

HUMAN FACTORS IN SMART AND CONNECTED COMMUNITIES

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HUMAN FACTORS IN SMART AND CONNECTED COMMUNITIES

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ABSTRACT

The vision of Smart Connected Community (SCC) is to integrate technology to improve economy, safety, education, health and provide equity in the society. Human factor plays a vital role in the SCC in human societal, psychological, physical factors in the technology uses from various aspects. In this research, first, we have studied the impact of the COVID-19 pandemic on smart cities through analyses of 311 data of cities and the residents in the United States. We have compared various aspects of municipal governments' service platforms and citizens' requests during pre-COVID, the lockdown, and the rest of the pandemic duration. Among multiple observations from the data, we discover the noticeable changes in the digital transformation of citizens' voices during the COVID-19 pandemic. We also find that various aspects of divides of residents, such as economic, COVID-related health, and demands are closely related to each other. We have built a comprehensive website that dynamically collects 311 data from municipal open data of cities in the United States that other researchers or urban planners can use to understand citizens' voices better and draw insights.

In the second part, we have discussed the effect of COVID-19 in transition of

learning in higher education. Two years ago in Spring 2020, a stay-at-home order was issued in the United States and other countries, due to the Pandemic. The education system has to adopt online classes in the middle of the semester. Not many institutions were prepared at that time. We did survey research at the beginning of the pandemic, more than 300 students in computing and engineering and other departments have participated in that survey [1]. After two years of the pandemic we all understood, online classes are very crucial to continue the education system. In some departments, it was easy to transform the classes online but in some lab-based departments, it was difficult. We did another two surveys of over 138 students in spring 2021 and over 379 students in spring 2022, to see how the opinion of the students have changed, what difficulties they have faced in the pandemic, what opportunities online education has presented, how students are comfortable with online classes and different online platforms (like, Canvas, Zoom, Proctorio and so on) and any suggestions to improve the online education system.

In the last part, our multi-disciplinary research team has conducted empirical research as part of technology education offered to women-in-transition in the Midwest. In this study, we report results from our interviews with 75 women-in-transition in the Midwest that were conducted to develop a tailored technology education program for the women in the beginning. More than half of the participants in our study are women of color and face precarious housing and financial situations. Then we discuss principles that we adopted in developing our education program for the marginalized women and participants' feedback on the program. Our team launched in-person sessions with women-in-reentry at public libraries in February 2020 and had to move the sessions online in March due to COVID-19. Our research-informed educational program is designed primarily to support the women in enhancing their knowledge and comfort with technol-

ogy and nurturing computational thinking. Our study shows that low self-efficacy and mental health challenges, as well as lack of resources for technology access and use, are some of the major issues that need to be addressed in supporting technology learning among women-in-transition. This research offers scholarly and practical implications for computing education for women-in-transition and other marginalized populations.

APPROVAL PAGE

The faculty listed below, appointed by the Dean of the School of Science and Engineering, have examined a dissertation titled "Human Factors in Smart and Connected Communities", presented by Rafida Zaman, candidate for the Doctor of Philosophy degree, and hereby certify that in their opinion it is worthy of acceptance.

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CHAPTER 1

INTRODUCTION

1.1 Smart and Connected Community (S&CC)

Smart and connected community, which is according to the National Science Foundation, a new era of transformation in which residents and their surrounding environments are increasingly connected through rapidly-changing intelligent technologies. A smart and connected community works with the community and finds solutions together with communities.

The main goals are

- Economic opportunity and growth,
- Safety and security,
- Education
- Health and wellness,
- Equity and overall quality of life

1.2 Human Factors

There are multiple research shown that new technologies were slowed down, or smart connected communities could not reach their goal due to Human factors were not

considered. Human factors are important to translate data into insight and, ultimately, into action, to empower people, the Voice of education plays a vital role in shaping the future, and also considers human factors in innovation that lead to equity. Innovations and new technologies can only impact our societies if they consider the human factor.

In our research, we study human societal, psychological, and physical factors in the technology uses from various aspects of Smart and Connected Communities (SCC).

- Residents' voices (crowd sensing)
- Learners - Teachers in Education
- Under-served people's: Technology Access Equity

After 2020, COVID-19 had a direct impact on all these human factors.

1.2.1 Human Factor: Residents' Voices in SCC

A fundamental aspect of smart cities is the interaction between the city government and the residents. Cities in the United States have a common channel where residents make phone calls to complain or request about their cities. 3-1-1 (311 hereafter) is a non-emergency phone number that the North American Numbering Plan assigns (NANP) [2], and adopted in most municipal communities in North America [3]. 311 service was introduced in the United States in late 1990 to reduce the overload on 911 emergency call service from relatively non-emergency calls such as trash pick-up, noise, pollution, or abandoned vehicles [4]. 311 service is used for the residents to reach out to their city government with their various issues and concerns in the community. It also

helps the government to understand the real needs and to build a better community and society with the best usage of the resources they have for the city [5].

Although 311 services started as phone call requests from residents, as shown in Table 1, most cities introduced diverse 311 request sources or channels available for citizens to raise their concerns [6]. The latest addition to 311 sources has been mobile apps that have been very helpful and effective in some cities, even becoming the most requested source during the COVID-19 pandemic.

Table 1: Sources of 311 Requests in the U.S. Cities

Common 311 Request Platforms
Phone call
Mail
Walk-in
Email
Fax
Voice mail
Delegation from other agencies (e.g., Parking Violation Enforcement)
Diverse Digital 311 Request Platforms
Website
Social media (e.g., Facebook and Twitter)
Mobile Apps (e.g., Android and Apple)

In addition, cities in the U.S. make operational government data publicly available, following the Honest Leadership and Open Government Act [7] that was enacted as a law in 2007 to strengthen transparency and public trust. Open city government data allows businesses, urban planners, and researchers to understand what the community wants or needs, where the state of the community is comparatively, and what kind of services and

businesses will be valuable for the community.

In Kansas City, Cisco and Sprint together started providing free Wi-Fi to the public in the downtown area of Kansas City. Cisco is providing the devices and Sprint is providing the network. During our meeting with Kenton Nuss (Business Solutions Manager - US Commercial at Cisco), and Kansas City chief data officer Eric Roche in 2016, we find the infrastructure for Kansas City data flow shown in Figure 1.

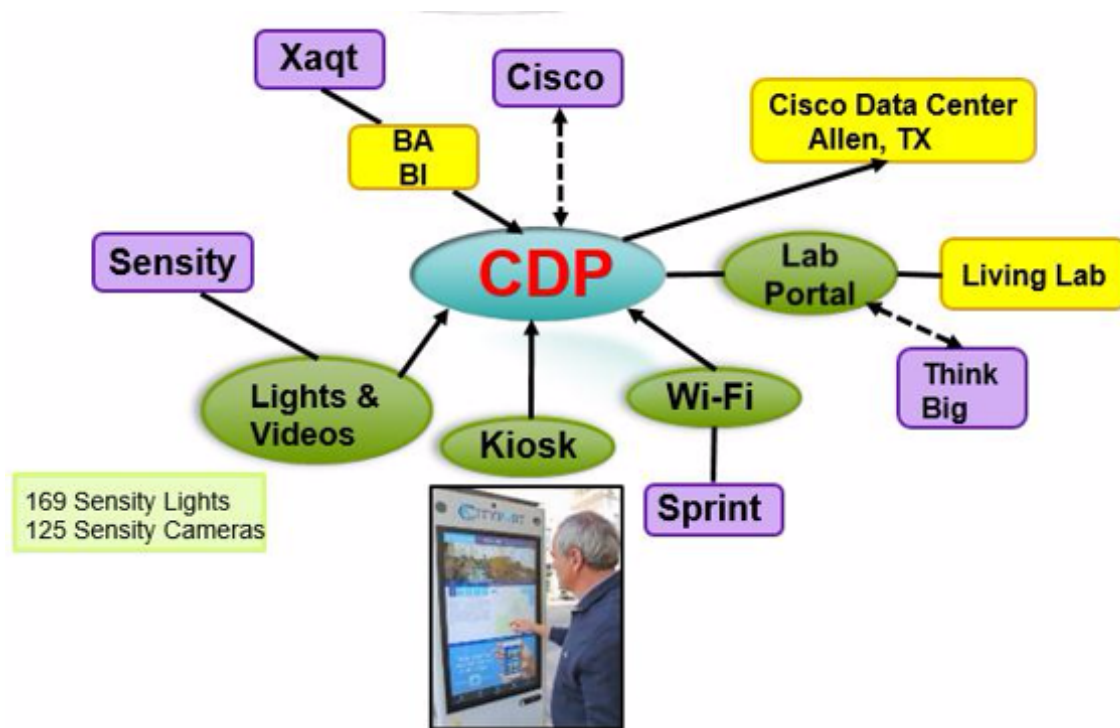


Figure 1: Cisco's Depiction of Infrastructure for Kansas City Data Flow

A combination of different functional systems are interconnecting to operate the smart city services:

- CDP of Cisco (Data Storage Cloud)

- Optical Fiber networking infrastructure (Google Fiber)
- Network operating (Sprint)
- Filtering data and publishing to ODP (KCMO City)
- Data processing & publishing to Kiosks (Living Lab)

To efficiently collect, compare and analyze various city governments' 311 open data, we have built a comprehensive website [8] that dynamically retrieves data from cities' open 311 data portals from 40 cities and provides visual analyses. Other researchers or urban planners can also use it to understand citizens' voices better and draw insights.

As the COVID-19 pandemic has infiltrated overall everywhere in the world and there are lots of analyses on the health sectors, hospitals, and other medical facilities, we wanted to measure how the citizens are facing issues in their daily life due to the pandemic. We have analyzed cities' 311 data over more than four years and compared various aspects of city governments' service platforms and citizens' requests during pre-COVID, the lockdown, and the rest of the pandemic duration. We aim to understand the kinds and extent of the impact of COVID-19 on cities and residents. In particular, we explore how COVID-19 affects service requests in multiple cities and the possible influence of online platforms on these mixed results.

We focus on the 311 data analysis from 2018 to 2021 that encompass before and during the COVID-19 pandemic periods. We have investigated the exhaustive list of cities that publishes 311 open government data. Due to space limitations and concise discus-

sions, we show the analysis of the representative cities that recognize themselves as smart cities. From the analysis, we have found only four cities among all cities studied have continued the pre-COVID trend of the increasing number of citizen participation or remained at a similar level of involvement in requests during the pandemic. The increased citizen participation in their governments is attributed to the corresponding cities' timely digital adaptation and prompt COVID-19-related facilitation. In the other cities, requests have dropped significantly during the pandemic compared to the pre-COVID times. We also observe the relationships between COVID-19-related health and safety issues, residents' economic conditions, and spatial disparities per zip code.

1.2.2 Human Factor: Learners - Teachers in Smart Education

The effective modes of education and the comparisons between face-to-face and online education have long been a topic of educational study. Online courses have been on a steady increase in the past two decades because of their clear benefits such as accessibility to education and flexibility of schedule, especially among adult learners with multiple responsibilities. However, the learning outcome of online has been perceived as inferior to face-to-face education, which has been the major setback of its implementation. Thus, online courses and programs have been mostly limited to outside of formal educational systems and regular programs [9].

COVID-19 is inducing a revolutionary period in education, and online education has been proven to be the only viable option at the time of the pandemic. The global scale and speed of the educational disruption from the COVID-19 epidemic are unparalleled, as

the United Nations stated in [10]. For many online educational institutes, this COVID-19 crisis is considered an opportunity to focus on filling the gap left in conventional face-to-face education. However, the educational responses to the pandemic vary across a country and the world with varied infrastructures and experiences. In April 2020, 272 institutions in 38 states in the US have at least one confirmed case, and over 1,400 colleges and universities have been moved to online instruction [11]. For many countries recognized the importance of online education due to COVID-19 and reacted promptly, such as the United States, China [12] and Saudi Arabia [13]. There are many countries, however, that is not much prepared for online education [14]. [15] remarked that some universities in Australia also have online education only in a few departments. In some developing countries where Internet penetration is low, it is reported that radio, TV broadcast channels, and phone texting are used for education instead of the Internet online education [16]. The extent of online offerings can vary, and some include the implementation of a virtual laboratory learning experience that includes the use of video games, multimedia content, and virtual simulations by generating a general engaging virtual environment [17].

In this study, we compared the changes in the comfort level of online education vs face-to-face from the 2020 Summer to the 2021 Spring. Based on the students survey 2020 Summer [1], we have seen online education was not much popular at the beginning of the pandemic. Online platforms like Zoom, Canvas, Teams, Proctorio, and so on used to have much less popularity before the pandemic. In summer survey study was done just after the Covid-19 lockdown, so most of the instructor was not even prepared for all kind of online platforms. After one complete year the United States, as well as the

world, continued online-based education, lots of schools adopted multiple applications, and training for the instructors. We wanted to see how that has changed the student's perspective. We did another survey at the end of Spring 2021. We saw lots of major changes perceived effectiveness of face-to-face and online education mentioned in the quantitative analysis section of this paper. We also did a qualitative study using ATLAS.ti 9 by coding computer programs. In the later part we the challenges still we are facing and the opportunities we had for online education.

1.2.3 Human Factor: Under-served People in Technology Access

While men continue to be the vast majority of the prison population in the United States, women's rates of imprisonment have been growing since 2000 [18–22]. Recent reports show that women have become the "fastest-growing" section of the incarcerated population, even when the total number of incarcerated people has declined following prison reforms since 2009 [22]. The growth is particularly salient in state prisons, with women's state prison populations increasing by about 800% nationwide over the past 40 years and doubling the growth rate among men. Almost two-thirds of women in jail are women of color with 44% Black, 36% White, 15% Hispanic, and 5% other racial/ethnic backgrounds [23]. The vast majority of incarcerated women are for non-violent offenses, often related to mandatory minimum sentencing for drug-related crimes [21, 24].

Women with criminal justice history rarely have been exposed to solid technology education and have extremely limited preparation for engagement in the formal economy due to past criminal justice involvement [25]. There are several reasons why women in

transition are not given sufficient opportunities for technology education relevant to them. The first reason is the lack of educational programs designed to respond to the increasing rates of women imprisonments in recent years [19–21]. The relatively recent influx of women into the prison system has presented significant challenges for prison education programs and reentry programs, which have been designed with a male population in mind. Historically, incarcerated women’s access to both health care and educational programs has been fewer and of poorer quality than those offered to similarly-situated men, despite that female inmates have a greater need for specific services in comparison to their male counterparts [20, 21]. Another complication for incarcerated populations is the restrictions on their Internet usage while in prison [26, 27]. This limitation, accepted and defended by prison officials as a necessary security measure, creates challenges when people leave prison and reenter a world that is increasingly dependent on digital access and literacy.

1.3 Digital Divide

As society increasingly relies on digital technologies in many aspects, those who lack relevant access and skills are lagging increasingly behind. Among the under-served groups disproportionately affected by the digital divide are women who are transitioning from incarceration and seeking to reenter the workforce outside the carceral system (women-in-transition). Women in transition rarely have been exposed to sound technology education, as they have generally been isolated from the digital environment while in incarceration.

1.4 Digital Equity

Equity is different from equality. Equality means providing the same resources or opportunities to everyone, But in that case, not everyone will have the same outcome and in our study, we are pursuing digital equity. For the same outcome required resources or opportunities, all individuals and communities have the Information and Communications Technology capacity needed for full civic and cultural participation, employment, lifelong learning, and access to essential services [28].

1.5 Digital Inclusion

Digital inclusion is a process to minimize the digital divide to get digital equity by ensuring ensure that all individuals and communities have access to Information and Communication Technologies (ICTs). Here, the digital divide is the issue, digital equity is the goal, and digital inclusion is the way to reach the goal. Digital inclusion has five elements [28]:

- Affordable, robust broadband internet service
- Internet-enabled devices that meet the needs of the user
- Access to digital literacy training
- Quality technical support, and
- Applications and online content designed to enable and encourage self-sufficiency, participation, and collaboration.

1.6 Summary of Contributions

For the first part research (chapter 2) is unique in that it

- Comprehensively studies the 311 data analysis, from an exhaustive list of cities that publish open data in the United States
- Investigates 311 data for multiple years that encompass before and during the COVID-19 pandemic period, and
- Analyzes the impact of the COVID-19 pandemic and the extent and disparities of digital transformation of citizens' voices in different communities.

In the next part study (chapter 3), we uniquely explore the perceived comparison between face-to-face and online education from computing and engineering students at an urban university in the United States in 2020, 2021, and 2022. As a stay-at-home order due to COVID-19 was implemented right in the middle of the Spring 2020 semester, all students experienced both face-to-face and online instruction for the same course for about the same duration within that semester. After a year passing in the lockdown situation majority of the students and faculties have already adopted online education as the primary mode of education. In Spring 2021 and 2022 we did another two surveys to see the acceptance and advancement of online education and the change of perspective of the students and faculties.

In the last part of our study (chapter 4) our research team has conducted a research study to understand the challenges facing women recently released from incarceration in

terms of accessing and using technology and how educational programs can be developed to support their technology learning. In particular, our results shed light on how COVID-19 influenced women's technology use and learning. Empirical data for this study come from interviews conducted in winter 2019 and spring 2020, with 75 women who have been recently released from jails or prisons in three cities in the Midwest. More than half of the participants in our study are women of color and face precarious housing and financial situations. In this paper, we also discuss principles that we adopted in developing our education program for marginalized women and participants' feedback on the program. Our team launched in-person sessions with women-in-reentry at public libraries in February 2020 and had to move the sessions online in March due to COVID-19. Our research-informed educational program is designed primarily to support women in enhancing their knowledge and comfort with technology and nurturing computational thinking. Findings from this study offer important implications for supporting technology learning among women in transition and other marginalized populations.

CHAPTER 2

HUMAN FACTOR: RESIDENTS' VOICES IN SCC, UNDERSTANDING WHAT RESIDENTS ASK CITIES FROM 311 CALLS

2.1 Related Work

There are several studies about residents' 311 request data. However, those studies have been mostly from one or a couple of cities. A study in [29] examines citizen survey data from San Francisco, CA, and finds that citizens' participation in their government reflected 311 requests generally leads to more satisfaction with their government. [30] explores how 311 requests can influence departmental budget allocations in San Francisco, CA, and in Boston, MA. [31] performed a survey with 26 interviews with government staff, civic technologists, and private sector stakeholders in nine cities around the United States to analyze the utilization of Open Government Data between local governments, civic technologists, universities, journalists, non-profit organizations, business corporations, etc. They found that the impact of open government data has been primarily within the local government itself and the usage by the residents themselves needs to be improved through digital equity efforts.

The issue of socio-spatial disparities between low-income and minority neighborhoods versus others was studied in [32], and the authors quantified and showed priorities and types of requests are quite different according to socio-spatial characteristics. [33] did research on opioid use disorder in Columbus, Ohio (which is one of the top five states for opioid-related overdose deaths) and how it affects the neighborhood social distress by

using the spatial dependencies on municipal (311) service requests data. The 311 requests spatial variations of New York City is studied in discussed in [34].

In our previous research [35], we compared top categories of the requests of multiple cities and discussed their diversities of request and data privacy. There are studies that assess and compare cities' Open Data Portals and assign quantifying indices such as [36–38]. However, they are about municipal data availability before the pandemic and do not analyze the data itself.

On COVID-19 related 311 data analysis, the recent article in [39] discusses a spike of 311 requests on school-related inquiries due to COVID-19 such as learning options, safety, and COVID-19 related resources in New York City.

2.2 Background of Data

2.2.1 Status of 311 Municipal Open Data Platforms

According to the United States Geological Survey (USGS) of the United States Department of the Interior, [40], as of 2021, there are at least 35,000 municipal corporations (e.g., cities and towns) in the United States and 326 incorporated places are with a population of at least 100,000 [41]. From US City Open Data Census [41] (managed by Sunlight Foundation and Open Knowledge Foundation), out of 326 cities, 42 cities have open data websites. They include New York City, NY, San Francisco, CA, Kansas City, MO, Washington DC, Chicago, IL, Saint Louis, MO, Santa Monica, CA, Baton Rouge, LA, Salt Lake City, UT, Chattanooga, TN, Cincinnati, OH, Gainesville, FL, Little Rock, AR, and Austin, TX. As presented in Table 2, only 20 cities provide open-source 311 data APIs by facilitating municipal open data platforms, including Socrata Open Data API

(SODA) [42], ArcGIS [43], Comprehensive Knowledge Archive Network (CKAN) [44], and Drupal-based open data portal based on CKAN (DKAN) [45], which enable residents to retrieve data dynamically and automatically. Majorities use SODA (13), followed by ArcGIS (3), CKAN (1), and DKAN (1).

Table 2: Municipal Open Data Platform Providers and the Corresponding Number of the U.S. Cities

Open Data Platform Providers	Cities
Socrata Open Data API (SODA) [42]	15
ArcGIS [43]	3
Comprehensive Knowledge Archive Network (CKAN) [44]	1
Drupal-based CKAN (DKAN) [45]	1

2.2.2 Classification of Digital Accessibility

We have classified cities' advancements in digital service accessibility into four different levels and summarized them in Table 3. Out of an exhaustive analysis of the 42 cities that have municipal open data, due to space limitation and concise description, we only show the significant results of representative Level-1 cities in this research. We will use several selected representative cities that have various digital service systems as examples, to illustrate how the pandemic has impacted the usage and needs of advancement of 311 service requests. For comparisons and analysis, we have built an analysis and visualization website based on the automatic and dynamic data retrieval of cities' open data portals [8]. First, we extract the JSON format data sets using the APIs from selected cities' open data portals. We then process them using javascript code to filter those data according to months, years, sources Categories, etc., depending on web user input. Finally, we show the analysis visualization of 311 service requests using Java scripts on our

analysis website. The website can be used to provide insights for municipal government officials, entrepreneurs, and researchers.

Table 3: Categorization of Cities in Digital Service Accessibility

Category	Definition	Examples of Cities
Level 1	It facilitates well-advanced 311 open data service platforms with various types of digital access, including websites, mobile apps, email, and phone services for reporting non-emergency municipal services.	Austin, TX; Boston, MA; Baton Rouge, LA; Chattanooga, TN; Chicago, IL; Cincinnati, OH; Gainesville, FL; Houston, TX; Kansas City, MO; Las Vegas, NV; Little Rock, AR; New York City, NY; Philadelphia, PA; San Francisco, CA; Saint Louis, MO; Santa Monica, CA; Salt Lake City, UT; and Washington DC
Level 2	It promotes diverse digital access methods, including websites, mobile apps, email, and phone services for 311 reports. However, it does not support dynamic open data service platforms.	Asheville, NC; Charlotte, NC; Denver, CO; Memphis, TN; Miami, FL; and South Bend, IN
Level 3	It does not provide 311 open data service platforms and digital access methods such as websites and mobile apps for citizens' requests. It only supports primary 311 request platforms, including email and phone service.	Cleveland, OH; Oklahoma City, OK; and Long Beach, CA
Level 4	It does not have any primary or digital service platform to facilitate citizens' service requests.	Abilene, KS; Colorado Springs, CO; and Norfolk, VA

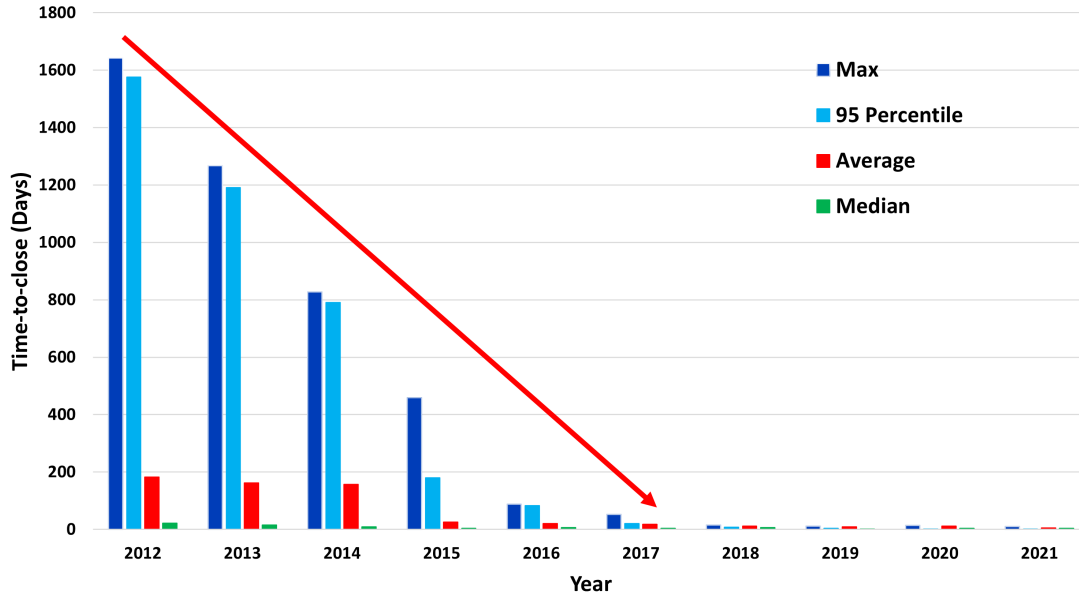


Figure 2: Time-To-Close in Kansas City for Each Year

2.3 Analysis

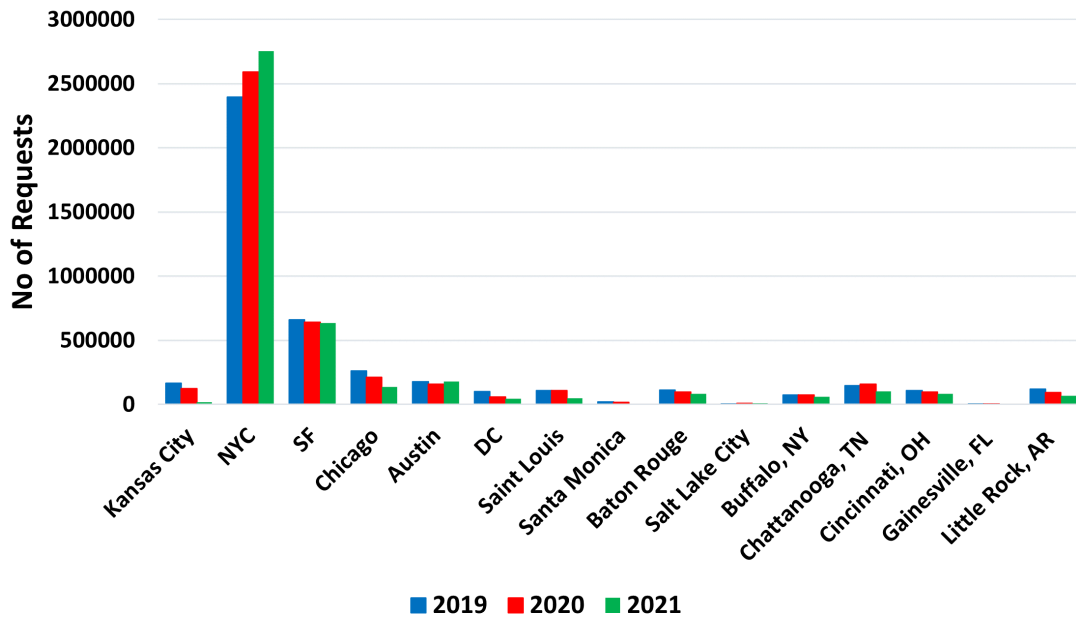
2.3.1 Time-To-Close of 311 Requests

Since the pre-COVID times, digital adoptions of city governments enable report tracking and improve streamlining of each request across different involved units within a city government, leading to a shorter Time-To-Close of 311 requests. Based on the request generation and closing times on the data, we computed the Time-To-Close that indicates the quality of city services. Figure 2 indicates the maximum or high percentile values have been significantly decreasing over the years. The average values have been decreasing as well. We note that the 311 service times of recent years are with minutes or hours on the same day.

