenges. *ACM Computing Surveys*, 54(8), 1–36. <https://doi.org/10.1145/3456628>

FACTORS THAT INFLUENCE THE ADOPTION OF THE INTERNET OF ROBOTIC THINGS (IORT) IN FULFILLMENT CENTERS (FC) & DISTRIBUTION CENTERS (DC)

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ABSTRACT

Countries are slowly starting to emerge out of the unprecedented global impact caused by the recent pandemic. During this period, customers got accustomed to shopping for everything online, including groceries and prescription drugs. Their expectations on service levels have also gone up, like fast and free delivery to their doorsteps, free returns, and multiple pickups or drop-off locations. This has placed undue pressure on the global supply chain. As a result of the boom in e-commerce and the subsequent need to fulfill orders faster, companies constantly look to improve their operational efficiency. Distribution or fulfillment centers are at the center of this fast-paced e-commerce supply chain. An industry that is largely manual, growing multifold compared to its labor pool, compounded by unprecedented employee turnover, puts fulfillment centers on the critical path and a perfect candidate for robotics. Automation of material handling technologies bolsters improvements in operations, at the same time, tackles labor challenges and scalability. This qualitative study focused on fulfillment centers that embark on a journey to adopt autonomous mobile robots in their warehouse operation and identify the key factors influencing such adoption. This study was a diligent attempt to fulfill an existing gap identified in the existing literature on this subject. This study was underpinned by the theoretical perspectives of the Technology-Organization-Environment (TOE) framework. A case study of a particular fulfillment center was done. This study concluded that except for Trialability, Structure, Size, and Partners, all the other constructs under the three contexts affected the adoption. There were a few key organizational factors that affected adoption, like top management's support, investment, and innovation and risk culture.

Keywords: Autonomous mobile robots, Internet of Things, Internet of Robotic Things