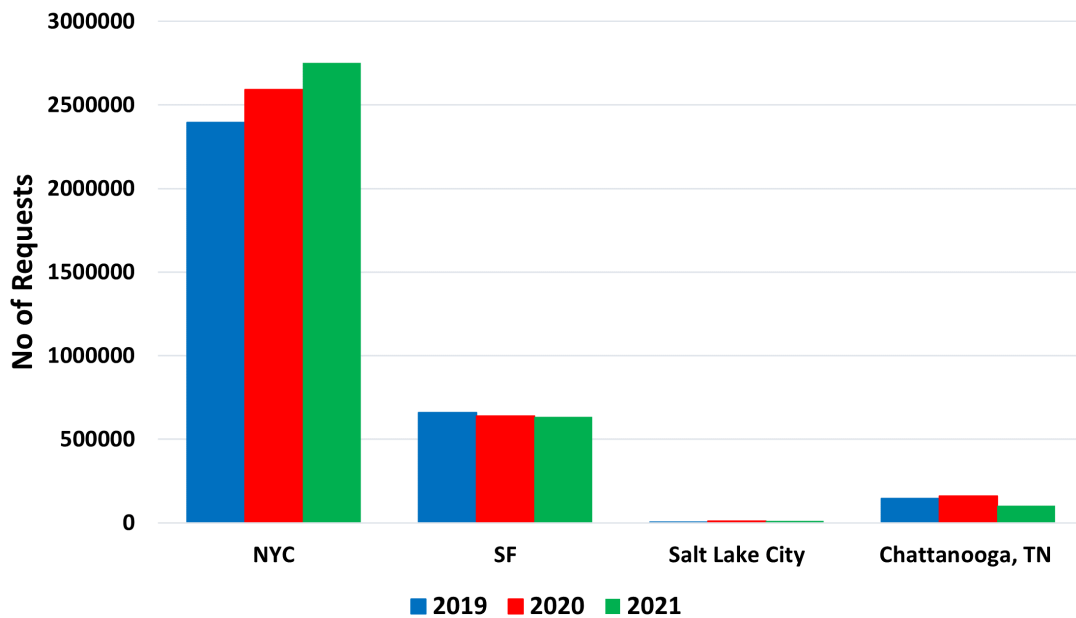
2.3.2 The Number of Requests Per Year

This analysis compared 15 level 1 cities' total annual 311 service requests via mobile app, website, email, and phone services for the last three years (from 2019 to 2021).

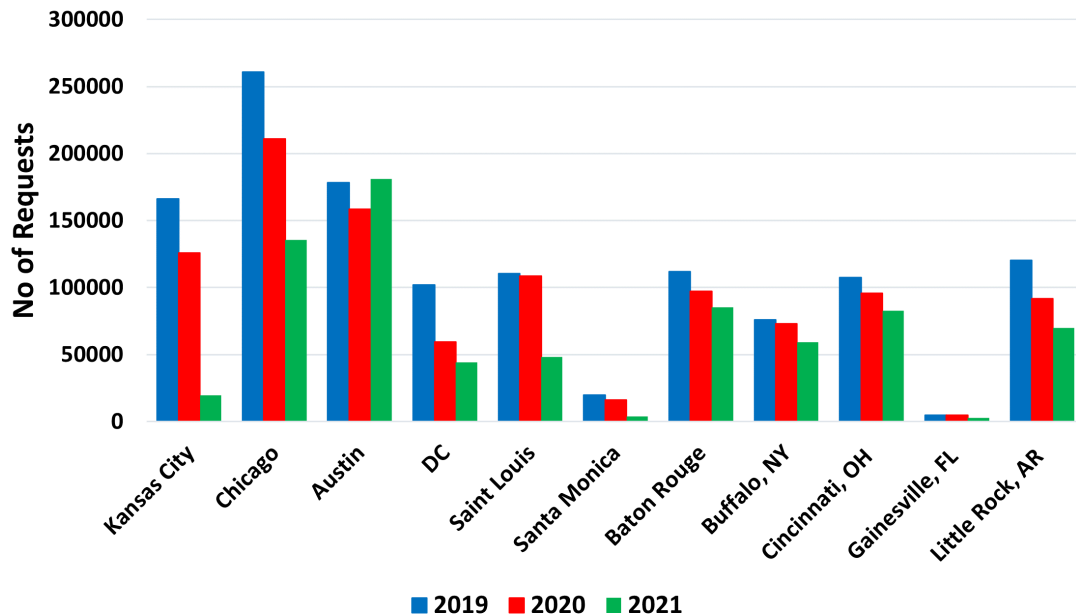
As shown in Figure 3a, the total number of requests in cities is proportional to the population of the city. NYC, San Francisco (SF), Chicago, and Austin show the highest service requests per year. However, in Figure 3b and Figure 3, 311 service requests per capita show that Chicago (0.11, 2.7M population with 300K requests) and DC (0.086) are around three times less than NYC (0.33, 8.4M population with 2.7M requests) and six times less than SF (0.69, 0.87M population with 600K requests). It shows that SF and NYC are two of the most active cities for service requests. Figure 3a also shows the trends before the Pandemic (in 2019) and during the Pandemic (in 2020 and 2021). Although most cities had a downfall in the total number of requests from 2019 to 2020, there is no common increasing or decreasing trend. For example, the service requests of NYC and Salt Lake have increased, and the service requests of Austin rebounded in 2021 after declining in 2020. After further analyzing the sources of the requests, we found that those cities have introduced new online service request methods during the Pandemic to improve digital service accessibility. Figure 3 shows that the service requests have decreased during the 2020 lockdown and pandemic period. However, NYC and SF have promptly added many COVID-19-related categories and information in their 311 services, such as social distancing and facial covering violations, school learning options, school schedules, and facility health and safety violations, which also resulted in the increased number of requests, even compared to the earlier year's requests. The agility and responsiveness of city services following citizens' needs could effectively improve



(a) Total Number of Requests Per Year in 15 Different Cities



(b) Total Number of Requests Per Year Increasing in New York, San Francisco, Sal Lake City, and Chattanooga from 2019 to 2020



(c) Total Number of Requests Per Year Decreasing in Most of the Cities from 2019 to 2020

Figure 3: The Number of Service Requests in 2019, 2020, and 2021

communications with citizens.

2.3.3 The Number of Requests Per Month

First, Kansas City shows at the beginning of 2020, the number of requests was increasing, following the trend of previous years, but after the lockdown started mid of March 2020 due to COVID-19, the number of requests dropped over 20% from January 2020 to April 2020, as depicted in Figure 4b. The number of requests slightly increased later in the year. However, the number of requests over the entire year did not surpass 2019's. Many other cities such as Austin and Chicago exhibited such behavior in the number of requests.

On the other hand, New York City and San Francisco had a similar trend at the

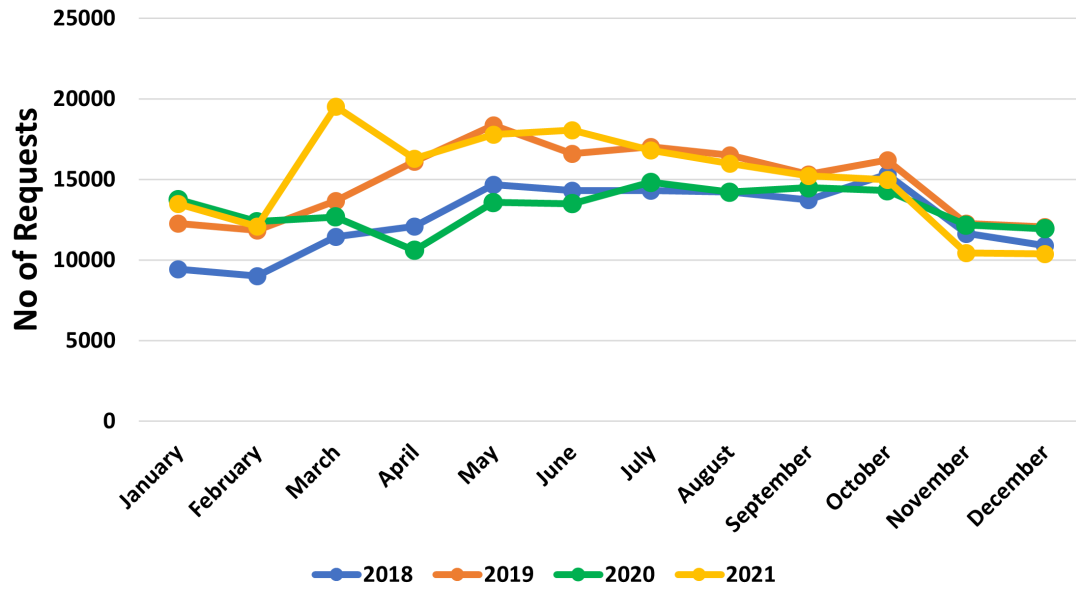
beginning of the pandemic in Figure 4c, and Figure 4d, the number of requests decreased from January to April around 15% and 35%, respectively. However, the number of requests increased the rest of the year. For New York City, the number of requests in August 2020 almost doubled from the one in January 2020. Austin, TX in Figure 4a shows that it has a similar trend to Kansas City, where the number of requests has dropped significantly in March/April and increased a little after April 2020, but they remained lower overall than in 2019's for the rest of the year.

2.3.4 Sources of the Requests

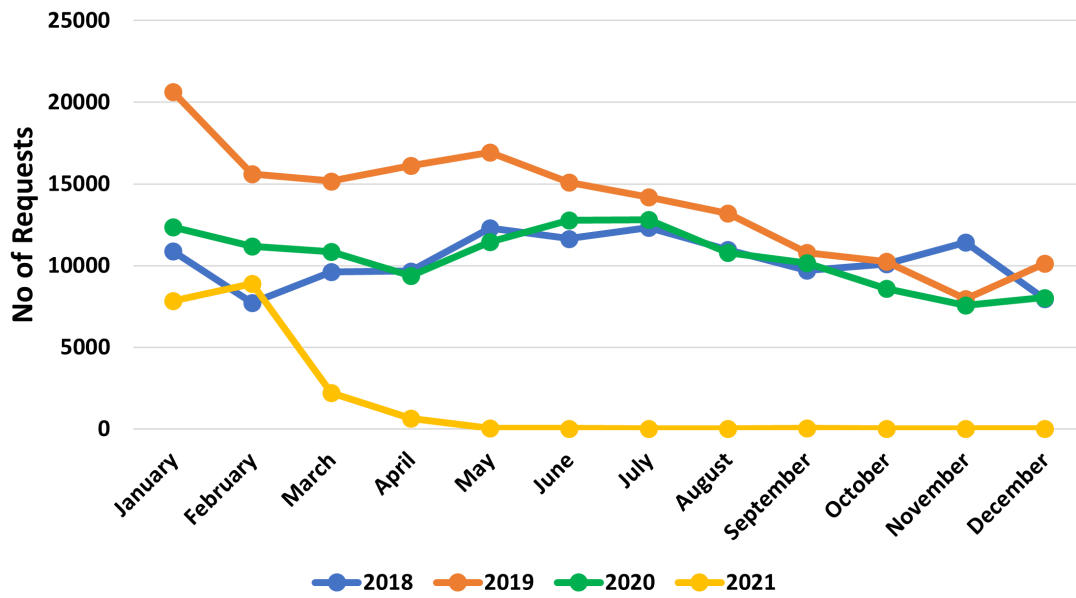
As from previous analysis, we have seen that the number of service requests has decreased for Kansas City during and after the Pandemic in the year 2020. Figure 6b shows Kansas City 311 request has decreased by almost 40% during the lockdown in the Pandemic. As the office was closed and people could not call for requests. Though Kansas City has an app it is less popular among the citizens due to its lack of features and usability. Mail, fax, and walk-in request are also pretty low.

Austin has a similar issue, during the pandemic, the number of phone call requests decreased in 2020, whereas Spot311 Interface web-based requests have increased by almost 15% during the pandemic shown in Figure 6a. Austin 311 app is also not very user-friendly.

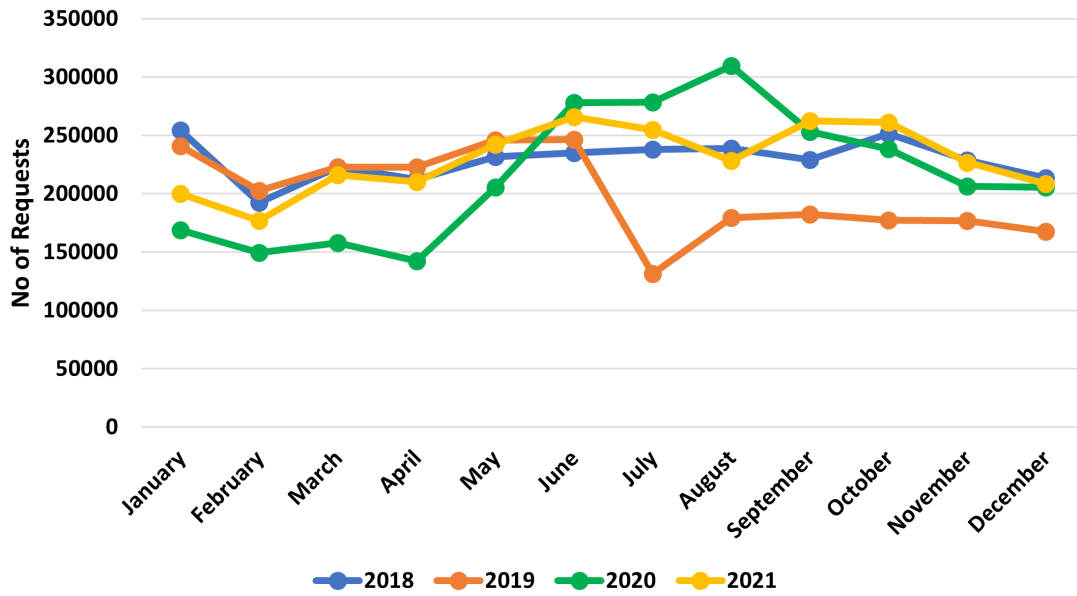
On the other hand, New York City is one of the biggest cities that has the number of service requests increased significantly amount during the pandemic. Observing Figure 5c we can say online requests and mobile app-based requests has remarkably increased in 2020 whereas phone call requests decreased by more than 25% from 2019 to 2020.



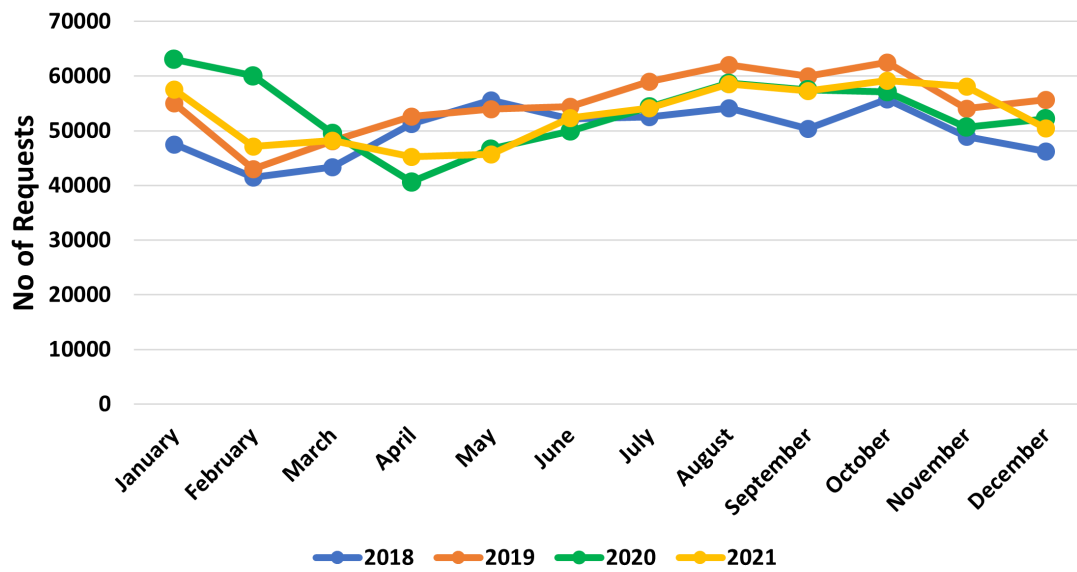
(a) Austin, TX



(b) Kansas City, MO



(c) New York City, NY



(d) San Francisco, CA

Figure 4: Total Number of Requests Per Month from 2018 to 2021

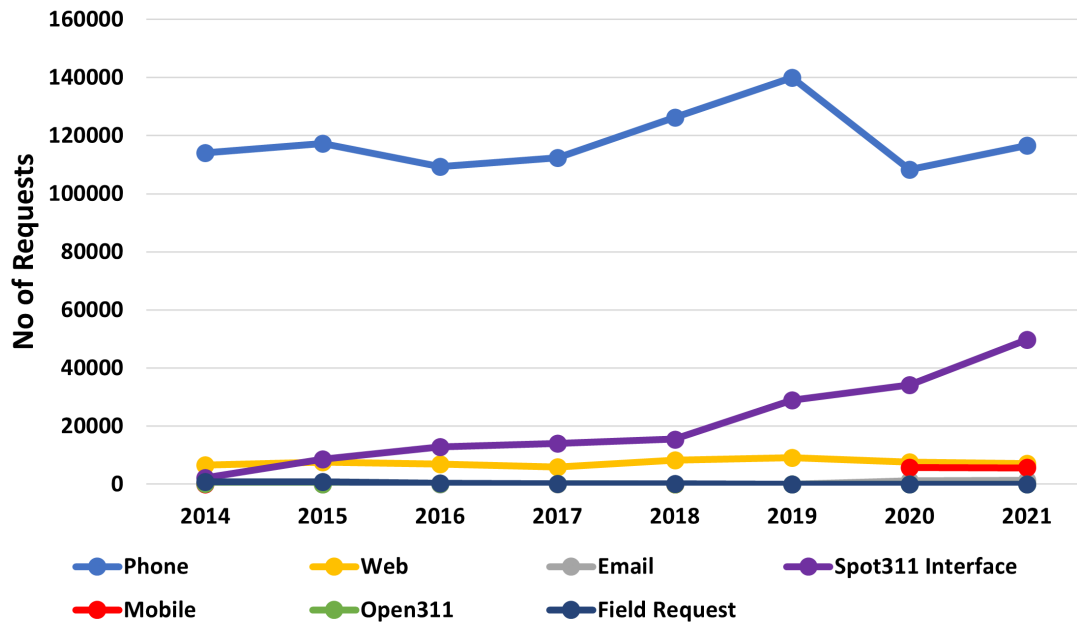
San Francisco also got a similar amount of requests before and during the pandemic. By analyzing the request sources in Figure 5d the phone call requests are decreased but the mobile app requests are increasing with time, and in 2020 mobile app requests are almost double the phone call requests.

Chicago did not disclose their sources of requests in the 311 open data portal. Some cities do not have mobile apps like Denver, Saint Louis, Santa Monica, etc. and some of those cities do not have any updated data or there is a significant decrease in the number of requests in 2020 than 2019.

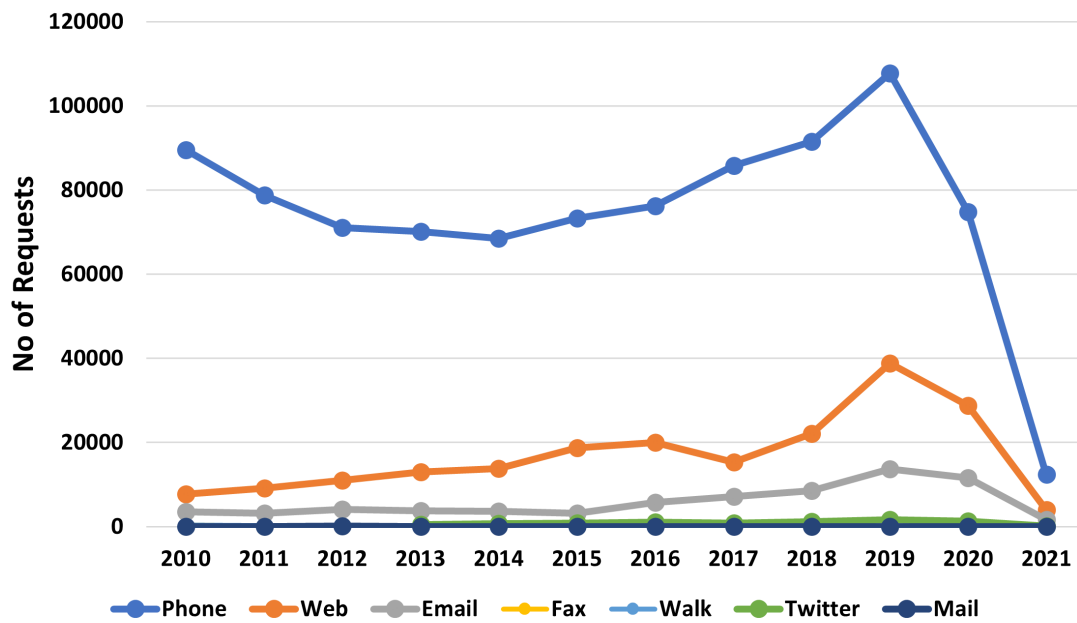
From this analysis, it can be explicitly visible that mobile apps or online requests are more efficient during the pandemic or any lockdown situation where people can not go to offices or send mail.

2.3.5 Top Categories

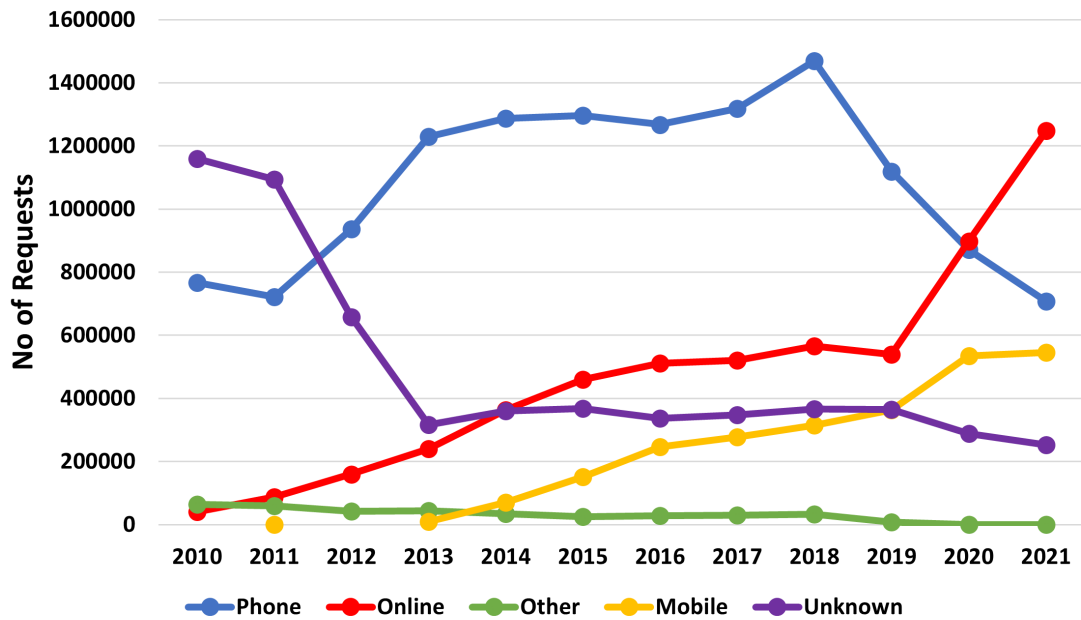
We compared different cities' top request categories to see if there are many changes over the year 2021 and we have seen changes that were not significant. Most of the cities' top categories are almost similar before and after the Pandemic. The top categories of Austin in 2021 are shown in Figure 7a, almost 25% of the requests are Austin code, and the second top category is traffic signal maintenance. Figure 8a shows the top categories remain the same all through the years. In Kansas City, we have showed for both 2020 and 2021 stream graphs, to show the no of requests flow in Figure 9a and Figure 9b respectively and in Figure 7b shows almost 34% of the total requests are for trash/recycling. New York City in Figure 7c had the top requests of 20% due to noise in the residential area, and second and third categories are illegal parking and heat/hot water issues, which also showed in Figure 8c. Figure 7d and Figure 8b show that 40% top



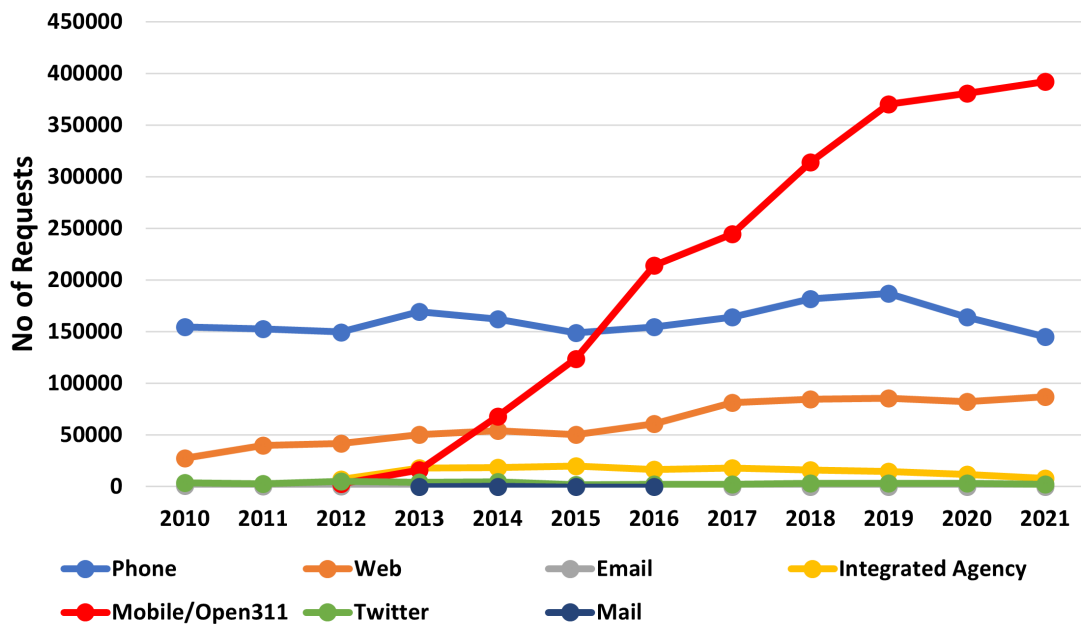
(a) Austin, TX



(b) Kansas City, MO

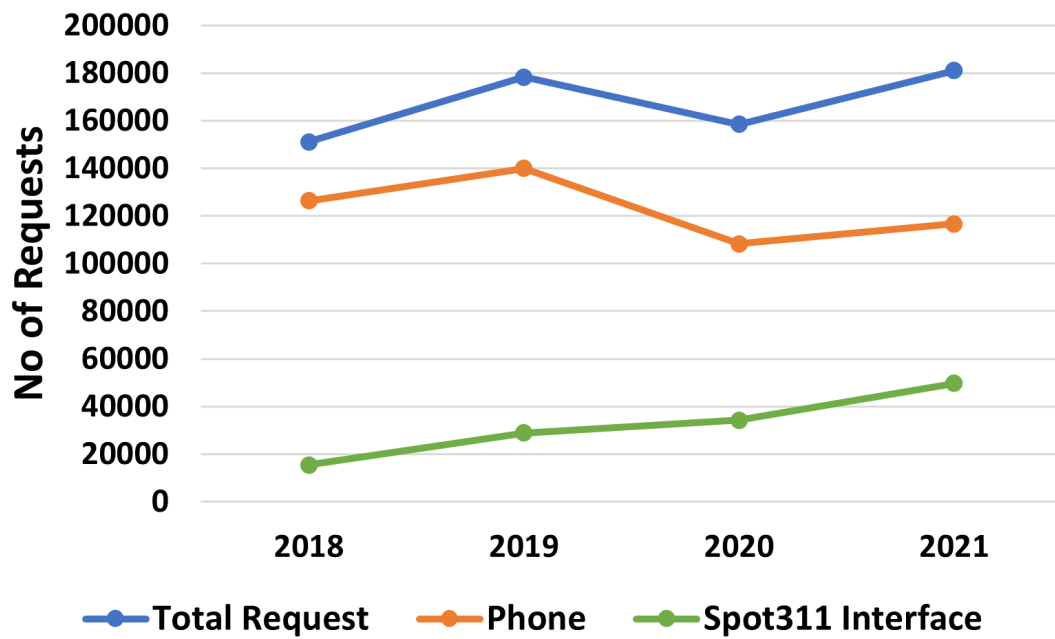


(c) New York City, NY

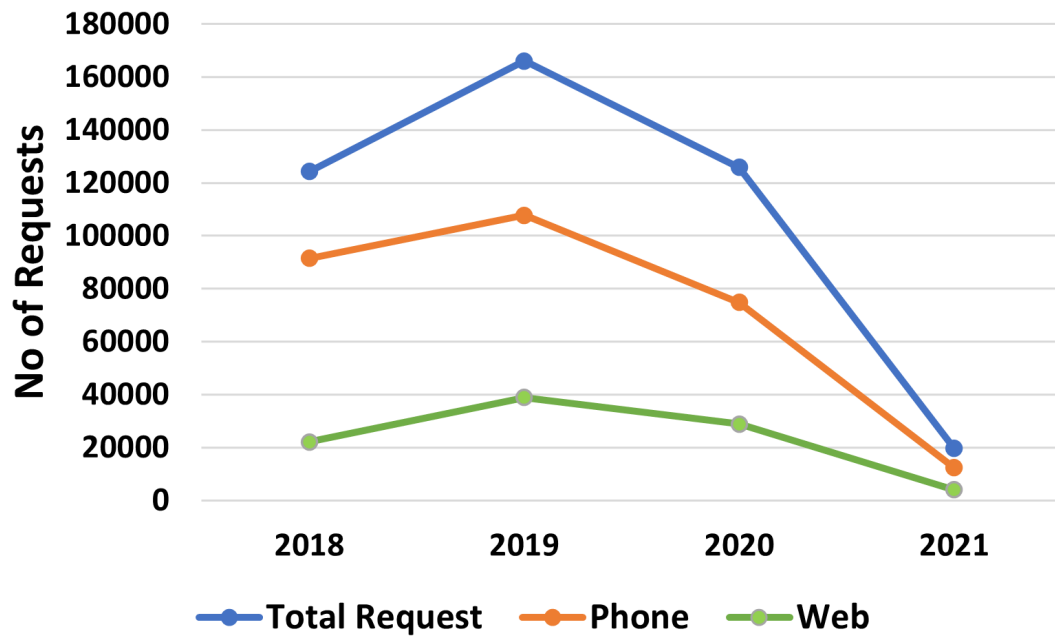


(d) San Francisco, CA

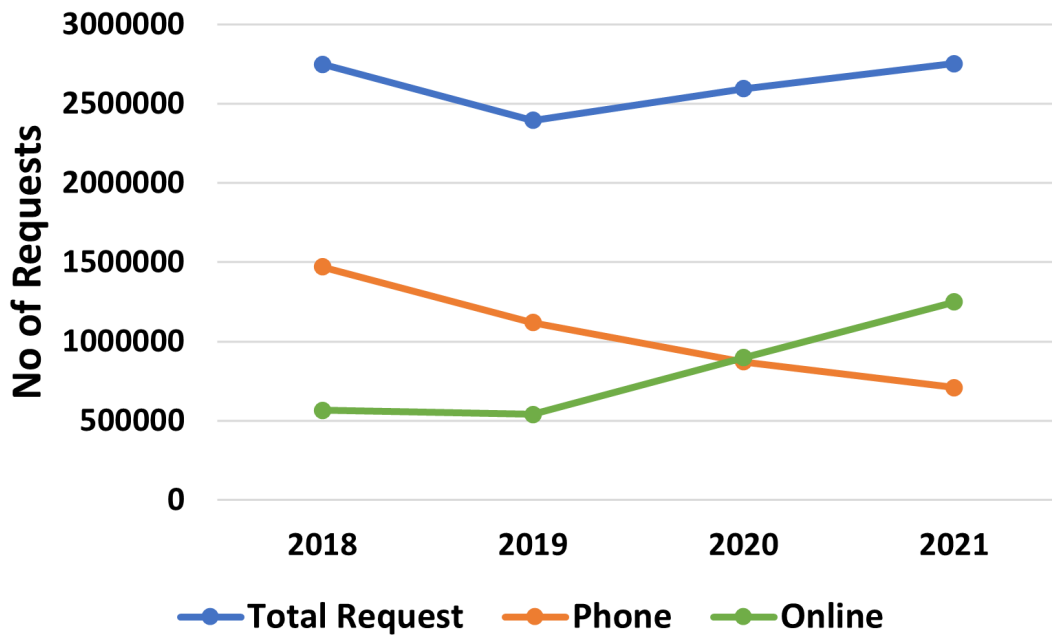
Figure 5: Sources of Requests Over the Years



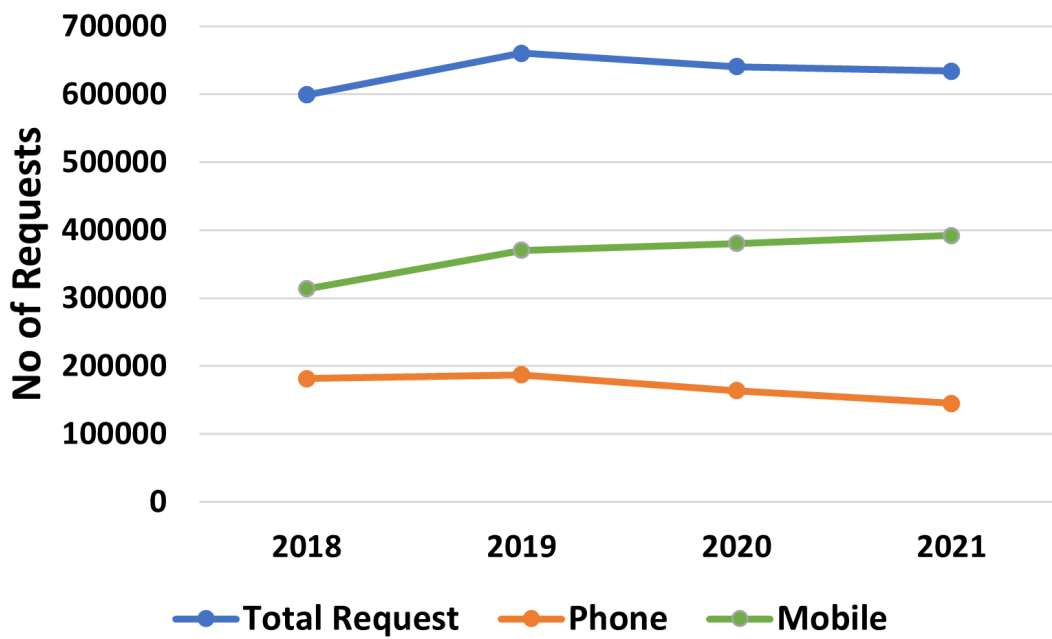
(a) Austin, TX



(b) Kansas City, MO



(c) New York City, NY



(d) San Francisco, CA

Figure 6: Phone vs. Online Requests from 2018 to 2021

requests in the San Francisco bay area come for street and sidewalk cleaning and almost 16% of the rest of the requests are due to graffiti issues. From all the steramgraphs it is visible that only the number of requests varied but the top Categories are almost the same over the years.

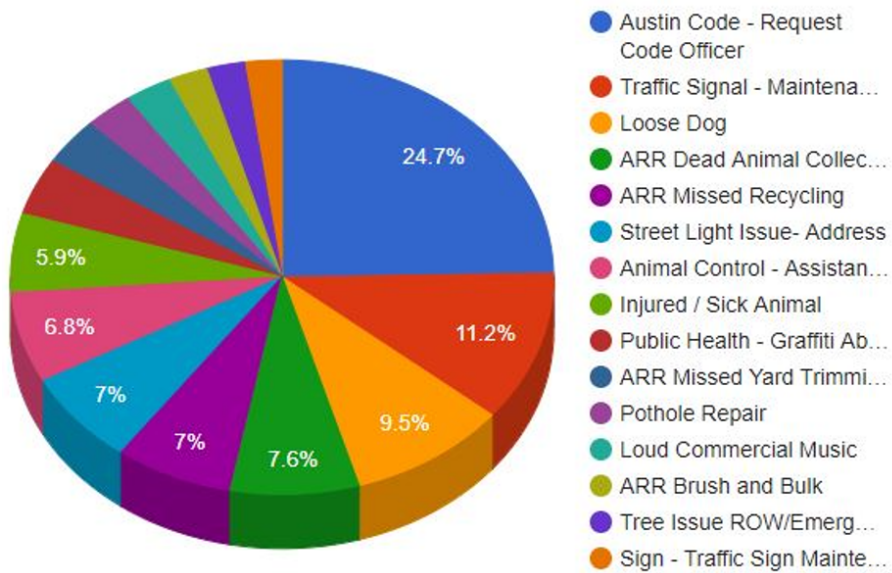
2.3.6 Digital Divide

The digital divide is the gap between the privileged and underprivileged populations in technology use. There are multiple factors that play roles in the digital divide (e.g. income, education, race, etc.). It can impact different levels, such as the economic divide, usability divide, and empowerment divide. Here we have done spatial analysis to see if COVID-19 cases, vaccination rate, 311 requests, and the top categories have any relation with the economic divide.

Figure 10a shows the visual map of median household income in Kansas City in the year 2020 from census data, Figure 10b COVID-19 cases per zip code in the year 2021, Figure 10c vaccination rate, Figure 10d shows the map of 311 requests in 2021, and Figure 10e shows the variation of top category service requests, among them trash/recycling is prominent in most of the low-income areas. Darker shades in the map Figure 10 show the highest median income and highest no of COVID-19 cases, vaccination rate, and 311 requests respectively. To see the correlation between income and all these factors we calculated the correlation coefficient using eq. (1).

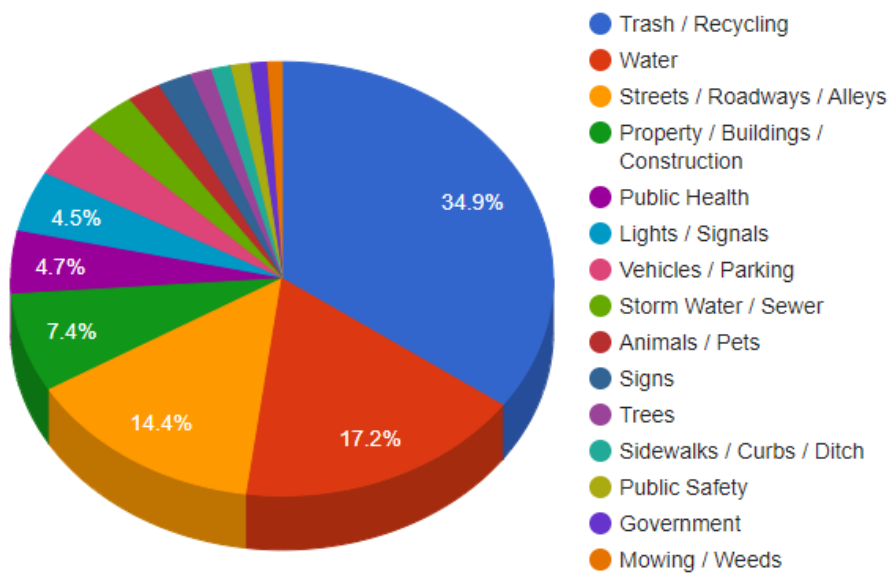
$$r_{x,y} = \frac{\sum_{i=1}^n (x_i - \bar{x})(y_i - \bar{y})}{\sqrt{\sum_{i=1}^n (x_i - \bar{x})^2 (y_i - \bar{y})^2}} \quad (2.1)$$

Category



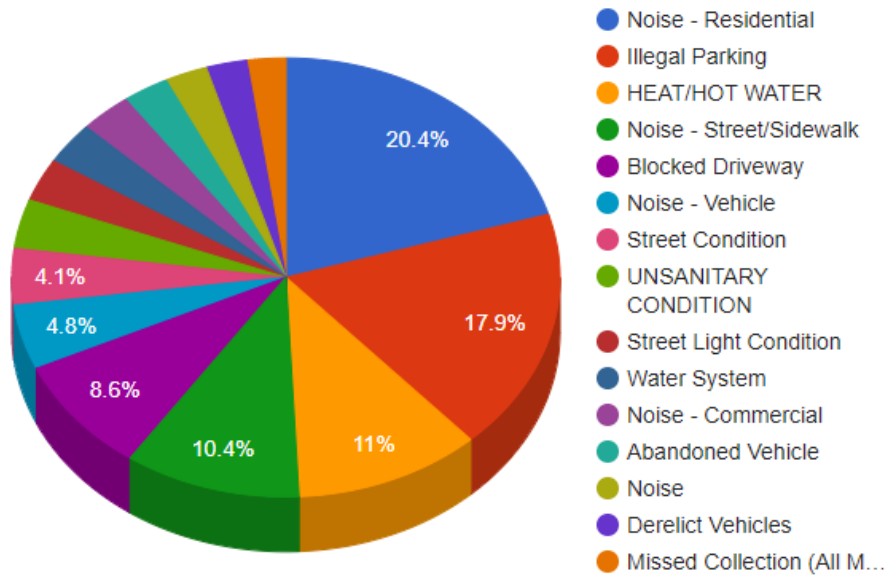
(a) Austin, TX

Category



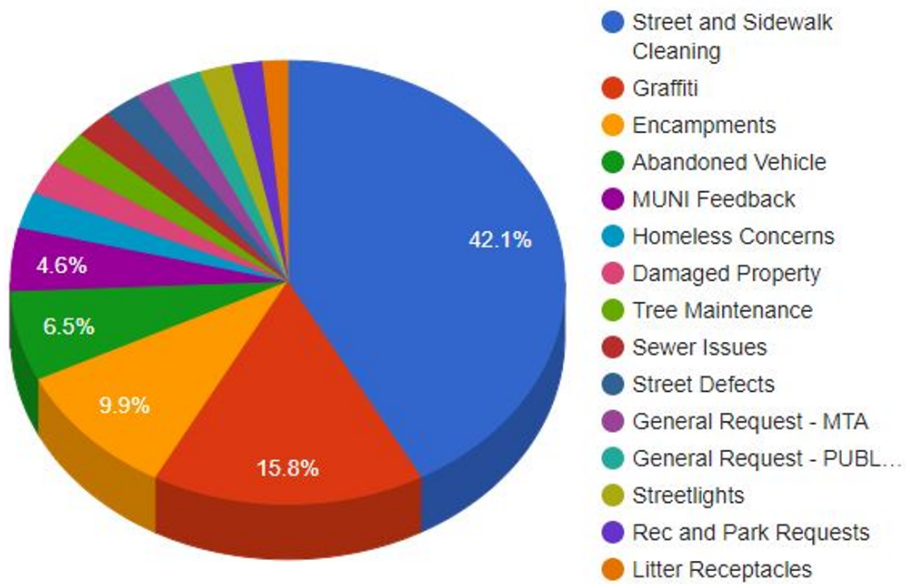
(b) Kansas City, MO

Category



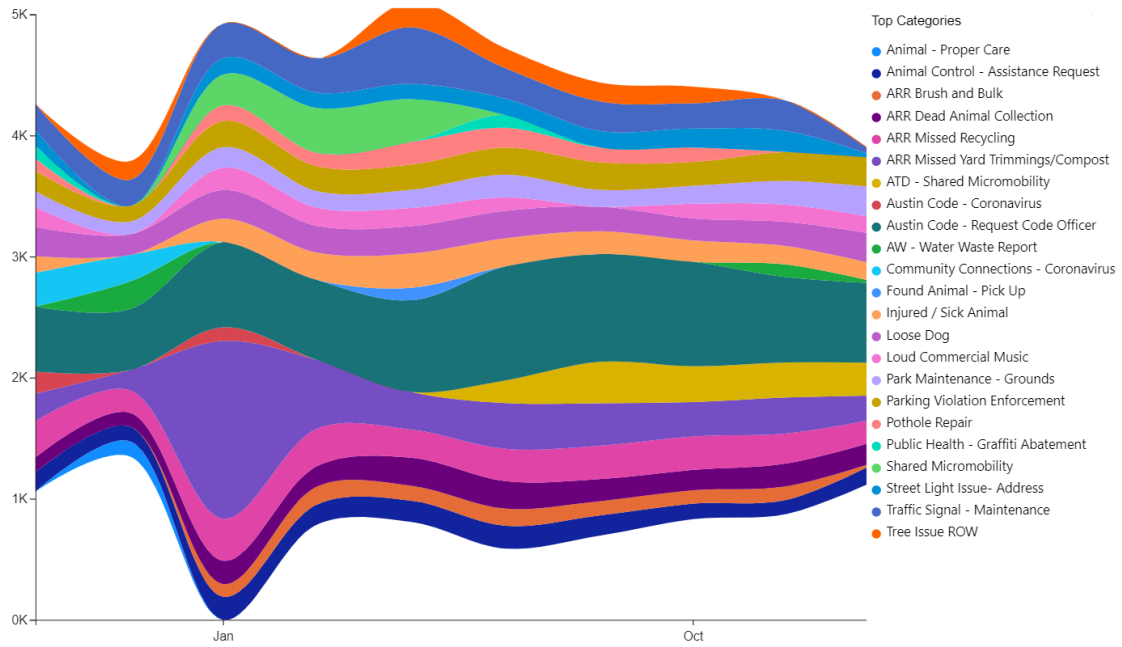
(c) New York City, NY

Category

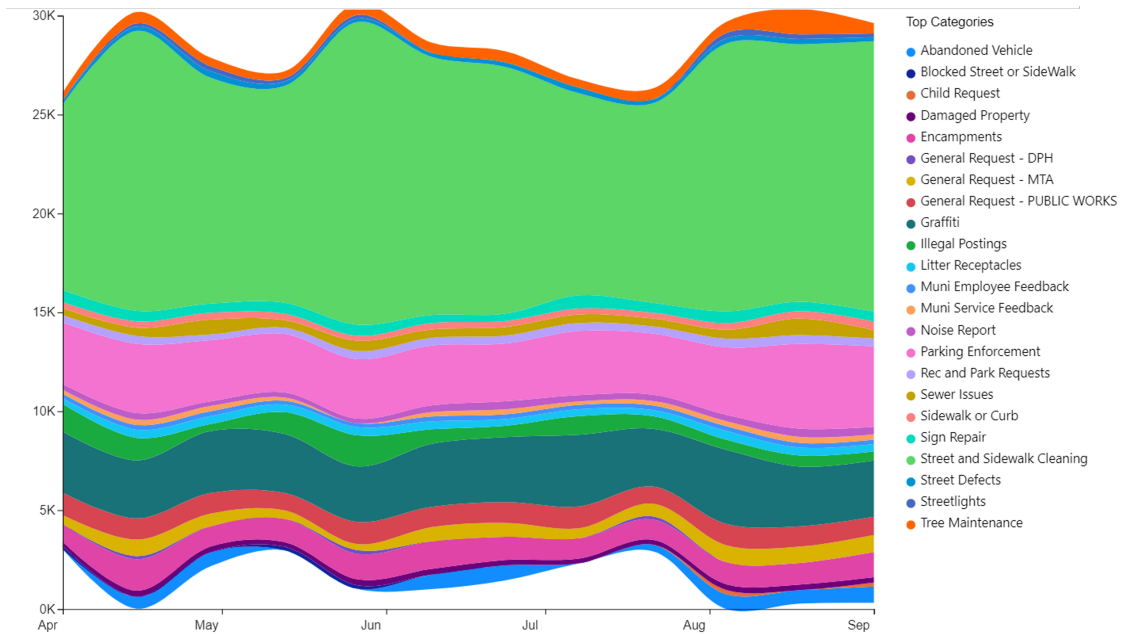


(d) San Francisco, CA

Figure 7: Top categories in 2021



(a) Austin, TX (2021)



(b) San Francisco, CA (2021)

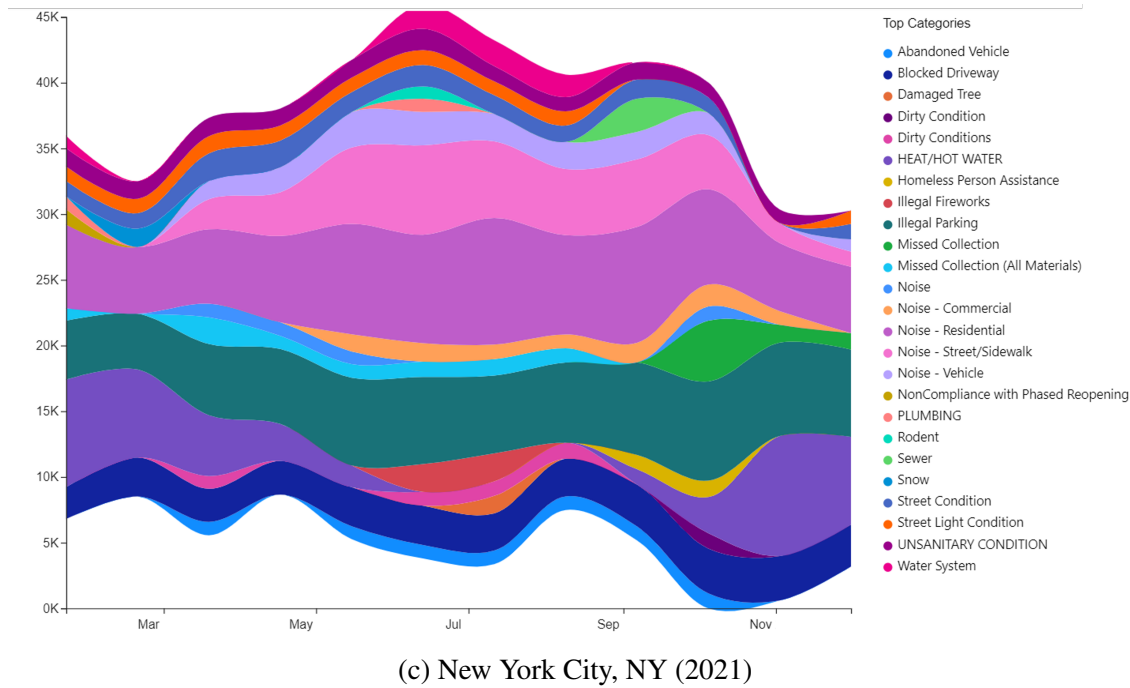
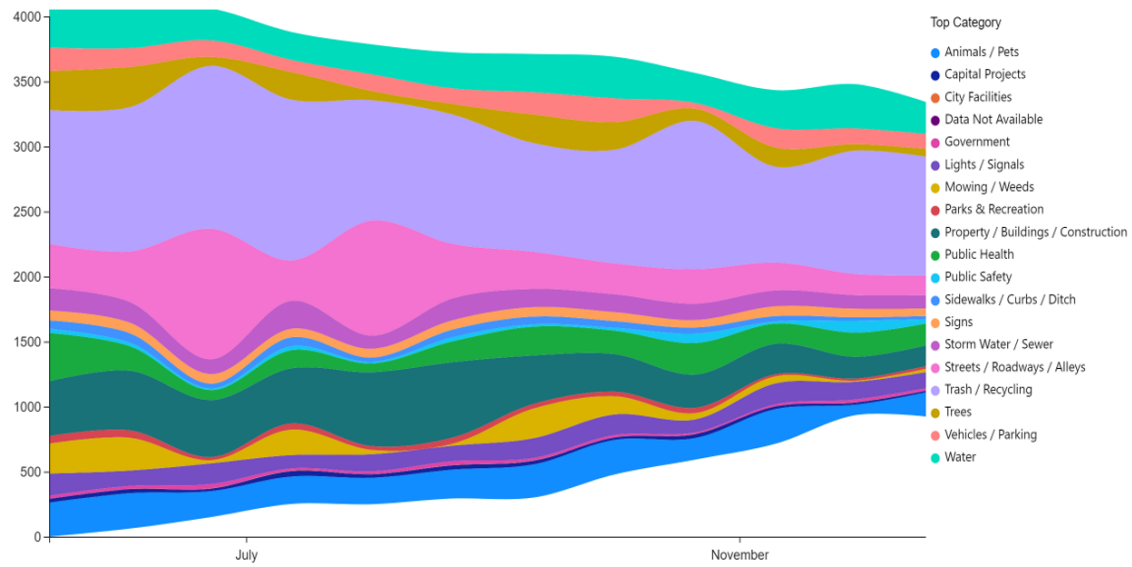


Figure 8: Requests Categories in Streamgraphs

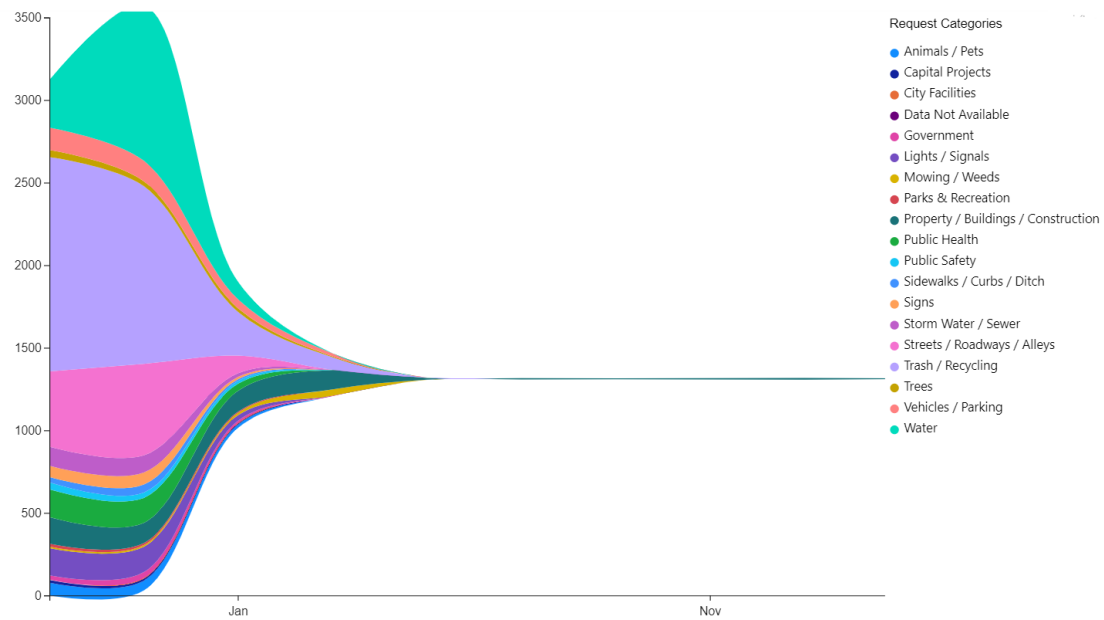
Positive Correlation means both factors are moving in the same direction and negative correlation means if one increases another decreases. Here, COVID-19 and income have a negative correlation of -0.31, COVID-19 vaccination and income have a positive correlation of 0.42, 311 requests and income has a negative correlation of -0.31, and the top service requests in Kansas City, trash and recycling have a negative -0.25 correlation coefficient with median income. Figure 11 shows the relation of median household income with all these factors.

2.3.7 Quality and Popularity of 311 Mobile Apps, and COVID-19 Related Categories

As seen earlier, the sources of citizens' voices have been transformed into digital forms, especially significantly during the COVID-19 pandemic, to the extent that digital

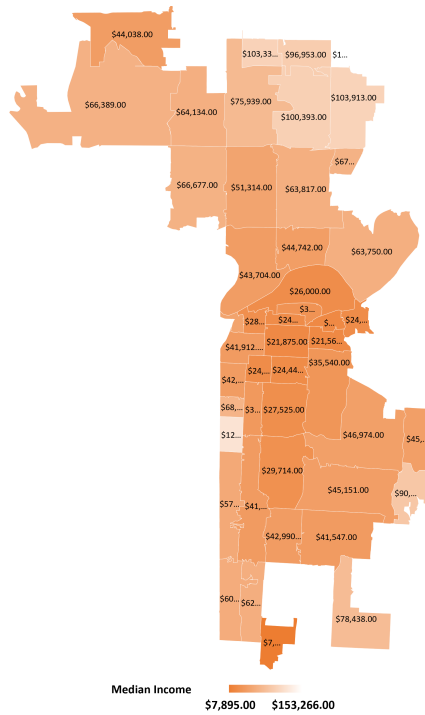


(a) (2020)

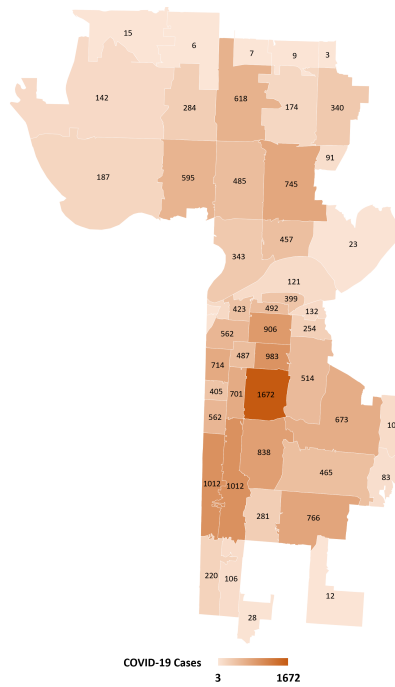


(b) (2021)

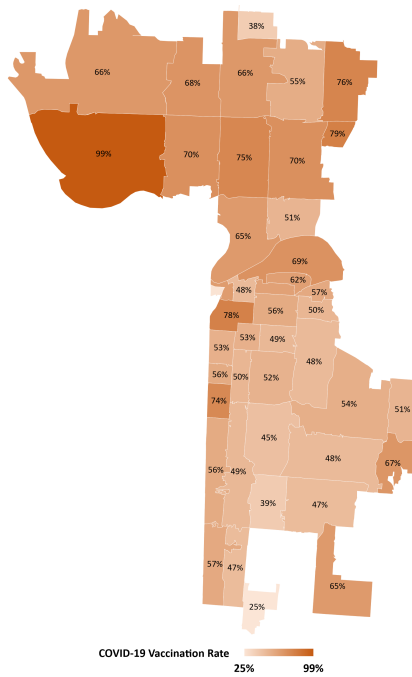
Figure 9: Requests Categories in Streamgraphs Kansas City, MO



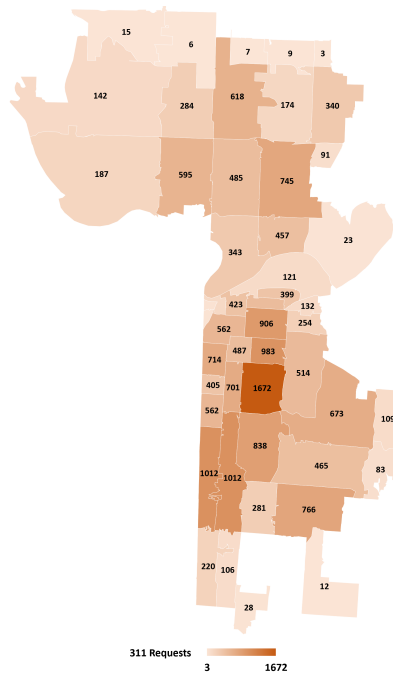
(a) Median Income Per Zip Code in Kansas City in 2020



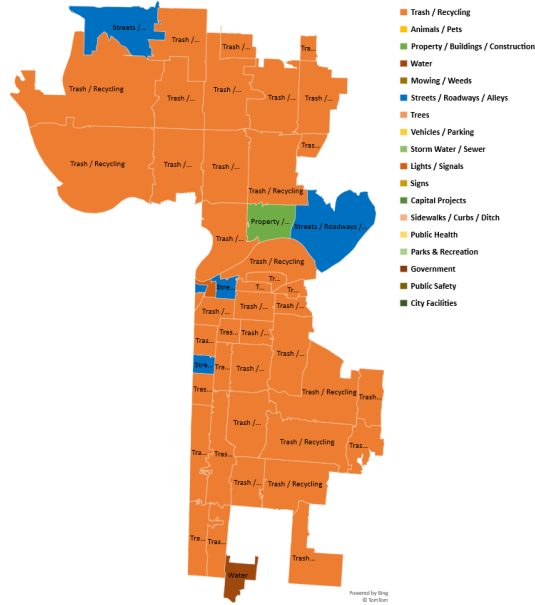
(b) COVID-19 Cases



(c) Vaccination Rates



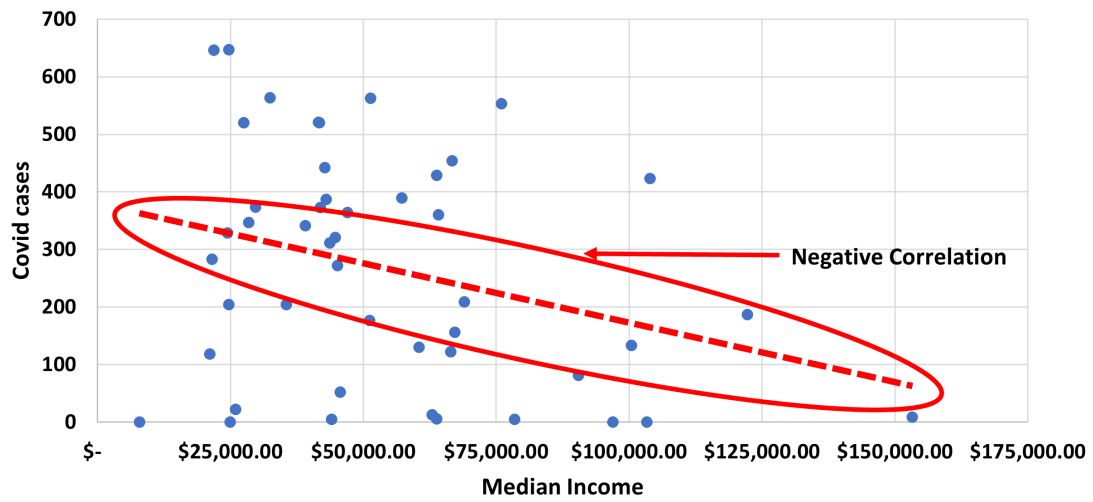
(d) Total Number of 311 Requests



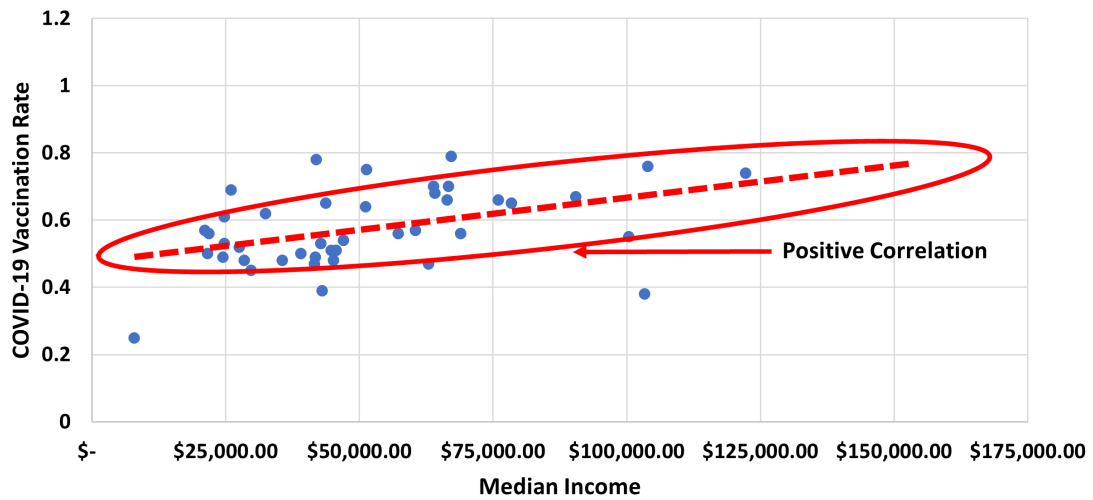
(e) Top Categories of 311 Requests

Figure 10: Variations and Divides Across Zip Codes in Kansas City in 2021

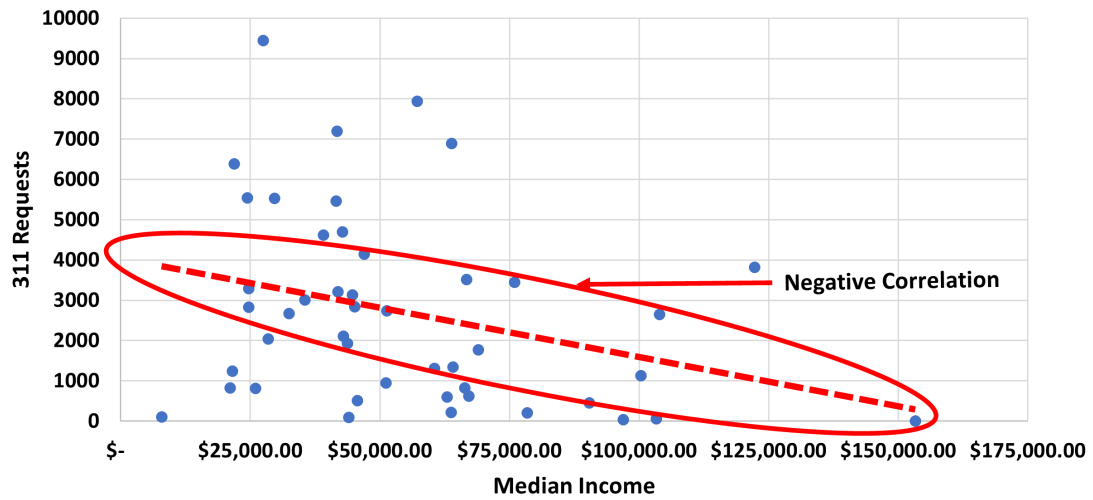
sources surpass the traditional means of phones or walk-ins in many cities. Furthermore, mobile apps have been emerging as an important source of citizens' voices. Thus, we examined the ratings of 311 mobile apps from different cities and the number of app downloads. In 2012, there were only 10 cities that had 311 mobile apps deployed [46]. As of Spring 2022, we find that most of the major cities have mobile apps, including New York, Austin, Los Angeles, San Francisco, Houston, Baltimore, Boston, Honolulu, Sacramento, Washington DC, Chicago, Philadelphia, Dallas, Oakland, Minneapolis, Memphis, and Kansas City. We checked how many apps has 4+ star, 3+star and 2+ star and how many people have downloaded them. Table 4 shows the classifications of 311 app ratings of notable cities, as 4+, 3+, and 2+ star apps based on mobile app store ratings. 311 mobile apps in New York City, Houston, and Los Angeles received 4+ stars. Kansas City,



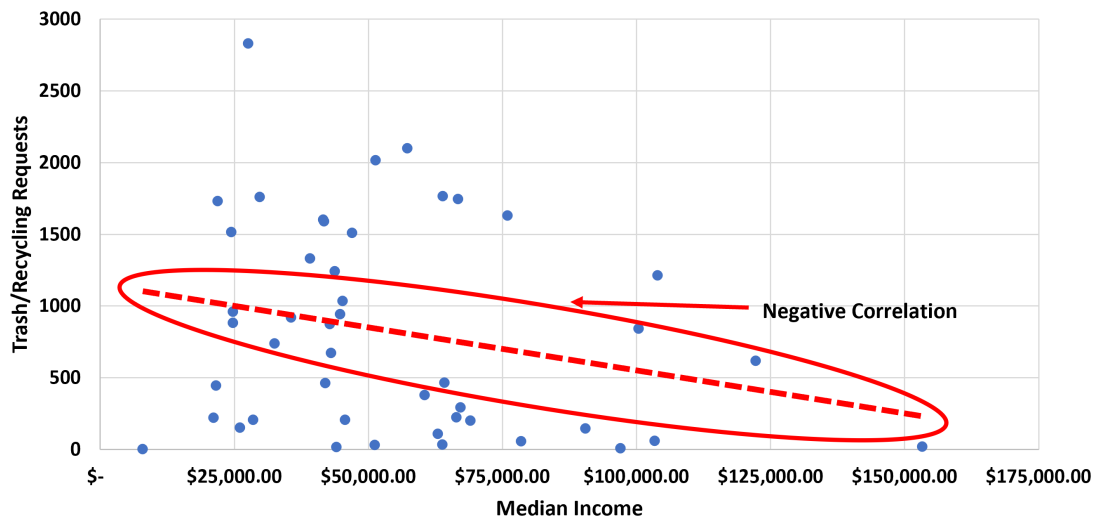
(a) With COVID-19 Cases



(b) With COVID-19 Vaccination Rates



(c) With Total 311 Requests



(d) Top Categories of 311 Requests

Figure 11: Correlation Between Income vs. Various Factors (Kansas City, MO, 2021)

San Francisco, and Austin are some of the cities that have received 3+ star rates. Chicago, Washington DC, and Baltimore are examples of cities with apps of lower ratings as of Spring 2022. The percentages of downloads per the population were under 1%, ranging from 0.1% to 0.8% for those cities. Thus, the adoption of 311 mobile apps is still in the early stage. In general, the higher-rated 311 apps tend to have a higher number of downloads. Among the cities shown in Table 4.

Table 4: Ratings and Number of Downloads of 311 Mobile Apps as of May. 2022

App Ratings	Cities	No. of Downloads	Population (millions)
34em4+ star mobile apps	NY	100K+	18.8
	LA	50K+	12.4
	Houston	10K+	7.1
34em3+ star mobile apps	KC	1000+	1.7
	SF	10K+	3.3
	Austin	10K+	2.05
34em2+ star mobile apps	Chicago	10K+	2.7
	DC	5000+	0.69
	Baltimore	5000+	0.57

2.3.8 Summary

We have analyzed city residents' 311 requests in 40 cities in the United States over several years, in order to understand the impact of the COVID-19 pandemic on the residents' interactions with the city government.

The number of requests has been increasing over time in the past several years before the pandemic. However, the extent of requests was reduced significantly across the cities, during the initial year of the pandemic and lockdown. While the requests increased in 2021, the second year of the pandemic, it is not yet at the level of pre-COVID periods.

Based on the request source data analysis, it is clear that citizens' requests are transformed into online digital platforms over phone requests or in-person walk-ins, during the pandemic. On the other hand, we find that even among the large and so-called smart cities, only a few cities have developed and actively used 311 mobile apps or any engaging online platforms that included COVID-19-related requests promptly and responsively. Spatial financial divides among residents were found to be correlated to COVID-related health demands in the cities. Overall, many city governments are yet to catch up with the rapid digital transformation of society and to improve geographic equity in various aspects.

Our future ambitions in this research are to compare non-emergency requests all over the world as well as to suggest a standard online platform for 311 requests so all the cities can maximize the utilization of non-emergency calls for city advancements.

CHAPTER 3

HUMAN FACTOR: LEARNERS - TEACHERS IN SMART EDUCATION, OPPORTUNITIES AND CHALLENGES INDUCED BY COVID-19 PANDEMIC

3.1 Related Work

The comparisons between face-to-face and online education have long been a topic of educational study. The article in [89] provides a comprehensive review of pre-COVID-19 research on online learning with respect to access, cost, and student performance in higher education. Existing studies on college courses typically find negative effects of online delivery on course outcomes, especially for academically less-prepared students. Thus, online courses without strong support to students may worsen educational inequities.

There are efforts to make a learning framework adaptive to individual needs. The authors in [90] proposed a novel deep reinforcement learning framework that adaptively provides exercises to students, recommending non-mastered exercise problems to address the immediate weakness of students. That is to gradually increase the difficulty level of exercise problems to keep the students engaged. A Workshop reported in [91] attempted to tackle issues of motivating and evaluating students of large-scale online courses using crowd-sourcing. In the Report in [92], 45 studies have been summarized on K-12 and higher education students to see the effects of Face-to-face, blended, and fully online courses and they found positive effects of fully online and blended formats on learning outcomes. A study in [93] assessed the satisfaction of Ghanaian international students in

China with the massive online learning in higher educational institutions in Beijing during Spring 2020. They found students were generally satisfied with the online courses, but the problems of cost and bandwidth of the Internet connectivity were significant challenges to some students. Another recent study [94] showed the comparison survey between online and face-to-face study in a private university undergraduate students in Cyprus and concluded that the majority of the students preferred face-to-face study.

In our study, we uniquely explore the perceived comparison between face-to-face and online education from computing and engineering students at an urban university in the United States in Spring 2020, 2021, and 2022 which is discussed later part of this writing.

3.2 Data Collection

The study population was the students taking courses from departments (multiple disciplines) at the School of Computing and Engineering at the University of Missouri-Kansas City during the semester of spring 2020. Later we have done a survey in spring 2021 and Spring 2022 as well. The survey solicitation was sent out by emails from a school administrative staff and a reminder email was sent by class instructors.

In 2020, Out of 334 responses, 58% identified themselves as undergraduate students in Computing and Engineering; 37% as graduate students in Computing and Engineering; 3% as undergraduate students in other disciplines; and 2% graduate students in other disciplines, as depicted in Figure 12a.

And in 2021, out of 138 responses, 71% identified themselves as graduate students in Computing and Engineering; 18% as undergraduate students in Computing and Engineering; 4% as undergraduate students in other disciplines; and 7% as graduate students

in other disciplines, as depicted in Figure 12b.

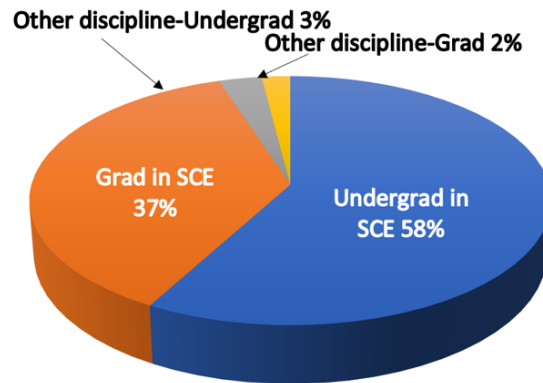
And in 2022, Out of 379 responses 8% identified themselves as undergraduate students in Computing and Engineering; 85% as graduate students in Computing and Engineering; 1% as undergraduate students in other disciplines; and 6% graduate students in other disciplines, as depicted in Figure 12c.

3.3 Quantitative Study Results

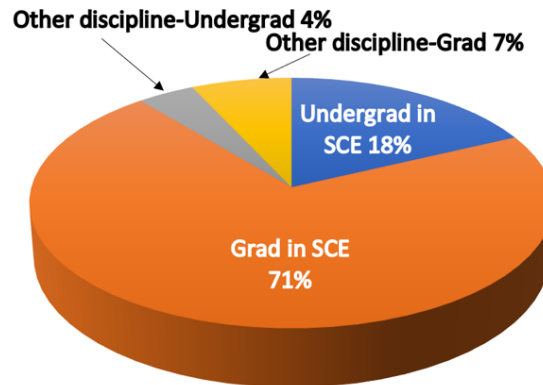
In this section, we will present the results of a total of 31 questions in Spring 2020, 40 questions in Spring 2021, and 47 questions in 6 Categories in the Spring 2022 survey and analyzed how the answers varied during and after the pandemic. Our survey questions were categorized on students' background, online and face-to-face performance analysis, synchronous and asynchronous learning environment comparison, online exam related, avatar use in the learning environment, mental health-related issues, and student's feedback (all the questions are mentioned in appendix 4.3.4). We only showed the significant results in the analysis section, and due to space limitations rest of the results are in appendix 4.3.4.

First, we will discuss internet connectivity and internet bandwidth for online education. As in Figure 13a, 13b, and 13c shows that the majority of the students used residential WiFi for their online education in every year. And majority of them have sufficient bandwidth for even synchronous streaming online education, which can be seen in Figure 14a, 14b, and 14c.

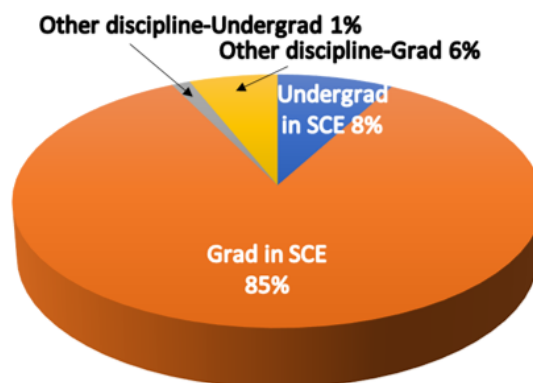
As in Figure 15a, 15b, and 15c, the overall comparison of online vs face-to-face education, beginning of the pandemic, when whole education system went to online, students mostly used to prefer face-to-face study. But after a whole year in this pandemic, in



(a) 2020

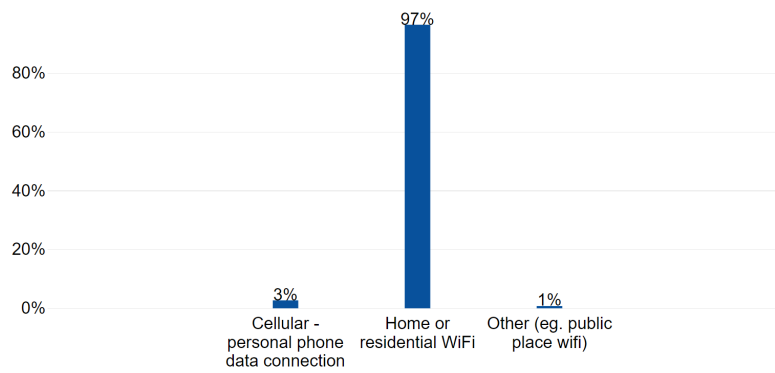


(b) 2021

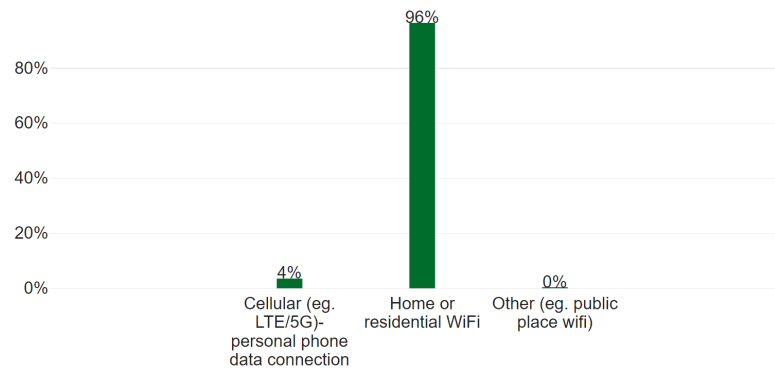


(c) 2022

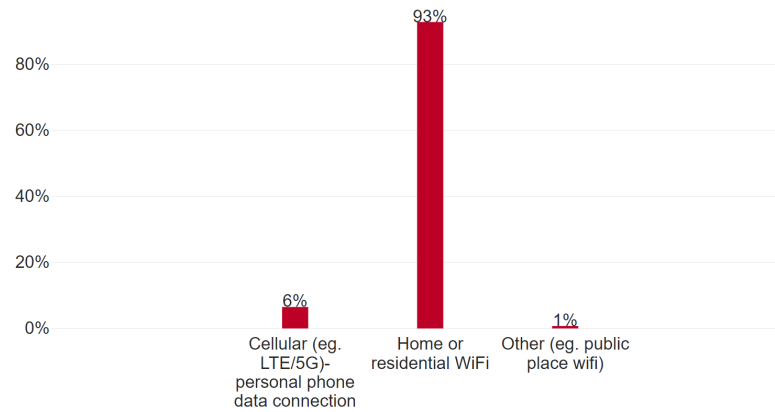
Figure 12: Survey Participant Characteristics



(a) 2020

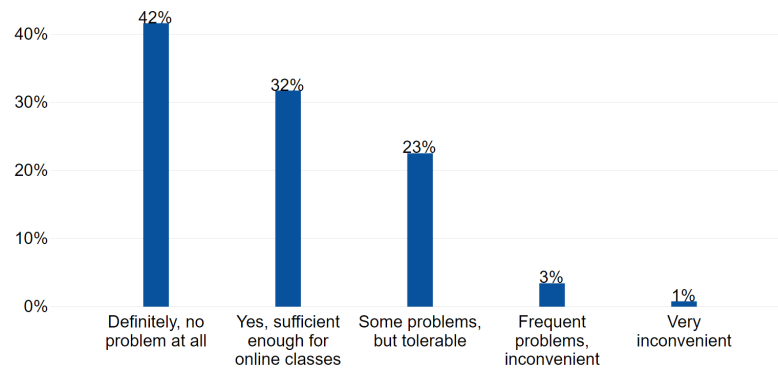


(b) 2021

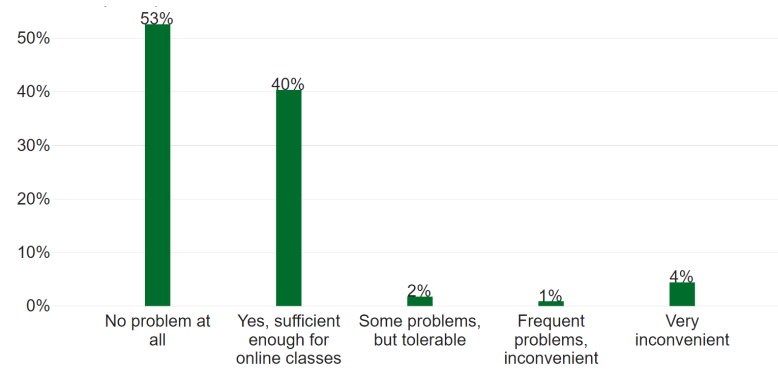


(c) 2022

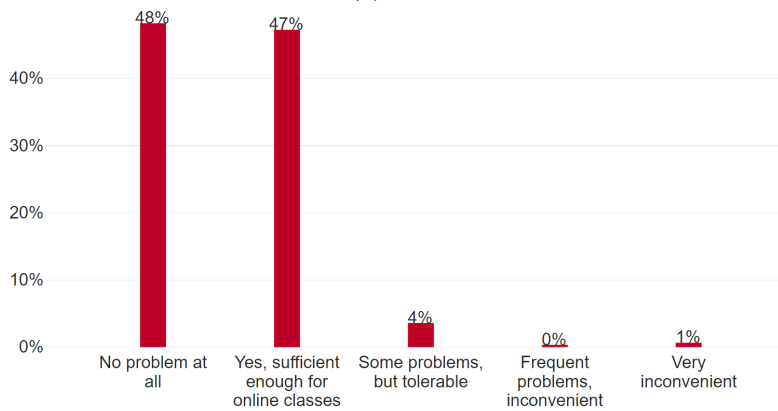
Figure 13: Responses to Q: What is Your Main Internet Connectivity at Home for Online Learning?



(a) 2020



(b) 2021

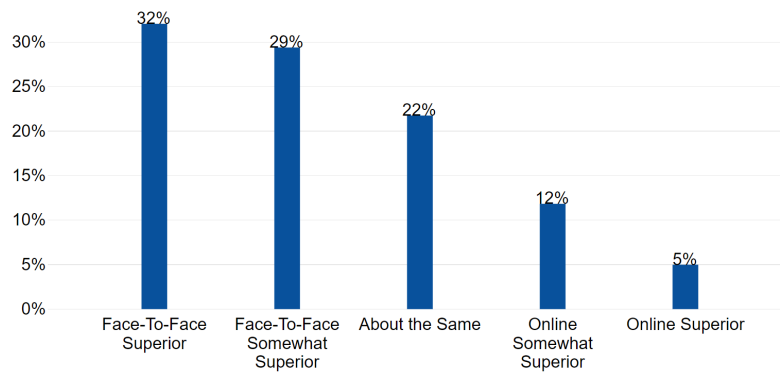


(c) 2022

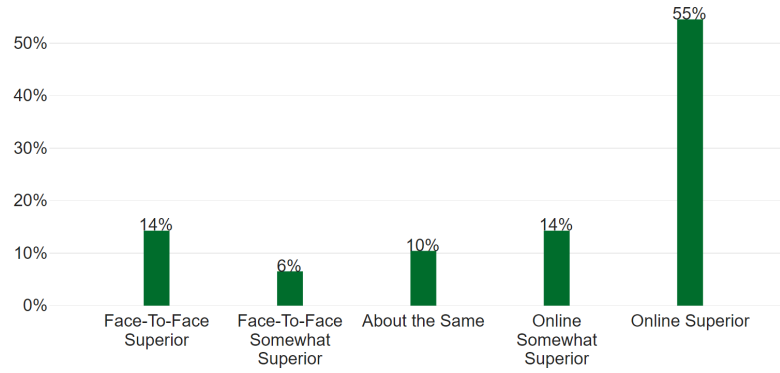
Figure 14: Responses to Q: Do You Have a Sufficient Internet Bandwidth for Online Education?

2021 students are liking online education more. Students' preference for face-to-face vs online is approximately 60% and 40% in 2020, and that changed face-to-face 40% vs online 60% in 2021. In 2022 also most students preferred online superior to face-to-face. In the spring 2022 survey 33% survey participants preferred face-to-face and 42% preferred online education. For more extensive analysis we wanted to see how many graduate and undergraduate students preferred online education over face-to-face, over the years. Figure 16a shows more than 65% of the 60% face-to-face preference are from undergraduate students in the 2020 survey. However, Figure 16b, and 16c shows 96%, and 81% of the total 60% in 2021 and 42% in 2022, respectively, are graduate students who preferred online education. So from the analysis, it can easily be said that graduate students are more comfortable with online education. And also with years passing by in the pandemic when online was the only platform available for education, students became comfortable more with online platforms. In addition, in the 2022 survey, all results were slightly decreased for online education, and we found a lot of comments from the students to come back to face-to-face, which can be seen in section 3.4.

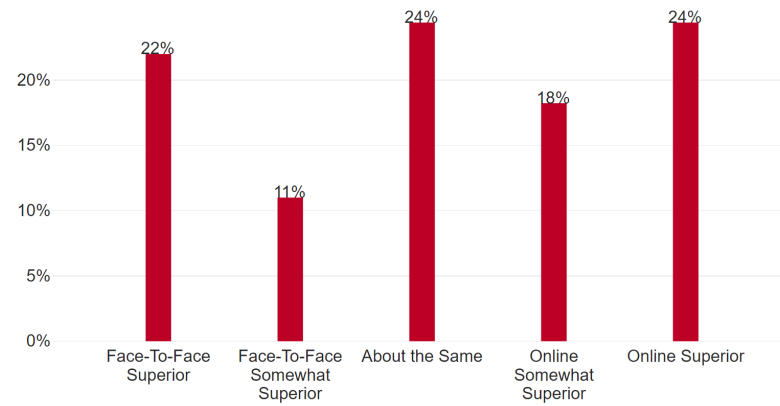
The technical comfort level with Canvas was always high among the students as they used it even before the pandemic (Canvas was introduced to UMKC students in spring 2018), which is visible in Figure 17a, 17b, and 17c. And technical comfort level with Zoom is a little higher in 2022 and in 2021 than in 2020, which can be seen in Figure 18a, 18b, and 18c. But the most significant changes happened in the technical comfort level with Proctorio (which is an online exam proctoring platform). At the beginning of the Pandemic more than 60% of students were finding it difficult with Proctorio shown in Figure 19a, as they never used it before. Whereas, in 2021 more than 85% students answered they are quite comfortable with Proctorio, which is visible in Figure 19b. And



(a) 2020

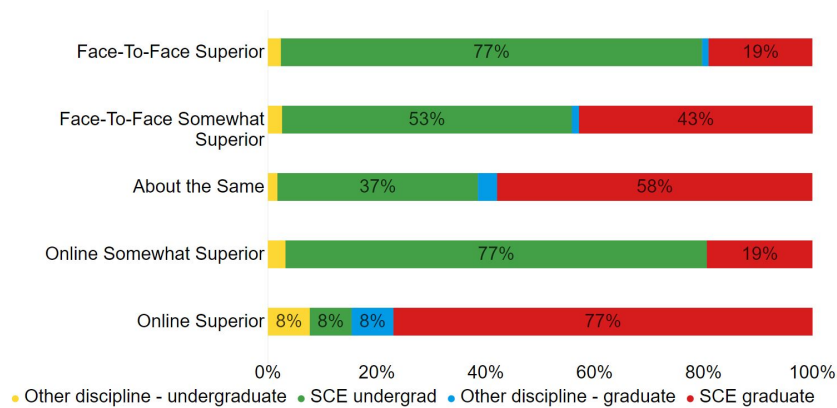


(b) 2021

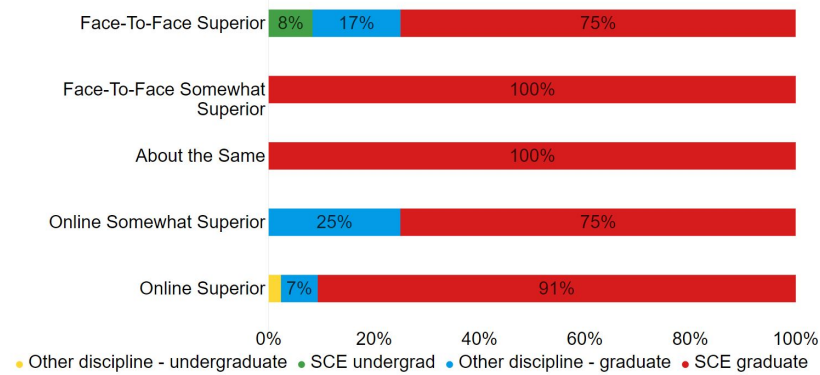


(c) 2022

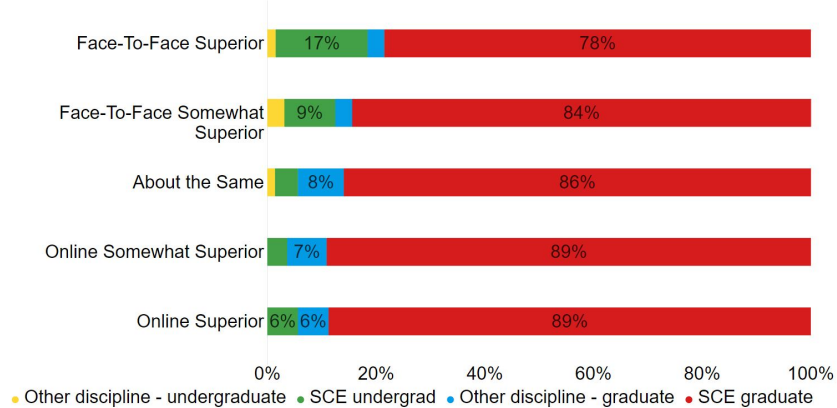
Figure 15: Online And Face-To-Face Courses Overall Comparison



(a) 2020



(b) 2021



(c) 2022

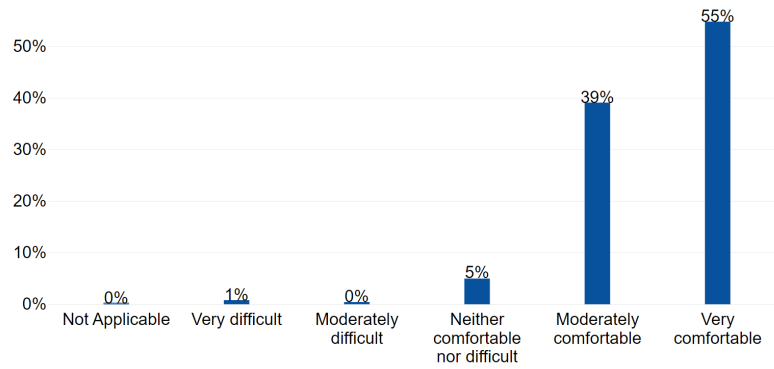
Figure 16: Online And Face-To-Face Courses Overall Comparison Graduate and Undergraduate Standpoint

in 2022, 79% of students said, they are comfortable with Proctorio, shown in Figure 19c.

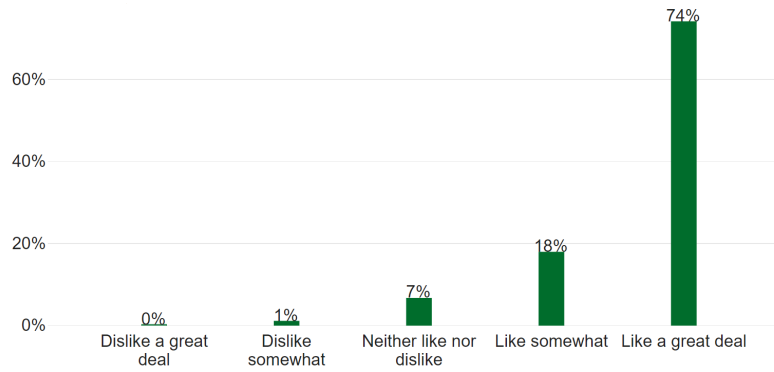
In all three years 2020, 2021, and 2022 students said the perceived learning outcome is about the same as online and face-to-face, showed in Figure 20a, 20b, and 20b. Support for students with different learning styles in online education has increased by almost 40% from 2020 to 2021 and 28% increased from 2020 to 2022, showed in Figure 21a,21b, and 21c. Almost 70% students said it is difficult to have student-to-student interactions in 2020. However, in spring 2021, 52% students preferred online education for interaction (as that was the only way to interact during lockdowns), which changed again in spring 2022. Almost 53% of students preferred face-to-face interaction, and by then lockdown was released in most of the U.S. states. Comparison of face-to-face and online education in respect to students-to-student interaction is shown in Figure 22a, 22b, and 22c. Similarly, in the question of student-faculty communications in 2020, students preferred face-to-face around 57%, whereas in 2021, 75% preferred online and in 2022 52% preferred online. Student-faculty communications are shown in Figure 23a,23b, and 23c.

The responses to the question about scheduling flexibility for students are a lot more in online education than face-to-face in all three years, as in Figure 24a,24b, and 24c. About more than 80% of students preferred online with respect to the ability of students to Work at their own pace in 2020, 2021, and 2022, showed in Figure 25a, 25b, and 25b.

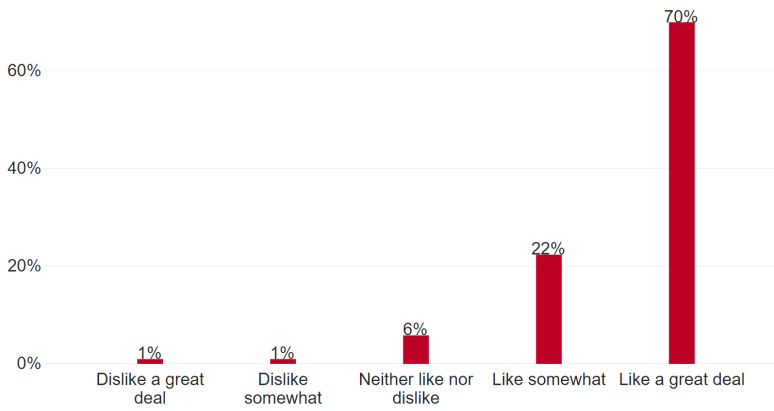
During the 2021 and 2022 surveys, we added a few questions to find out among synchronous and asynchronous, are superior to the students. Figure 26a shows in 2021, 51% students preferred asynchronous learning during the period of complete lockdown and most students were doing classes from different time zone. Figure 26b shows in 2022



(a) 2020

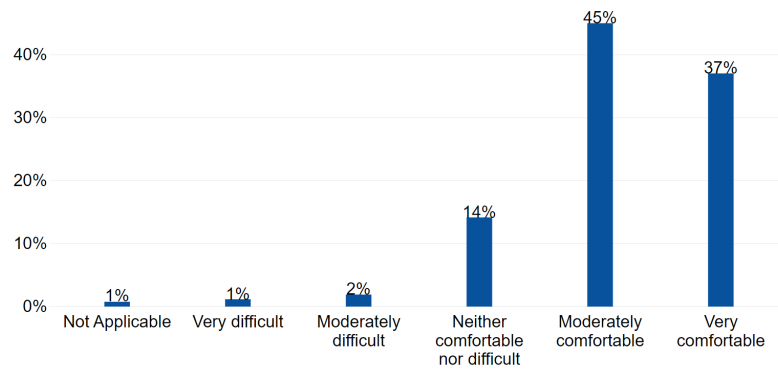


(b) 2021

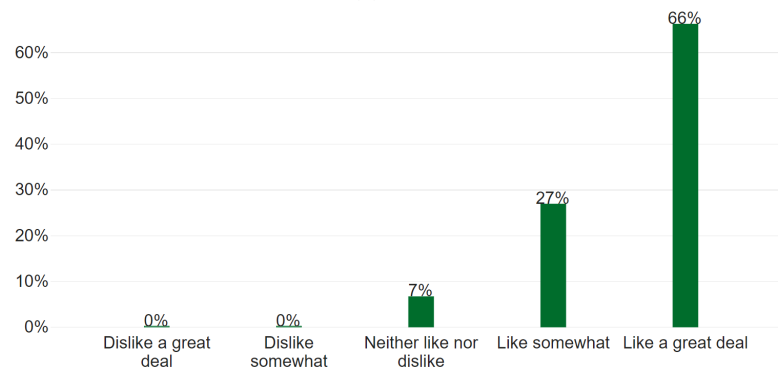


(c) 2022

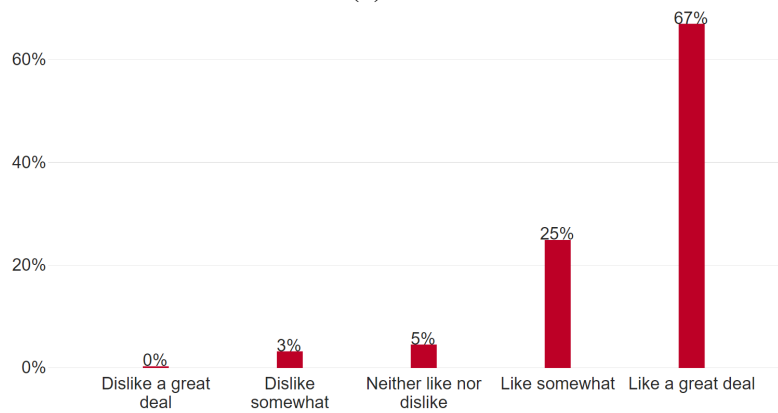
Figure 17: Technical Comfort Level with Canvas



(a) 2020

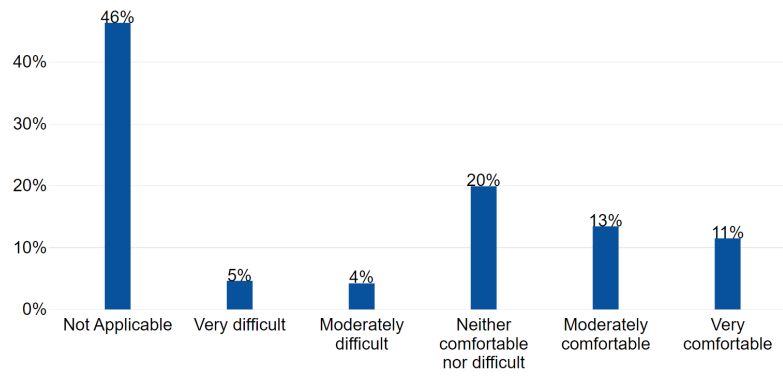


(b) 2021

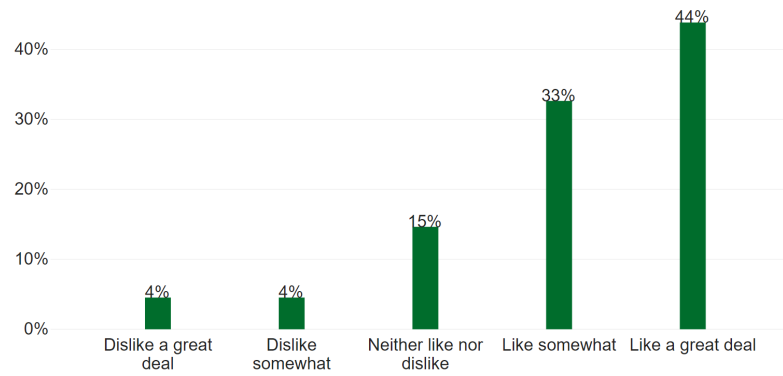


(c) 2022

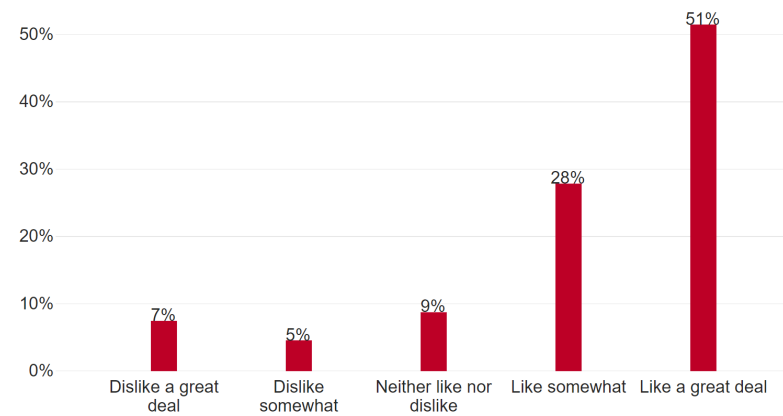
Figure 18: Technical Comfort Level with Zoom



(a) 2020

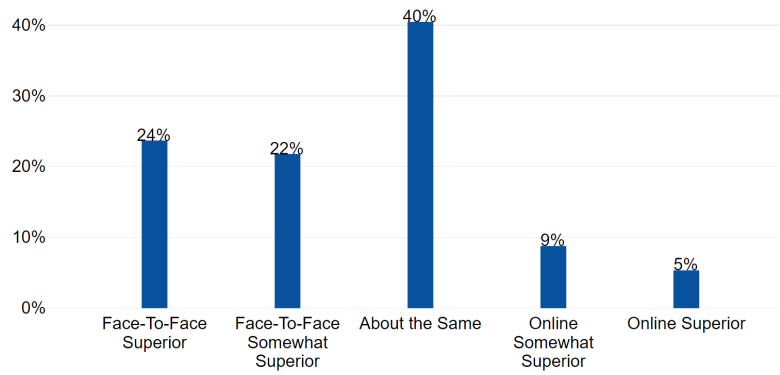


(b) 2021

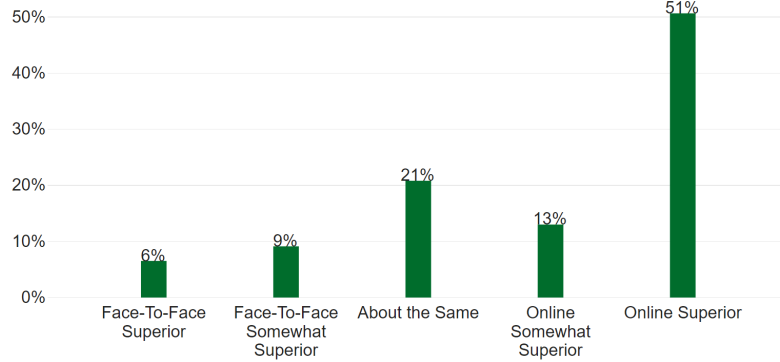


(c) 2022

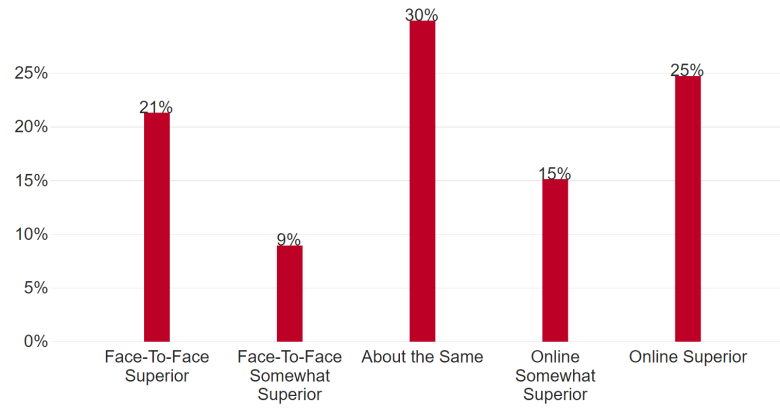
Figure 19: Technical Comfort Level with Proctorio



(a) 2020

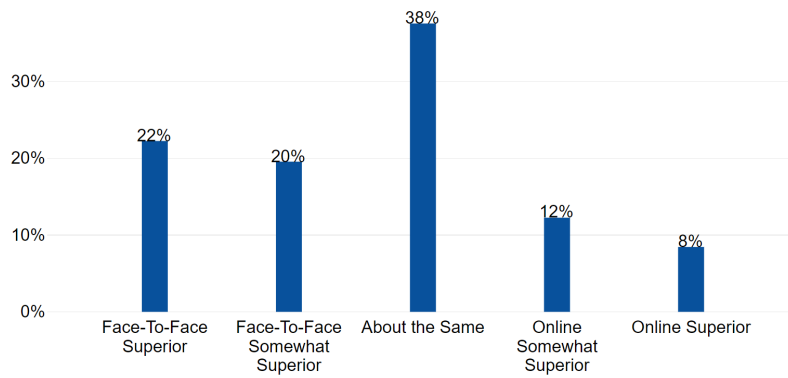


(b) 2021

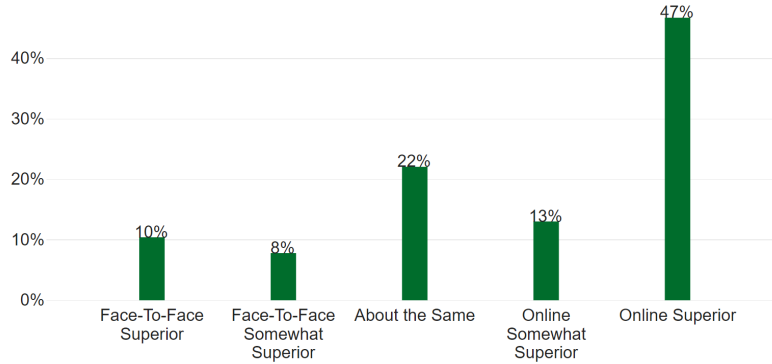


(c) 2022

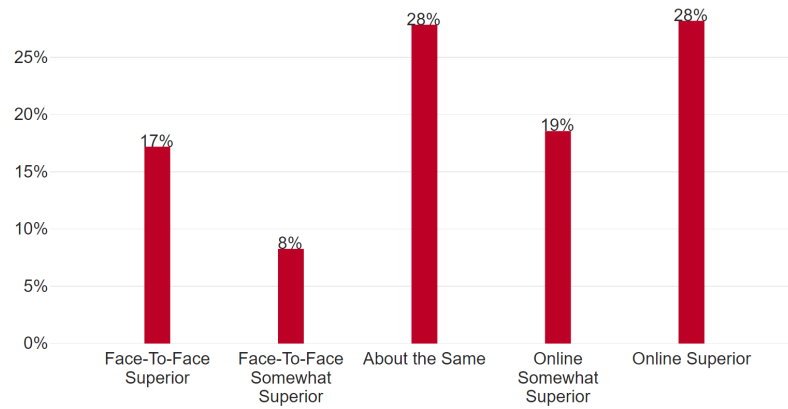
Figure 20: Learning Outcomes In Online Education Compared To Face-To-Face



(a) 2020

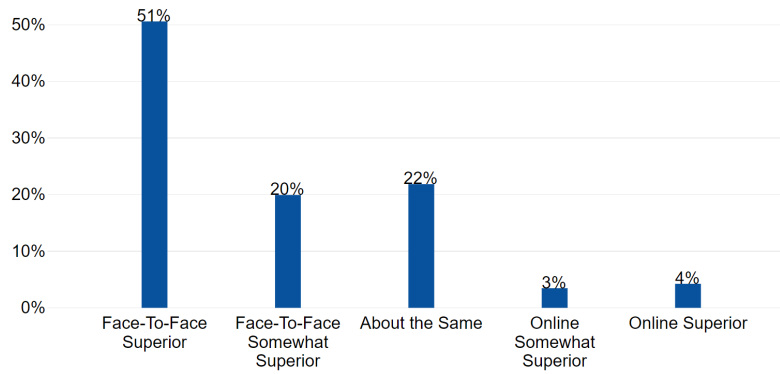


(b) 2021

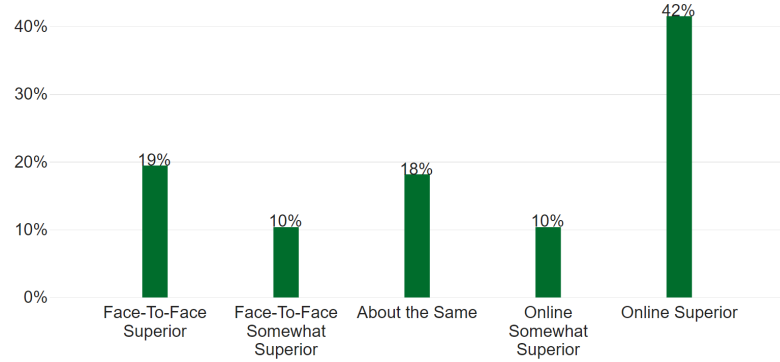


(c) 2022

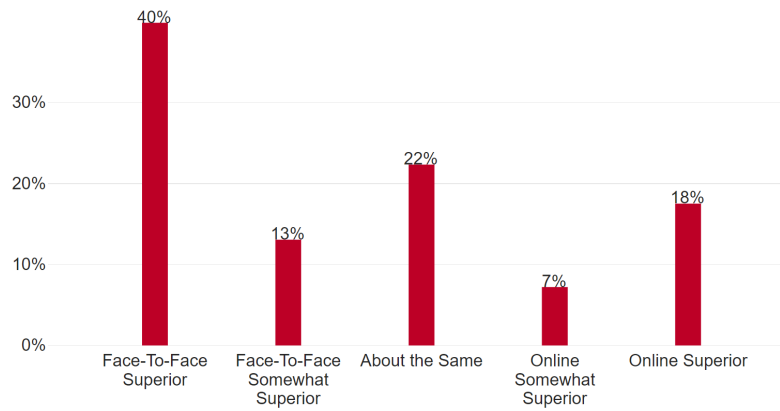
Figure 21: About Support For Students With Different Learning Styles



(a) 2020

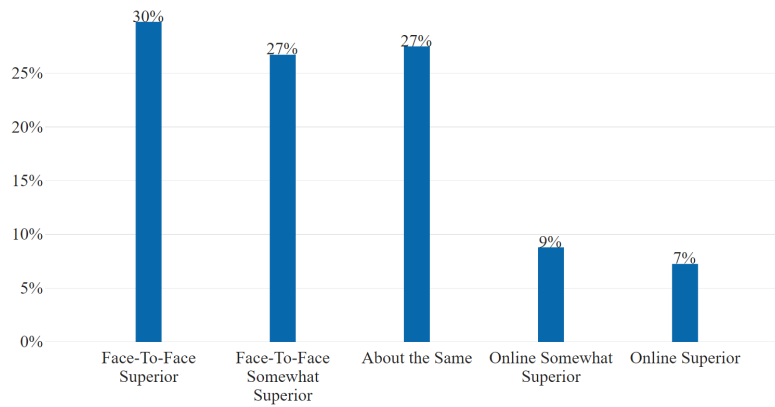


(b) 2021

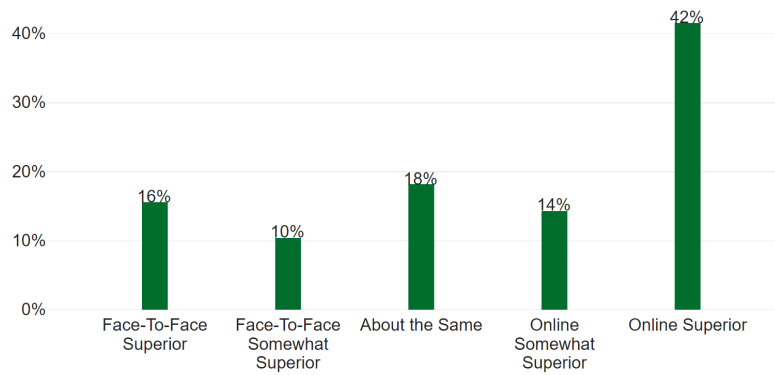


(c) 2022

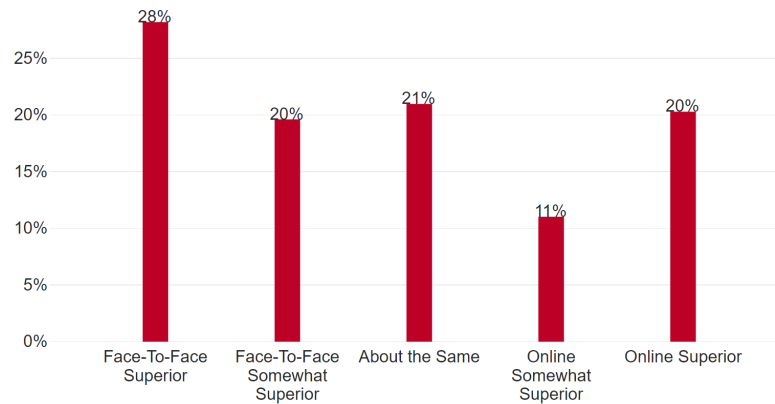
Figure 22: About Student-To-Student Interactions



(a) 2020

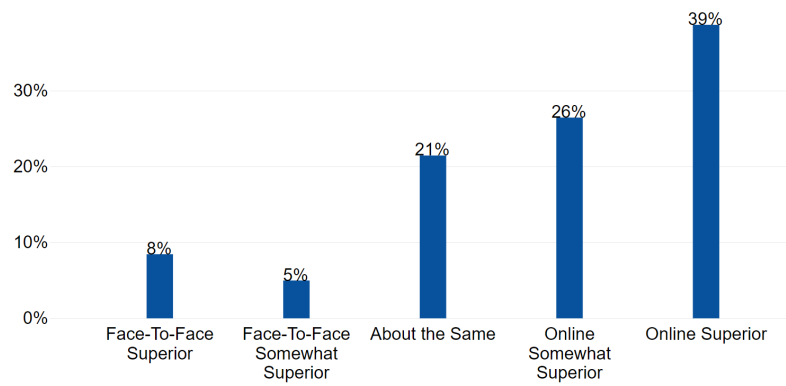


(b) 2021

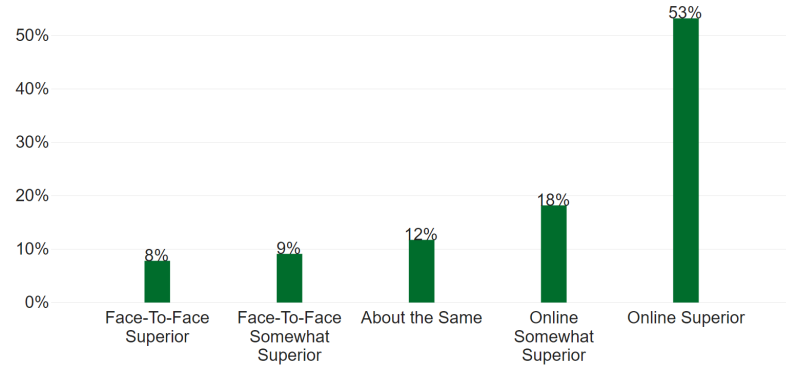


(c) 2022

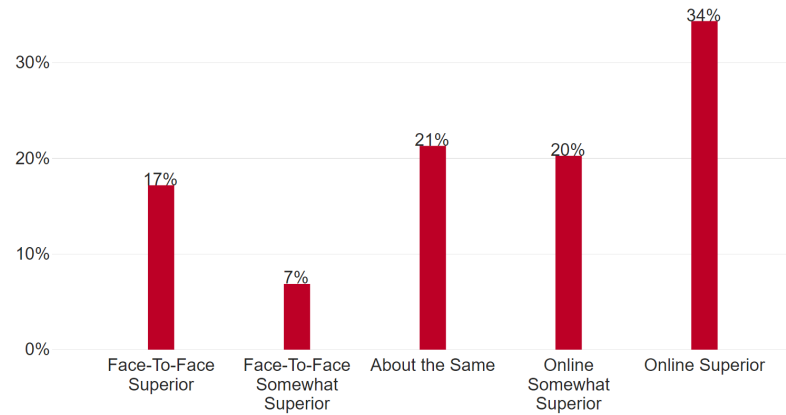
Figure 23: About Student-To-Faculty Communications



(a) 2020

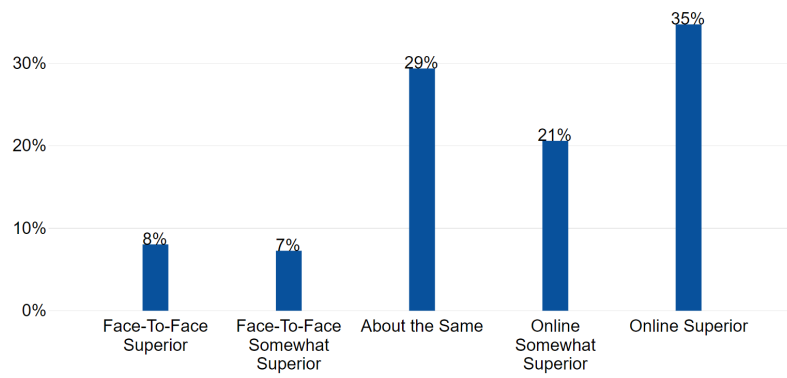


(b) 2021

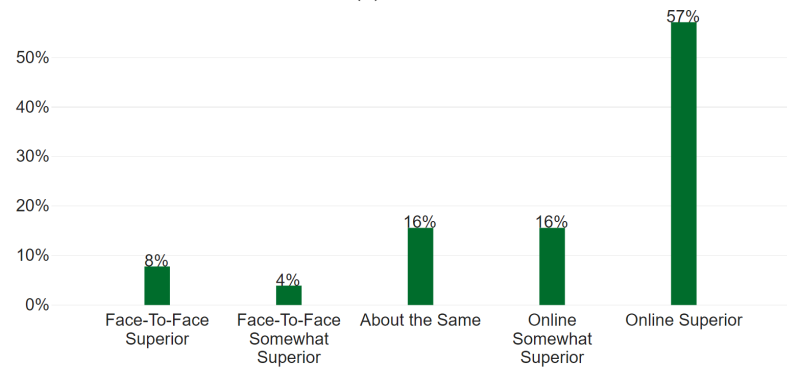


(c) 2022

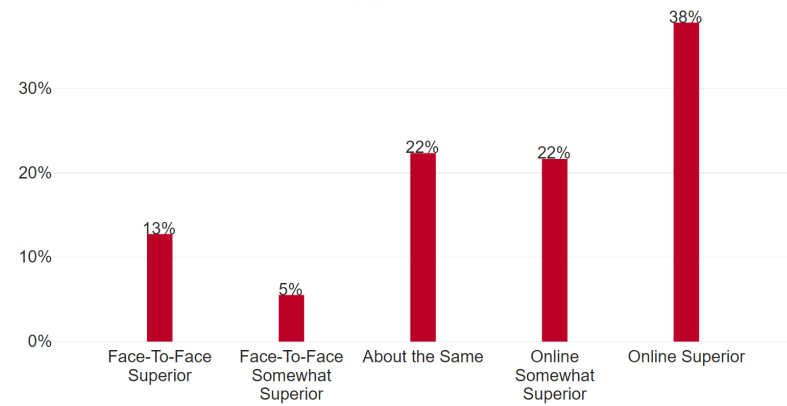
Figure 24: About Scheduling Flexibility for Students



(a) 2020



(b) 2021



(c) 2022

Figure 25: About Ability of Students to Work at Their Own Pace

synchronous learning overall is slightly superior. Figure 27 shows in the 2021 and 2022 presentation of course material is about the same in both synchronous and asynchronous learning.

When Zoom synchronous lecture is recorded, more than 70% students played it at least once in 2020 which increased to almost 90% in 2021, and 98% in 2022 shown in Figure 28a, 28b, and 27a. We have done the same comparison for synchronous vs asynchronous as we did for online vs face-to-face, which are shown in Appendix 4.3.4.

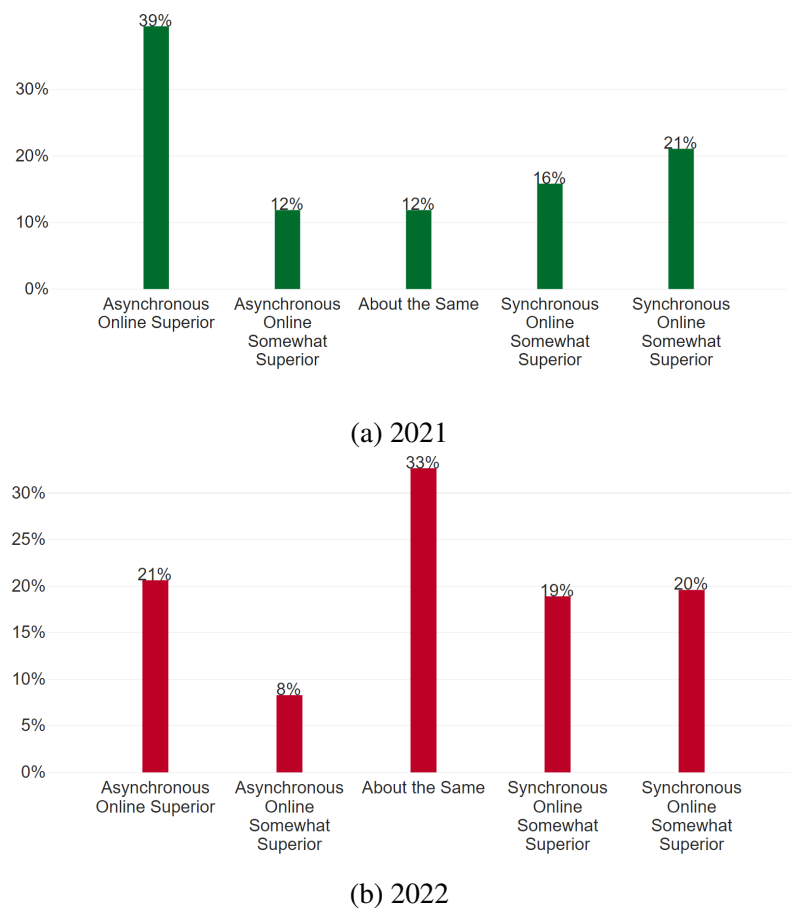


Figure 26: Comparisons between Online Synchronous vs. Asynchronous Courses; Overall Comparison.

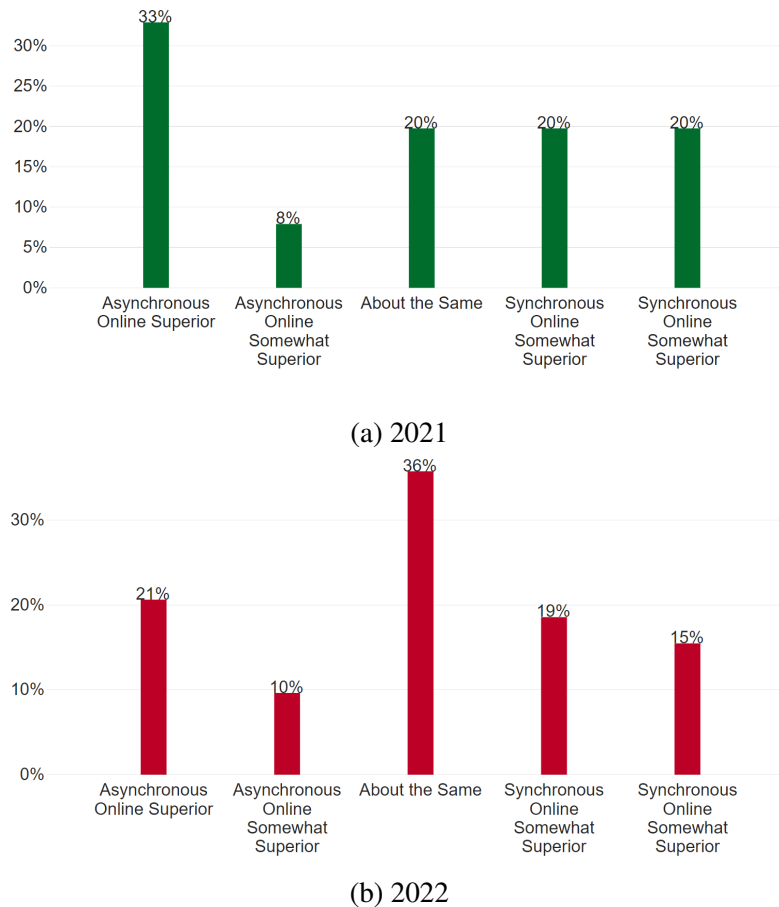
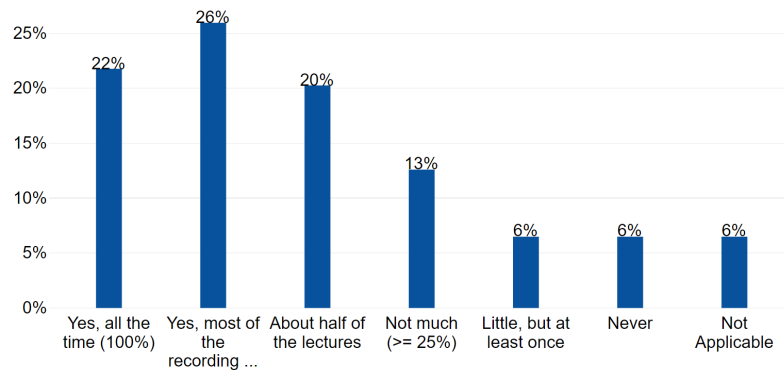
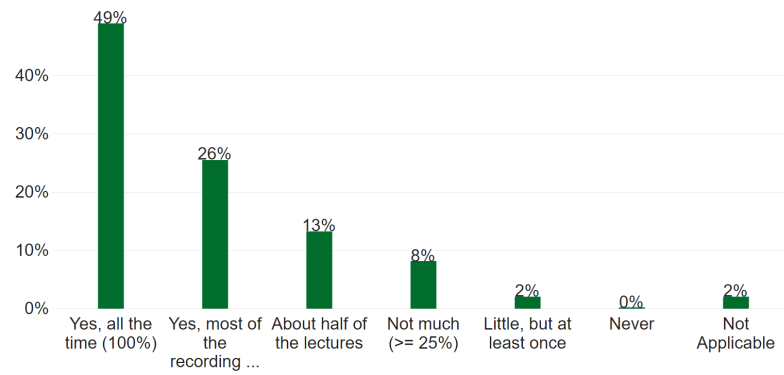


Figure 27: Comparisons between Online Synchronous vs. Asynchronous Courses; Presentation Of Course Material.

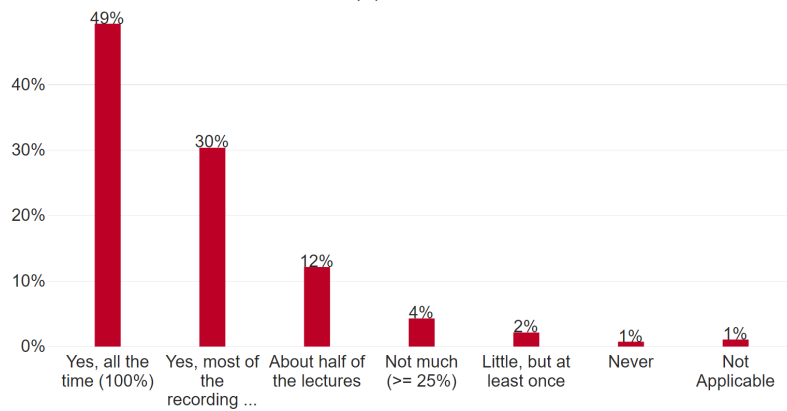
One way to create a more realistic and engaging learning environment is the use of "avatars", i.e., asking students to create unique characters in order to investigate and experience real-world scenarios from different points of view. We have added a few questions about avatars (a graphical representation) in the 2021 and 2022 surveys, as some students may not prefer to upload their pictures on the online platform. According to the survey results, only a few students have used avatar and few students have seen others use it in both 2021 and 2022, showed in Figure 29, and Figure 30, respectively. In response



(a) 2020



(b) 2021



(c) 2022

Figure 28: Responses to Q: When the Synchronous Online Instruction is Given, Did You Still Watch the Recording of the Lecture?

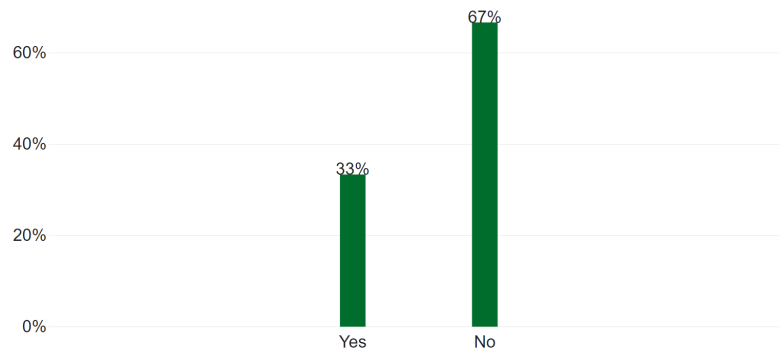
to the question about their thought of adding an avatar in online classes, more than 50% of students said they are okay to try it in both years, which is shown in Figure 31.

During the lockdown, lots of students faced mental health issues. We have a few questions to find out if the online class has any effect on mental health. Figure 32a shows 20% of 2021 survey students feel online classes have at least some effects on mental health, which increased to 27% in 2022, shown in 32b. Figure 34 shows in both 2021 and 2022, more than 50% of students preferred online synchronous with recording available for the learning options.

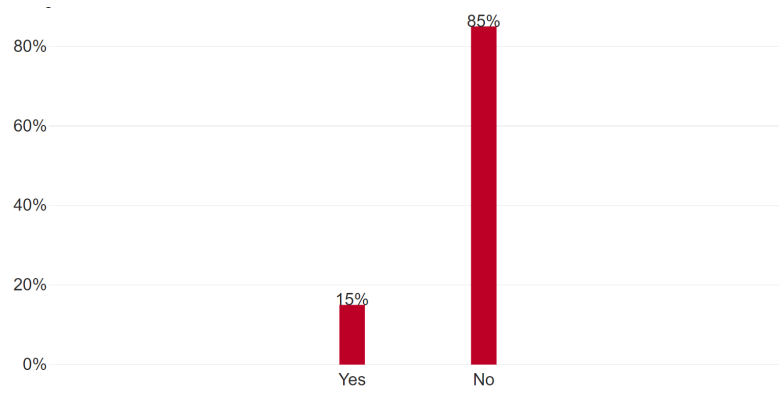
In 2021 there were lots of comments related to online exam integrity. So, we added a few questions related to the online exam in the 2022 survey to find out students' perspectives on online exams. Figure 36a shows 76% students have taken online exams multiple times, Figure 36b shows almost 67% are comfortable with online exams. 62% students said online exams can ensure academic integrity is shown Figure 36c. 68% students said online exams have enough flexibility for different types of assessments, shown Figure 36d. In response to the question about if online proctoring tools are functional and reliable enough, 60% of students said yes, which is shown in Figure 36e. Finally, we asked which type of exam they preferred most, and Figure 36f shows 57% students preferred online remote exams, which is slightly different from their preference for online synchronous vs asynchronous classes in Figure 26.

3.4 Qualitative Study Results

Using the same grounded method in ATLAS.ti 22 we used in 2020 [1], we developed codes by comparing patterns and sentiments and created reports on the comments of the students on online education for all three years. We considered all the online platforms

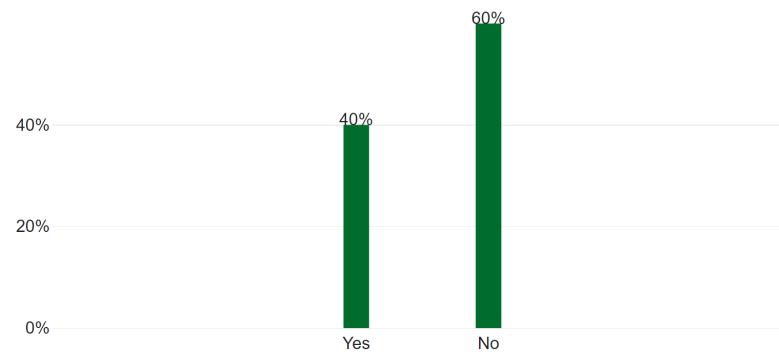


(a) 2021

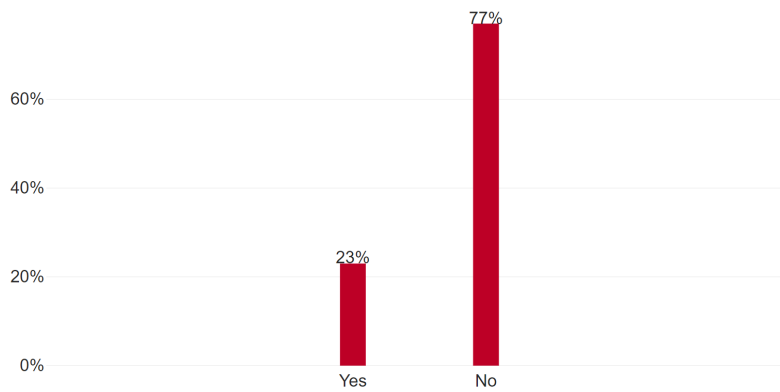


(b) 2022

Figure 29: Response to Q: Have You 'Used' Avatar Filters During Online-synchronous Classes or Meetings?

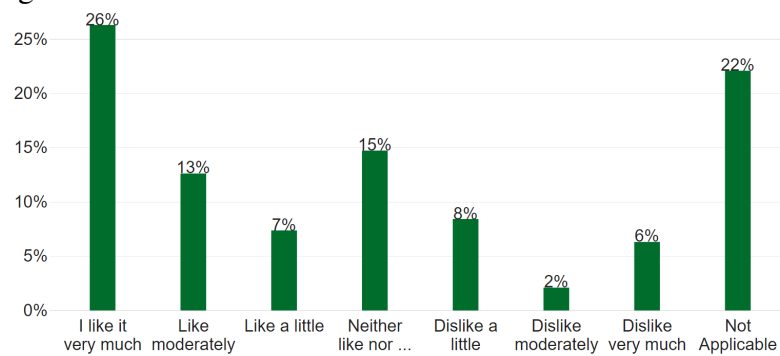


(a) 2021

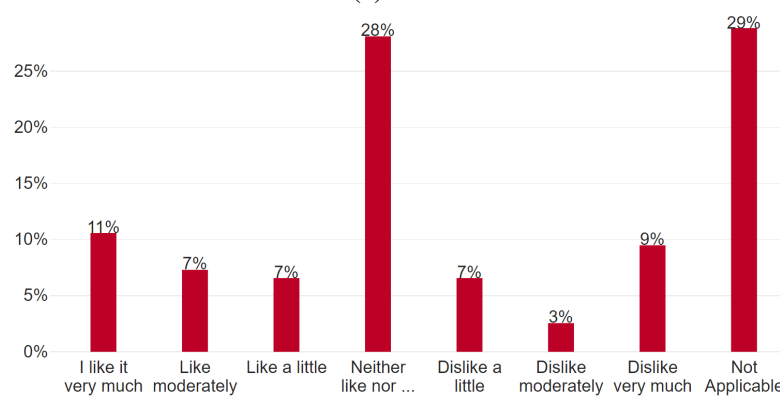


(b) 2022

Figure 30: Response to the Q: Have You 'Seen Other People' Using Avatar Filters During Online Meetings or Classes?

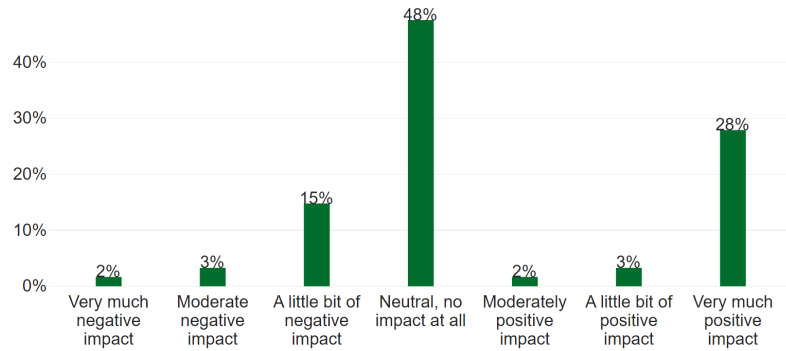


(a) 2021

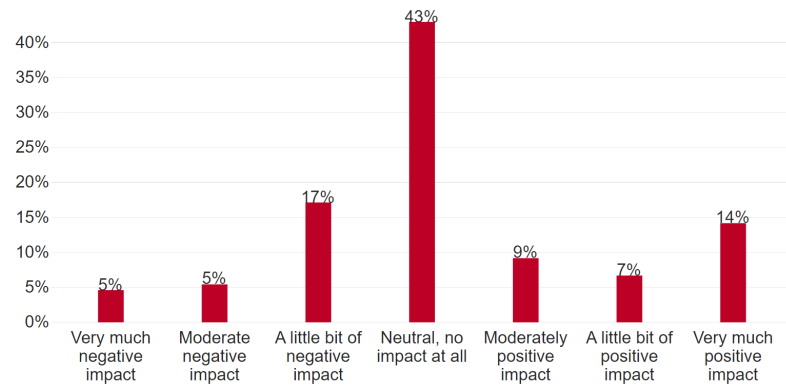


(b) 2022

Figure 31: Responses to Q: What Do You Think of Adding Avatar in Online Classes?

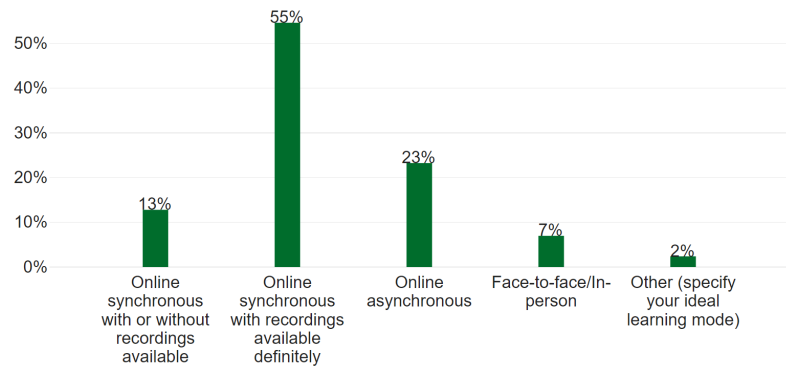


(a) 2021

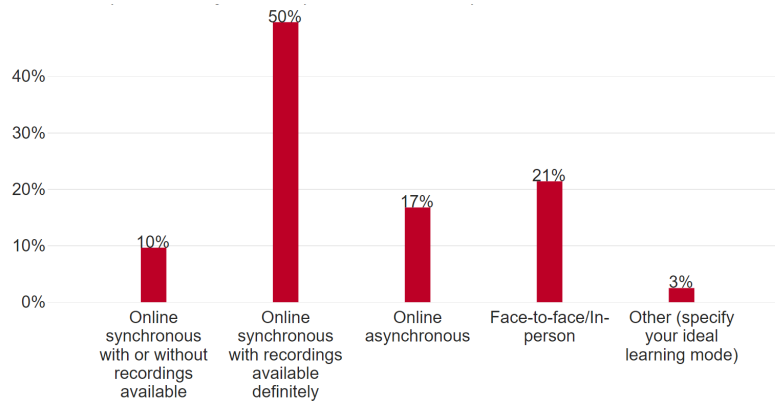


(b) 2022

Figure 32: Response to Q: Do You Think That Online Classes Impact Your Mental Health?

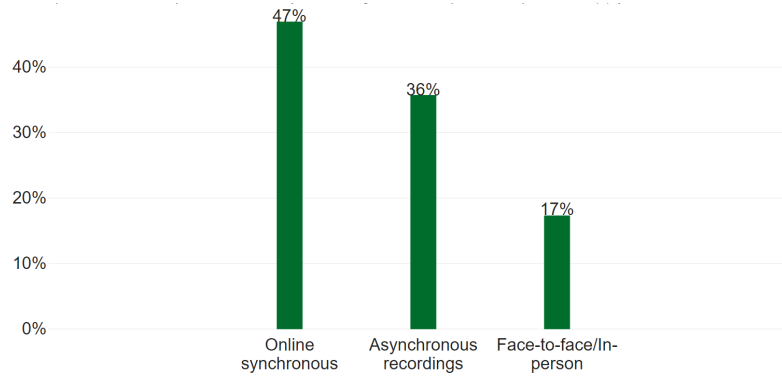


(a) 2021

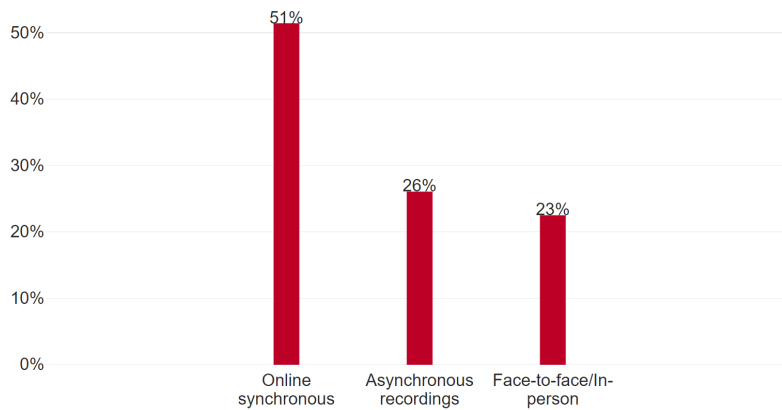


(a) 2022

Figure 34: Response to Q: What is the 'Preferred' Mode of Your Learning if There are Options of In-person and (a) Synchronous Online (b) Asynchronous Online?

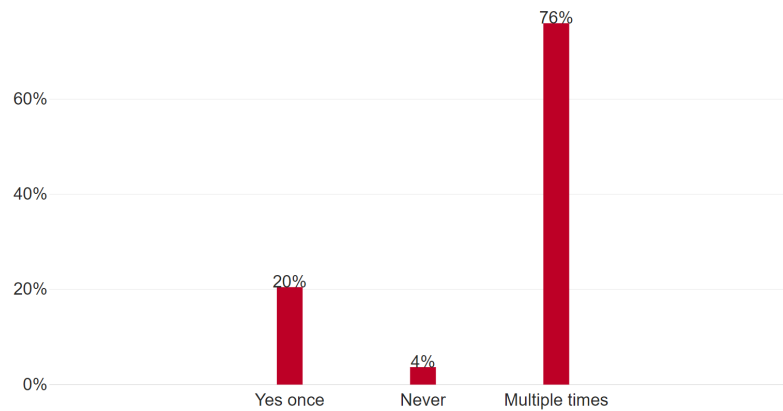


(a) 2021

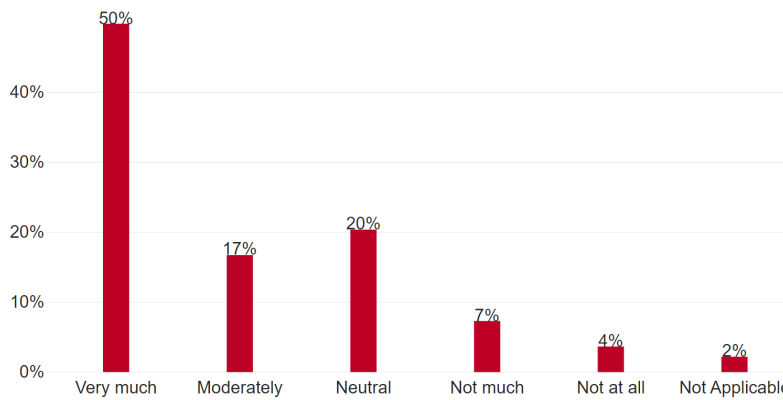


(b) 2022

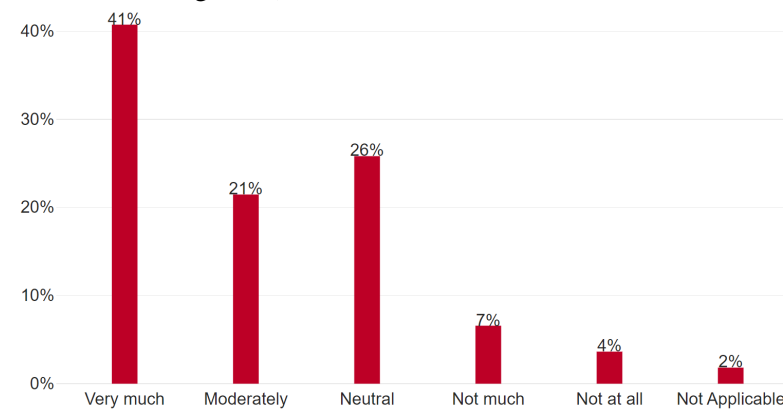
Figure 35: Response to Q: Among the Online Classes You Had, How Do You Find the Course Variations in the Use of Technologies?



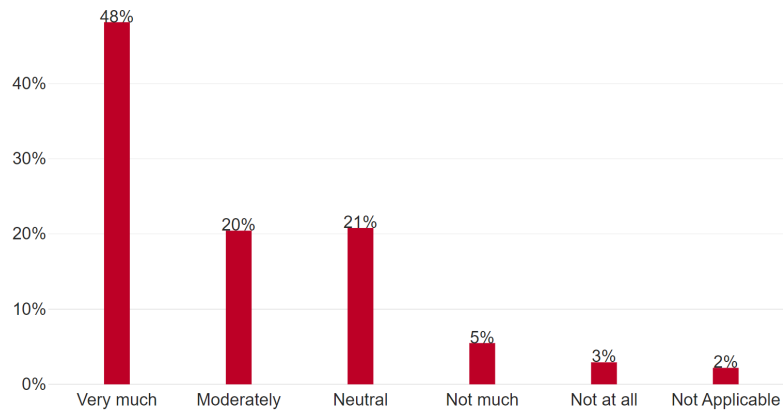
(a) Response to Q: Have You Taken Any Online Exams on Any Courses?



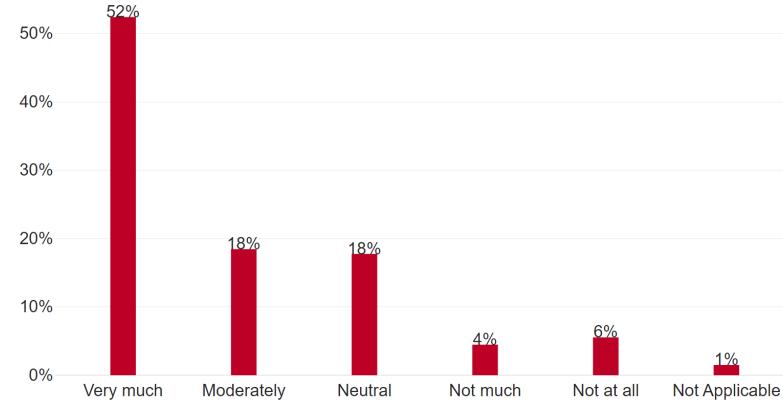
(b) Response to Q: How Comfortable are You to Give Online Exams With Available Online Tools? (Screen Recording, Web Camera, Sound Recordings, etc.)



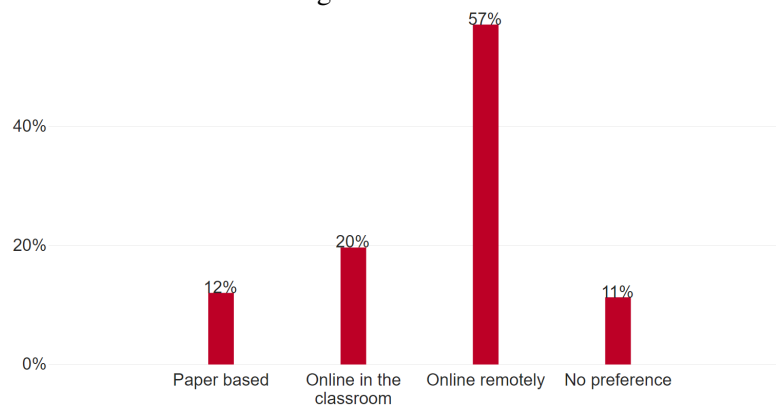
(c) Response to Q: According to Your Experience, Do You Think Online Exams Can Ensure Academic Integrity?



(d) Response to Q: Did You Find Online Exams Have Enough Flexibility of Different Types of Assessments?



(e) Response to Q: Do You Think Online Proctoring Tools are Functional and Reliable Enough?



(f) Response to Q: Which Type of Exam You Prefer the Most?

Figure 36: Online Exam-related Responses in 2022

3.4.1 Positive or Satisfactory Responses About Online Courses

A good number of students preferred online education due to flexibility, instructors' efforts, and comfort in the Pandemic. Some of the comments added here, all the quotes are from different students.

"There should be more online classes."; 2022

"Online classes make much better understanding for the students."; 2022

"Everything is good as it is provided online exams remotely for flexibility."; 2022

"Overall it has been a good experience with the online mode of study."; 2021

"Make online classes for coming fall."; 2021

"My first semester was an awesome experience to me, and my professors helped us learn many things."; 2021

"Online class is very helpful to the student and very flexible."; 2021

"I've actually been very happy with the way everything turned out– that's the benefit of being in computer science because most of the instructors already have a 90% online course."; 2020

"Offer more online classes for those in the SCE program. I wish more classes were offered online as I live so far away."; 2020

"I honestly preferred online, the switch from in-person to online literally made no difference to me, especially in my computer classes. If anything, I learned even more and caught on way better."; 2020

3.4.2 In-person classes are Better

However, some students prefer in-person classes over online education.

"I have used zoom, Panapto videos. Student interaction on online classes makes

perfect set of having class online, use of avatar sometimes iteration sometimes for me, being classes online we can learn a lot, but we should have focus more than face to face.”; 2022

”Online learning is difficult because of the environment. I found that i was able to focus more and it helped when I had a space completely dedicated to classes - that wasn’t my room or any place that I associated with entertainment.”; 2022

”I will avoid them at all costs. Every online class I have taken has been lower quality than their in-person counterparts, and seem to involve teachers investing less effort, students cheating, and a lack of any real support structure.”; 2022

”People enrolled to be in-person should attend to class in person I think that is also part of academic honesty.”; 2022

”In my opinion, online classes open doors for lackluster efforts from me. I get very bored, cannot interact with students after class or professor. They can be available once in a while in the cases of emergencies but using online classes as primary mode is a definite no for me. Face to Face classes improve communication between professor and student and also allows student interactions which helps understand topics better.”; 2022

”In person classes are better from learning and applying learned knowledge. We can also interact with other student in better way so I prefer in person classes.”; 2021

”What is true about in person vs synchronous vs asynchronous (and likely what you will not hear from students) is that in person is the most effective for learning however it places the most stress on students so it is but in large the least popular. In person, and synchronized to an extent, hold students more accountable to learn the material do home-work/review etc. However online provides FAR more flexibly and is better for student’s stress.”; 2021

3.4.3 It Depends on the Instructor

On the other hand, some comments from the 2020 survey indicate, it is more of an instructor (probably teaching style and engagement with students) than the mode of education that makes a difference.

"It depends on the instructor for the course. Some professors made the transition to online learning almost seamlessly and other professors less so."; 2020

"Some teachers have suffered greatly from the switch to online courses."; 2020

"Historically, instructors have been terrible about consistently using Canvas/LMS to show a calendar of assignments/exams and posting resources. This semester, my classes were mostly good about it but I imagine many courses suffered from a lack of online engagement the same way that in-person classes do."; 2020

3.4.4 Use of Chat

Some suggestions were about using chats like the followings.

"Online classes you have to rely on emails which can be responded to way later than expected."; 2022

"Maybe professors could allow more use of the chat. Some of my instructors let students discuss different topics during the lecture (which facilitated conversation about the material)."; 2021

"Apart from email, there should be some tool from where we can connect with professor and clear our doubts."; 2021

3.4.5 Equity Issue

There were a couple of remarks about the Internet access issue.

"One thing I mention is that perhaps a professor for his or her particular class could do a mass survey for the students BEFORE classes begin, which could ask certain questions about their internet bandwidth, quality of home environment (to do work and listen to potential lectures) and etc."; 2020

"I don't think online learning is fair to students who have no internet access or their own computer or students who live in a household with many other people. I didn't have trouble but I don't think it's fair while there are students who aren't able to participate under these conditions."; 2020

3.4.6 Different Approach for Test and Proctorio Issue

We got some suggestions on the improvement of the tests and some students find difficulties with Proctorio. Here are some quotations:

"Adding a software proctoring also increases the difficulty of a test or exams by adding an emotional factor of being constantly watched. This time to time it spits focus and concentration. Besides, it adds additional stress factors especially if one lives with his/her family. I would rather come to class and take tests there instead of being recorded and watched as a monkey in a box. Even if it does software."; 2022

"As for online exams, I understand that it's difficult to prevent cheating, but I think some of the proctoring apps are overkill. One required me to show my drivers license and record my room. At the same time, I feel that making students go on zoom and proctor the students that way isn't a good solution either. Perhaps there is a way for the students to stream their screen (only to the teacher) and the teacher is able to view all screens at the same time?"; 2022

"Online open book will be better I guess instead of close book."; 2022

"More group projects where students are assigned randomly. So that everyone can make new friends."; 2022

"A better thing would be to adapt exams to be open book and on the understanding of info rather than being able to just regurgitate stuff word for word."; 2021

"Online tests should bring open book/note (because let's be honest you cannot prevent students from looking up answers) but be structured in a way that asks more open ended questions instead of memorized information."; 2021

"I feel that with online courses, shorter, more frequent tests would be something interesting to try. More tests would push students to get studying in, but also induce less stress since it wouldn't be as heavy on the grade."; 2021

"Using Proctorio for exam was quite uncomfortable. It works well when we had a personal room or space for ourselves."; 2021

"Proctoring software is stressful and distracting during online exams."; 2021

"The video proctoring of exams I STRONGLY dislike. I think it's an incredible invasion of privacy and we should NOT be required to use video cameras."; 2020

"Proctorio is making getting grades really difficult, since the exam pattern using that tool is very intense and makes me really nervous."; 2020

"Proctorio caused many classmates extensive grief during high-stakes testing."; 2020

3.4.7 Academic Integrity

There were suggestions to build AI (Artificial Intelligence) based LMS platform to ensure academic integrity, such as:

"Build a better LMS with stats, AI and machine learning capabilities which can

protect the academic integrity of students. As of not it is a total failure according to me coming to protecting honesty of dishonest students and they are getting same GPA as a honest student.”; 2022

3.4.8 Mental Health Issue

There was a comment about the mental health issue.

”It is crucial to mention the mental health of fully online students, I felt in my time fully online for two semesters, it was very difficult to stay happy when you rarely talk to anyone, it is very difficult to meet or talk to people and this downgrade in mental health might result in a downgrade in performance in courses as well.”; 2021

3.4.9 Avatar Related

Avatar related question was new addition to this survey. some comments were related to Avatar are given bellow. *”Change of Avatar faces in middle of a class may disturb the decorum of the class.”; 2021*

”It is best to have records to review and consolidate what I have learned.”; 2021

”I have no experience with people using online avatars.”; 2021

3.4.10 Synchronous Lectures

Though more than most students were comfortable with zoom, there were a few students who differed. Here are a few comments related to synchronous lectures:

”According to me online synchronous is the best method to learn the subject. Because to discuss doubts to professor it is possible and by learning at home.”; 2022

”I’m not the biggest fan of online zoom lectures. I lose focus very easily.”; 2021

"Use Teams please instead of Zoom."; 2021

3.4.11 Asynchronous Preferable

Few students felt online asynchronous (mostly recorded) classes are more beneficial.

"Asynchronous classes are a huge help because people who work or cannot regularly attend have the option to go to school."; 2022

"I prefer online and recorded classes. So, we can learn them anytime . The tools which we have are good I don't want any additional features. The avatar can be avoided. Online classes are good we live a little far from campus. It is very difficult for us to commute we like online class."; 2022

"Hybrid pre-recorded classes for asynchronous and synchronous classes for working out additional problems. Some professors write their lectures, in this case digital notebook could be projected. I would have loved the ability to access slides and notes from canvas on a digital notebook. Students can't always grasp everything on the first time watching a lecture, so recorded lectures is a huge plus."; 2022

"All the records should come with subtitles."; 2021

"For asynchronous the lengths of the recorded videos should not be more than half an hour, its more easy to understand and grab information from small videos."; 2021

3.4.12 Improvement Suggestions

Some students suggested some improvements can help in different aspects. Here are a few important ones:

"I think the best online class would be a teacher-hosted class in a VR environment

where it mimics in-person class, but with physical separation in real life.”; 2022

”I really wish teachers would put more effort into online classes. I also wish they didn’t assume they had to use only videos of them there are millions of videos of what they are explaining that can probably do it better than them in less time.”; 2022

”More consistency on how professors use canvas. I’ve had professors that wouldn’t directly upload files onto canvas, but they would have a link to Dropbox or Google Drive or an excel sheet.”; 2022

”It would be nice to have multiple ”office hours” for an online class. The asynchronous class is great for me to work during the week and cover the material over the weekend, however, if office hours are during my weekly meeting at work, it is hard to step away.”; 2022

”let the students do the work and ask them for feedback force them to pay more attention to the class in online classes. but using different tools or platform make them confused and they prefer to not attend such a class.”; 2022

”To conduct group discussions in online classes and paper presentation.”; 2022

”Interactive online classes and progressing of people by communicating each other will be more helpful.”; 2022

”Instead of focusing on all students at once, one-on-one interaction with students can boost online learning by determining their learning curve. Instead of physical books, internet learning websites play a significant role. Example: Plural, Udemy.”; 2022

3.4.13 Summary

In April 2020, around 1400 U.S. institutions moved classes online in response to the COVID-19 [11], which showed us that online education would be an undeniable

future either as its own or as an available hybrid option with a face-to-face version. In this research, we have conducted mixed methods research that involves collecting, analyzing, and interpreting quantitative and qualitative data from the survey from students who took classes at the School of Computing and Engineering of the University of Missouri - Kansas City to see the perspective and comfort level from their side. Considering different aspects, it can easily be said students have adopted online education pretty easily, but there still might be a number of issues that can be addressed relatively easily, as well as necessary steps that can be taken to resolve them. During 2020 lots of learning technologies became popular (e.g., Zoom, Proctorio, Panopto), some learning technology was popular before but used more in pandemic (e.g., Canvas). In 2021, most students couldn't travel and was scattered all around the nation or the world. That year online (mostly asynchronous) education was more popular and effective. But 2022 data shows in terms of interaction, learning outcomes, and overall comparison, students are preference towards face-to-face, increased, still online is most preferred option. From our three years of research we came to the conclusion that strategies could help for continued online sessions in the future.

CHAPTER 4

HUMAN FACTOR: UNDER-SERVED PEOPLE IN TECHNOLOGY ACCESS, INFORMAL TECHNOLOGY EDUCATION FOR WOMEN TRANSITIONING FROM INCARCERATION

(This work is supported in part by the US National Science Foundation under Grant No. 1906795 & 1907002. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of the National Science Foundation.)

(All research protocols were approved by the Institutional Review Board (IRB) of the University of Kansas, KS, USA.)

4.1 Background

Computer science education has become popular and is perceived as a promising path, especially among young people. As the demand for technology professionals outpaces the supply of skilled workforce by far [47], efforts have been made to diversify and increase the workforce in computing [48–50]. Furthermore, as the fourth industrial revolution accelerates the societal need for technology for all aspects of our lives [?], technology skills and access to information and communication technology are more critical than ever. As governments or industries have initially focused on communication infrastructures [51], the Internet penetration rate is close to saturation for developed countries. With the rapid and broad societal changes, however, the digital divide becomes

more detrimental for underserved populations. Understanding the diverse ramifications of the digital divide and devising nuanced solutions have become important [52]. Studies show that despite the increasing availability of the Internet and online services, its use and efficacy are not balanced, especially for underserved populations such as those with particular race/ethnicity backgrounds, conditions of disabilities, and low socio-economic status [?, 53]. Recognizing these underlying social, economic and cultural aspects of the digital divide is the first step toward digital equity [54] and to tackle the *persistent social* inequality concern that goes beyond the basic availability of information and communication technology.

4.1.1 Women in Computing

The issue of the underrepresentation of women in computing has been widely recognized for many years. A number of studies have been conducted to understand the factors and influences that repel women away from computing. Culture and climate of CS as being unwelcoming to women [55], images of CS as being male-oriented [56], lack of access, role models, and encouragement [57], social stereotypes and lack of a sense of belonging [58] and confidence [59, 60] have been reported as major factors of diminishing attractiveness of computing for women. A study in [61] finds that early exposure is critical for young women to be drawn to computing. There have been many social and cultural efforts aimed at making the discipline more inclusive of women, such as Girls Who Code [62], Girl Scout coding programs [63], COMPUGIRLS [64], and networking groups of women in professional societies [65, 66]. However, the issue of gender imbalance still remains significant, and most of such efforts are centered around young women. Understanding the special needs of various underrepresented populations,

and diverse and tailored social efforts are much in need.

4.1.2 Women of Color in Computing

Women of color form a small proportion of women in computing education programs and related career paths [67]. A recent study [68] shows that women of color, particularly black women's social experiences, are often different from black men and non-black women in the United States. The racial and gender disparity in K-12 CS education is typically attributed to the disparity of access to computing classes and technology [?]. Socio-economic inequity further amplifies such a digital divide mentioned among all women. Unlike other groups, early exposure to computing before college in fact, drives black women away from computing in their career choices. Instead, having friends in the computing area and family support were more significant for their career choices in computing. Understanding the needs of different individuals and the importance of social support of family and friends are important for black women to be drawn to and to stay in computing.

4.1.3 Existing Prison Education or Reentry Programs

There are several notable prison education or reentry programs that have guided other related programs. Education Development Center (EDC) [69] is a global organization to advance long-term solutions for education, health, and economic opportunity. They design, implement and evaluate various innovative informal education programs, including prison and reentry education. *The Prison Teaching Initiative (PTI)* at Princeton University [70] is a volunteer group teaching accredited college courses in New Jersey State prisons. *From Prison Cells to Ph.D.* [71] is an organization that provides mentor-

ing and educational counseling to individuals returning from incarceration, and aims to inspire them to excel beyond the norm of their life circumstances and societal expectations of them. *The Initiative for Race Research and Justice* [72] is a group studying unjust and inequitable policies and practices and conducting research to support equitable tools for formal and informal education. *Operation Restoration* [73] supports women and girls and their families impacted by incarceration with the resources necessary to make a sustainable transition into society through higher education, employment training, job placement, case management, and advocacy.

Most such programs are focused on general education areas such as history, psychology and math, and technology is a relatively new topic that is being incorporated in their existing curricula. Our research team's education program is unique in that we focus on technology education for women transitioning from incarceration.

4.1.4 Performance Metric of Reentry Programs

The most common and natural performance metric of correctional or reentry programs is the rate of recidivism [74]. Broadly defined as reengaging in criminal behavior after receiving a sanction or intervention, recidivism is an important performance measure for justice agencies in their effort to evaluate the outcomes of Justice Resources [75]. Recidivism is mostly reported as a single statewide rate over various time intervals. The measurement of reoccurring criminal data is irregular and difficult to collect. Thus it is often insufficient for assessing the impact of changes to policy and practice. There are efforts to improve metrics for better data collection and for program evaluations. The efforts include assigning unique identifiers of cases, developing long-term records, collecting additional contextual information, and frequently updating changes in status. Data

sharing agreement with FBI and Nlets [76] in 2008 allows researchers to obtain federally integrated criminal history information.

4.1.5 Project Team and Period

Our Multi-Institutional Project Team involved

- The University of Kansas, School of Journalism, Social Science, Learning Center
- University of Missouri â Kansas City, School of Computing and Engineering
- University of Kansas, Medical Center

This project is started on September 2019 and effective till August 2023 (a possibility with an extension).

4.2 Our Program Background and Research Questions

In our research-informed technology education program for women-in-transition, we consider participants' needs and desires in learning technology as well as the demographic and social-psychological attributes of the participants. Our interview data on these issues guided the research team to develop a tailored technology education for women in transition. We note that our team is multi-disciplinary encompassing disciplines of digital and emerging media, computer science, communication, preventive medicine and public health, women's studies, policy and social studies, and adult learning. Our empirical research study and technology education program design is guided by the following research questions (RQ) related to women transitioning from incarceration.

RQ 1. What are the primary barriers women transitioning from incarceration face before and during COVID-19 in terms of technology access and use?

RQ 2. How are social-psychological characteristics and technology access barriers influence technology learning of women transitioning from incarceration?

4.3 Study Method and Survey Results

In the beginning, we conducted interviews with 75 women who have been released from jails or prisons in the Midwest in early 2020. Participants for the interview research were recruited in collaboration with community organizations that support women's reentry and Departments of Corrections in three neighboring Midwestern cities. All 75 interviews were conducted in winter 2019 and spring 2020, with 48 interviews partially or fully conducted after COVID-19 stay-at-home orders in the three cities in March 2020. We continued this process every 3 months to include more participants every year for the last three years. Interview questions are available in Appendix 4.3.4

4.3.0.1 Participant Characteristics

Key characteristics of interview participants are summarized in Table 5. All 75 participants identified themselves as female. Of them, 68 participants answered education, age, and race/ethnicity questions. The ages of the participants ranged from 26 to 65 years old ($M = 41.85$; $SD = 10.60$; median: 40). Specifically, about 30.9 % ($n = 21$) were aged between 25 and 34; 29.4% ($n = 20$) between 35 and 44; 25% ($n = 17$) between 45 and 54; and 14.7% ($n = 10$) were 55 or older. In terms of their formal education, 30.9% ($n = 21$) said they had completed high school; 26.5% some college ($n = 18$); 19.1% some high school or less ($n = 13$); and 23.5% ($n = 16$) had vocational training, associate degree, or bachelor's degree. In terms of race/ethnicity, 41.2% ($n = 28$) said Black, 29.4% ($n = 20$) White, 19.1% ($n = 13$) Hispanic, 7.4% ($n = 5$) American Indian or White/American

Indian, and 2.9% (n = 2) other. The time they spent in prison or jail ranged from 3 months to 16 years.

Table 5: Research Participant Demographics and Digital Media Use

<i>Variable</i>	<i>Value</i>	<i>Count</i>	<i>Percent</i>
Age	25-34	21	30.9 %
	35-44	20	29.4 %
	45-54	17	25.0 %
	55 or older	10	14.7 %
	Total	68	100 %
Race	Black or African-American	28	41.2 %
	White or Caucasian	20	29.4 %
	Hispanic or Latino	13	19.1 %
	American Indian or White/American Indian	5	7.4 %
	Other	2	2.9 %
	Total	68	100 %
Education	Nursery school to 8grade	1	1.5%
	Some high school	12	17.6 %
	High school completed	21	30.9 %
	Some college	18	26.5 %
	Vocational training	9	13.2 %
	Associate degree	5	7.4 %
	Bachelor's degree	2	2.9 %
	Total	68	100 %
Time Online	Not at all	8	10.7 %
	Less than an hour	6	8.0 %
	1 hour - less than 3 hours	15	20.0 %
	3 hours - less than 5 hours	17	22.7 %
	5 hours - less than 7 hours	9	12.0 %
	7 hours or more	20	26.6 %
	Total	75	100 %

Note: A total of 75 interviews were conducted. Several of them declined to answer demographic questions.

4.3.1 Current Study Data

This external evaluation report covers data from 2020 to 2022. All evaluation questions included in the original proposal are listed in 4.3.4

4.3.1.1 Reasons for Participating:

We have done a survey before enrolling the participants that why they are participating in this program. Here are a few reasons they mentioned.

- Search the internet
- How computers work
- Branding
- Develop fliers, business cards, and slide shows
- Website Development
- Coding
- Make, edit, and attach PDF
- Resume development online job searches and online job applications
- Digital Storytelling
- Helping children with schoolwork

4.3.1.2 Course Design

Sample topics for courses at different levels are shown in Table 6. In covering these topics, we help them understand how experiences with deeper STEM topics such as basic coding principles (both graphical and command line), computational thinking, and elementary computer architecture can empower them to be more efficient creators and users of digital content and information [77, 78]. Our program guides incorporate resources available through Google Computational Thinking for Educators [79] as well as our own examples for our participants to support their development of computational thinking. Coding is considered one of the most important job skills of the future, as an increasing number of businesses rely on computer code [80].

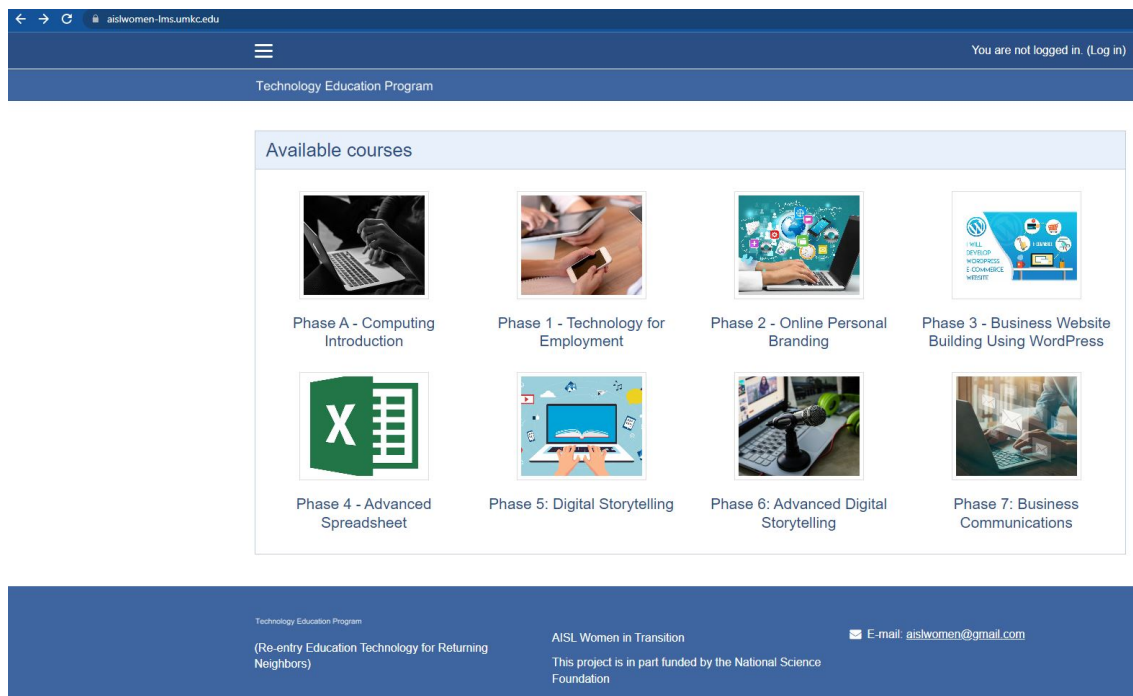


Figure 38: Education Program Courses in LMS

These courses are offered by professors and Ph.D. students in our project team

who have experience in teaching technology for women-in-transition or other marginalized populations. For each level of the program, participants complete weekly readings, lectures, and assignments. When our programming was offered at a public library, participants used laptops rented from the library. Since moving online due to COVID-19, participants relied on their own digital devices. Through our conversations with participants, we learned that most participants used their smartphones to participate in the online education program. To better support program participants' learning online, we have built our learning management system [81] based on an open-source learning platform [82].

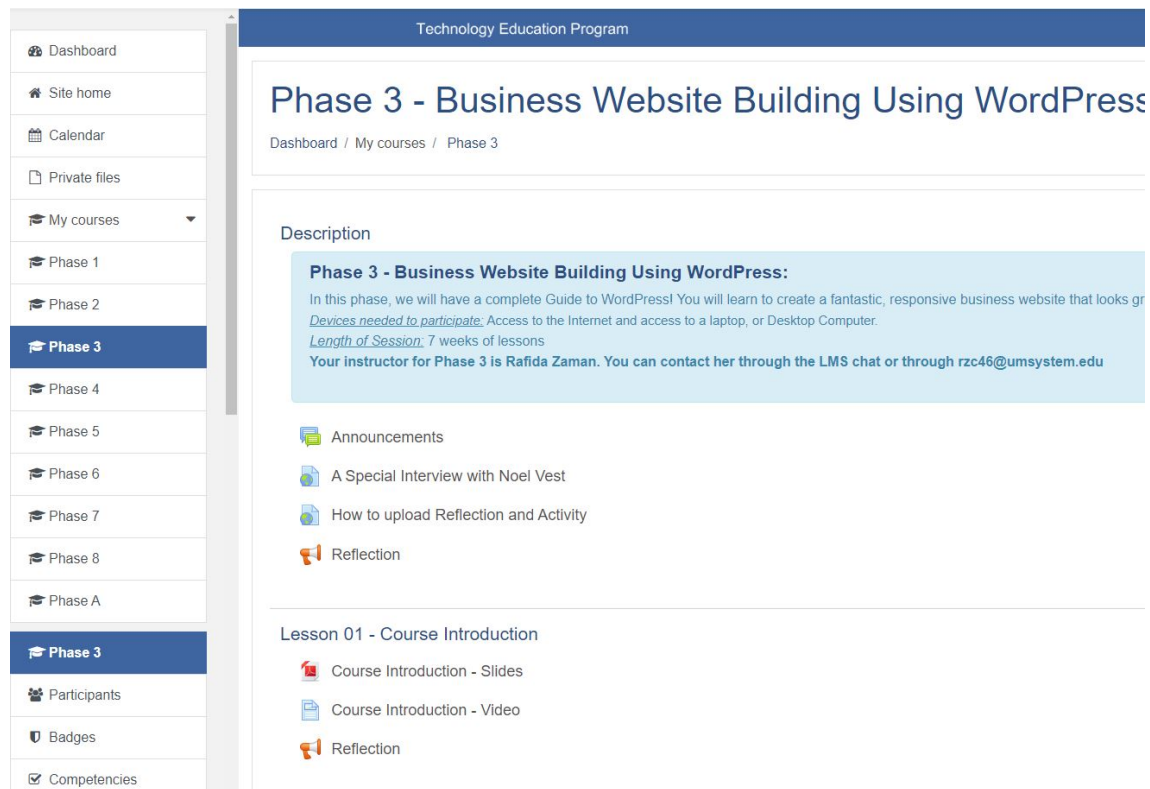
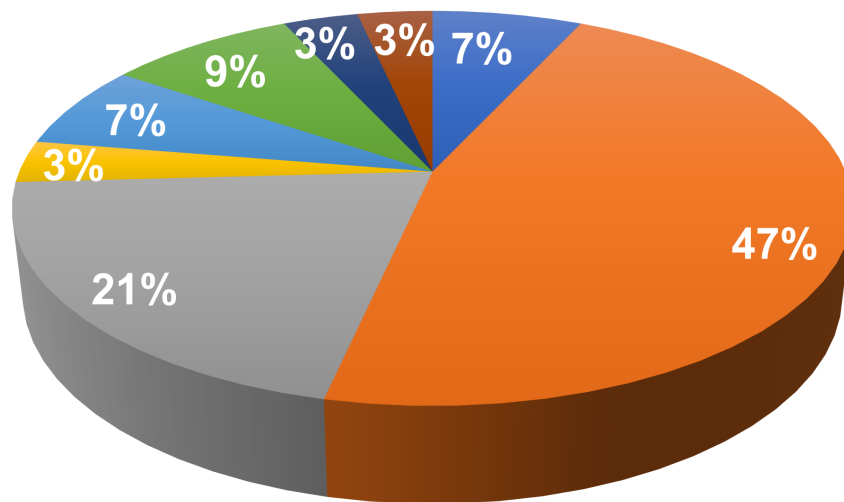
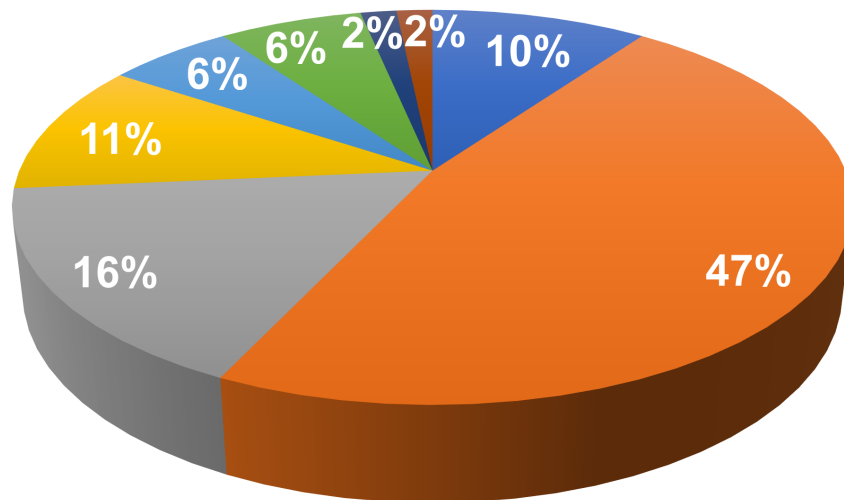


Figure 39: A screenshot of one of our in LMS



■ Phase A ■ Phase 1 ■ Phase 2 ■ Phase 3 ■ Phase 4 ■ Phase 5 ■ Phase 6 ■ Phase 7

(a) Total 58 participants Completed at Least One Phase, August 2022.



■ Phase A ■ Phase 1 ■ Phase 2 ■ Phase 3 ■ Phase 4 ■ Phase 5 ■ Phase 6 ■ Phase 7

(b) Total 121 Participants are in Progress in all Phases, August 2022.

Figure 40: Participant Characteristics

4.3.2 Qualitative Results

We have used ATLAS.ti 22 to do the qualitative analysis of the reviews and feedback we received from the participants, after successfully running this program for 2 years. Figure 41 shows the device they used to attend this program. 60% participants used laptop, 25% used desktop computers, and 15% used their smartphones. Figure 42 is generated from the feedback of the participants using ATLAS.ti 22.

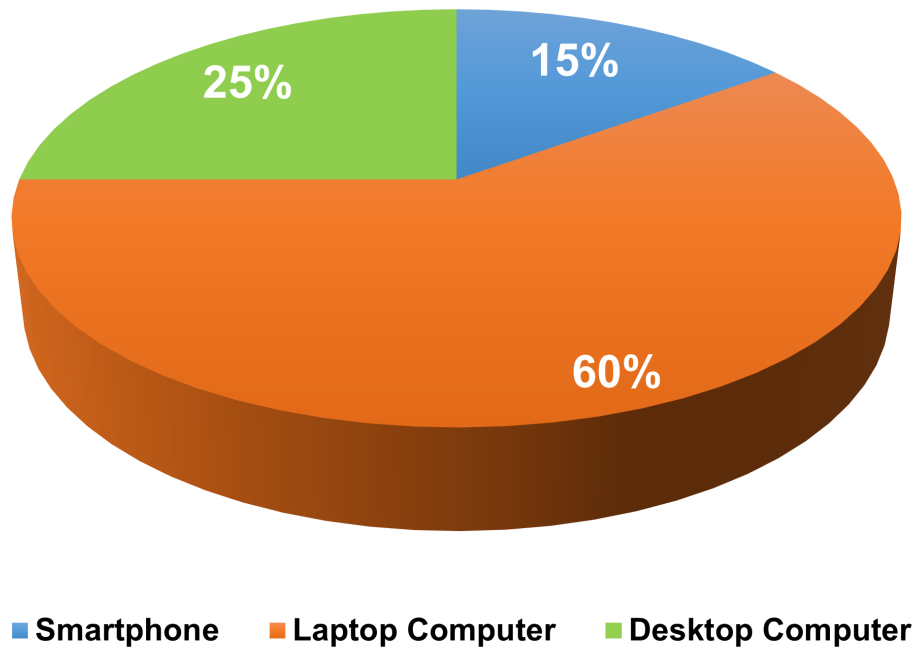


Figure 41: Response to Q: What device did you use to complete the lesson?.

We have collected all participant's reviews and feedback and used ground theory to get a better outcome from it. All important outputs are presented in this part of the study.

program.; Phase A

Very well, I enjoyed the activities very much it was filled with tons of information that I enjoyed learning.; Phase 1

I feel I Have a better understanding of what I need to include on a resume. I feel I did well, and I want to continue to improve on it.; Phase 1

Very successful. I feel I did a great job!; Phase 1

Thank you all for the time you take for these lessons. Also, for the device, I'm using right now to complete these assignments!; Phase 2

This was a great lesson and Iâm excited to learn more; Phase 2

Very successful. I feel I did a great job!; Phase 2

Thank you! I have learned a lot; however, I have room to grow in building web-sites.; Phase 2

I learned how to use word press! Iâm still brand new and will take some more practice. I also learned there are MANY options when it comes to building a website!;
Phase 3

Thank You Rafida for all your help with this lesson! I enjoy learning from you!!;
Phase 3

I did enjoy making a web page, I do understand the concept.; Phase 3

Pivot tables were kind of cool. A lot easier to understand than the charts.; Phase
4

I can see where a spreadsheet could come in handy for everyday stuff.; Phase 4

I love how the slides and videos are available and helpful in the coursework.;
Phase 4

I truly want to learn Excel, to advance in my current job.; Phase 4

4.3.2.2 Accessing to the LMS Site

Some participants commented about accessing the LMS site that we have created for this program, was user-friendly.

I found it pretty user friendly.; Phase 1

I think I did ok and was able to maneuver through the website really well.; Phase

1

It was very easy and simple to navigate.; Phase 1

I was able to navigate effectively.; Phase 1

Very easily using the link provided in the initial email.; Phase 1

However, some participants found it difficult to navigate through the website. We were well aware that most participants are digitally challenged so we made a recorded video to show all the navigation steps and posted at the home page. Here are a few comments:

I didn't feel that I was able to navigate effectively.; Phase 1

It was difficult to follow, the different settings had me confused because I'm using a MAC and the ribbon displayed is worded differently.; Phase 1

A little lost between activities at times.; Phase 1

Had trouble downloading templates from online and things.; Phase 1

4.3.2.3 Inspiring, Feeling Confident

Some participants said they felt confident after completing the phase.

I have been inspired and feel so much more confident going into the career process of my life for what feels like the 100th time. I have the fear of being successful rather than failure. I'm getting there.; Phase 1

I feel a lot more confident in using google tools and I appreciate being able to compare with Microsoft word and excel.; Phase 1

I USUALLY GO TO THE WORKFORCE CENTER TO DO MY RESUME. IT WAS KINDA COOL DOING IT MYSELF.; Phase 1

I feel accomplished today.; Phase 1

Definitely very confident and happy to have an updated resume!; Phase 1

4.3.2.4 Short, Long-time Goals

Short-term goals to gain a better understanding of word press. Long term helps others build websites, and find my passion.; Phase 3

I want to start working on homes and selling them; Phase 3

My short-term goals are to continue to keep up on all my commitments. My long-term goals are to continue my path of sobriety and help others find recovery!; Phase 3

To find my passion, my career, become financially stable, and travel outside of the United States.; Phase 3

My short-term goal is to be able to finish modules in 6 weeks. my long-term goal is to use information I am learning frequently.in 6 weeks. My long-term goal is to retain all information I have learned in these modules and use them free.; Phase 3

My short-term goal is continuing in my current position working toward Lead/Assistant Manager and my Long-term goal is becoming the Store Manager.; Phase 3

My short time goal is to get through today and my long-term goal is to obtain a career.; Phase 3

To learn a new skill is my immediate goal. To be more knowledgeable and advance within my company.; Phase 3

I have applied at Kansas Gas so that is a short-term goal. And long-term is my recovery.; Phase 3

Short term would be to gain the knowledge of this course effectively and my long term would be to use this knowledge to better my employment.; Phase 3

My long-term goals are to have great job and to be able to provide for myself.;
Phase 3

I want to learn as much as I can and find a career path that I am comfortable with.; Phase 3

Short-term obtain certification for auto technician. Long-term to have my own auto shop.; Phase 3

Short-term goals are to get through this course and pass and move on to another long-term goals is to collect as much knowledge and certificates to better my business understanding.; Phase 4

My short-term goal is to finish phase 4 with a better understanding of excel. be able to navigate through with confidence.; Phase 4

Short term goals are to make sure all assignments are completed, and I gather an understanding. Long term goals are to complete not just this phase but all phases in the program.; Phase 4

My short-term goals are to keep doing the best I can in all aspects of my life. Long term goals are to stay sober and start helping other women in achieving long term sobriety!; Phase 4

To become more efficient with excel and to be able to use it in helping my boss or to acquire a better job in the future.; Phase 4

4.3.2.5 Website for Businesses/Jobs

I have a few ideas for little side ventures that this knowledge will be useful for.;

Phase 1

I plan to use excel spreadsheets to budget my business and to budget my personal life.; Phase 1

I will most likely use the business cards but will make them a bit fancier.; Phase 1

My husband has a business we are planning on starting up these templates and knowledge will prove to be very useful.; Phase 1

I'm going to use this for my lawn care business or whatever business I choose in the future.; Phase 1

Right now, I am open to the ideas dynamic noncommercial and static informational until I get ready to start my business or my husband does whoever goes first.; Phase 3

I would like to make a web site that helps me find jobs.; Phase 3

I want to build a future auto shop website.; Phase 3

I would like to design a website that helps me get a job.; Phase 3

4.3.2.6 Helped to Make Better Resume

Having more strengths and experience in the future to add on my resume.; Phase 1

Now that I know about these templates I can further work on a better resume.; Phase 1

By updating it as needed as well as hoping to have more jobs and experience to place on my resume.; Phase 1

I will continue working on updating and personalizing my resume for jobs as I search for a career. It makes looking for work on sites like Indeed much simpler and makes you appear more professional and invested.; Phase 1

Yes! I will be able to update this resume with current contact information when I'm able to.; Phase 1

4.3.2.7 Will Use in Future

I will continue by furthering my education to be able to add that to my resume.;
Phase 1

I'm excited for when I complete my associates degree that I'll have the knowledge to be able to build a solid resume.; Phase 1

Adding on to education and skills as I complete more school.; Phase 1

I will use the Microsoft word templates in the future if there's ever anything I need to advertise.; Phase 1

Continue to add on as I learn new skills or change jobs.; Phase 1

I plan to use my resume skills to update and apply to jobs I have been wanting.;
Phase 1

A LOT THIS WILL HELP ME, HELP OTHER PEOPLE, ALSO CAN MAKE MY OWN CURRICULUM TO DO WORK FOR MY SCHOOL WITH ALL.; Phase 1

4.3.2.8 Felling Nervous

I am a little nervous about my resume. I don't know why, but the concept of building a resume has always given me a sort of anxiety which I am sure seems silly. I can't explain it myself but it's there. I would appreciate your feedback. ; Phase 1

I was a bit uneasy just because I donât have the greatest background with work history or completing school.; Phase 1

4.3.2.9 Desired Branding Goal

The content is all about me and what I am passionate about. It contains my goals and even includes my resume!; Phase 2

I attempted to make content related to my goal of one day owning a bookstore/coffee shop.; Phase 2

It is something that I will try to do for others in the future.; Phase 2

I believe my content fit in well with my desired branding goal.; Phase 2

It gives the resources that a recovery coach would be offering to their clients.; Phase 2

4.3.2.10 Facebook as Social Media

I plan to continue to look for jobs on social media until I find one. I also want to start posting items that I have collected over the years on Facebook Market. Most of these items are antiques and I can post them in the appropriate category.; Phase 2

I can apply quickly on indeed and use assessments to assess my skills to show to employers, Facebook can personally connect when employers interview me, and LinkedIn can expand my social ques with professional references and employers. ; Phase 2

4.3.2.11 LinkedIn as Social Media

Most networking is attained through social media platforms; while this is not a familiar engagement for me, itâs the way of the world, I'd better get LinkedIn!; Phase 2

I am going to improve my LinkedIn to be a bit more professional. I may create a separate account for my current job. ; Phase 2

I created a LinkedIn account and uploaded my resume. I am more aware of how social media content can be viewed and effect a prospective employers outlook.; Phase 2

I can use resumes and sites such as LinkedIn to advertise my skills and abilities. ; Phase 2

4.3.3 Social Media for Jobs

I use social media to its full advantage! I have my resume uploaded onto their and luckily for me my resume has been reviewed by 2 different professionals!; Phase 2

By getting alerts for new job postings. Look at several different platforms when looking for new job opportunities.; Phase 2; Phase 2

I will make sure my social media is very professional and geared toward other professionals in my profession.; Phase 2

I learned that these days youâre more likely to get hired using social media and that almost all jobs are online now for the application process. I would use social media to improve my communication skills to best advertise my interest with a job by giving the employer the most possible information I can for them to access on me online before I were to meet them in person because I feel like the more, they know about you the better chances they are to be interested in you as an employee.; Phase 2

Use it to continue to look up employment and housing opportunities.; Phase 2

Build a resume, posting and searching for new jobs/careers, finding relative work experience and requirements, and/or finding training for future jobs/careers.; Phase 2

4.3.3.1 Social Media for Professional Networking

Use Linked in to find jobs apply and build professional networking.; Phase 2

Creating business pages to have more followers and more business.; Phase 2

I can create a professional profile and persevere until I am comfortable with social media. Hopefully I can use social media to showcase my expertise in many areas thereby landing a position or career that I will enjoy for years to come.; Phase 2

4.3.3.2 Social Media for Marketing

As I researched possible future positions in the field, I wish to apply I came to the realization that social media is an essential part of many marketing and customer service positions. In order to effectively communicate with customers many businesses are utilizing these platforms to reach the customer where they are most comfortable. In order to further my job skills to match the positions I wish to apply to I need to expand my knowledge of these platforms and begin educating myself on how to utilize them properly. Also, many of these platforms now have areas where you can perform job searches as well to further my future job searches. I will continue to utilize what I have learned from this lesson and have come to the understanding that social media isn't just an option these days, for many companies it is a requirement.; Phase 2

4.3.3.3 Mindful What to Post

I will be more mindful of what I post and how much. I will attempt to showcase my communication abilities and never bad mouth current or past employers.; Phase 2

4.3.3.4 More Related Current Work Situation

This lesson is more so related to my current work situation, which is definitely helpful. However, the website I will be creating is for more of a goal to build on and expand in the future as I get my brand and shop up and running.; Phase 2

4.3.3.5 No Access to Social Media

With no access to social media, I just say how hypothetically I would use them.;
Phase 2

4.3.3.6 Confused!

I am still a little confused on the different types of websites.

4.3.3.7 Too long Video!

The video had too much information in my opinion. to long?? went to fast as well for me to take notes. I had to keep going back and looking at the slides. I did complete the activity however I still donât know how to use the print screen option.

4.3.3.8 Struggled, Need More Help!

I do because I have never used social media before. Maybe, in time, I'll get more comfortable, and I can see how others in class did their profiles.; Phase 2

I am sorry to say that I let the social media aspect intimidate me. even though Ms. Darcey gave me alternative ways of dealing with this issue.; Phase 2

I struggled with the content and arrangement.; Phase 2

I STRUGGLED A LITTLE BIT AT FIRST, I STOPPED AND CAME BACK WATCHED THE VIDEO OVER AND GOT IT.; Phase 4

Video is not very easy to understand.; Phase 4

I struggled a bit with this lesson! I feel like this lesson would be better learned in person.; Phase 4

Need a little more help with the date functions.; Phase 4

I had to go to google to figure out how to name my spreadsheet.; Phase 4

4.3.3.9 Thoughts on Concluding Digital Story

We have created Phases 5 and 6 as digital storytelling and advanced digital storytelling. In this phase, participants learn how to edit stories, and create stories with interviews, podcasts, vlogging, and animation. We asked the participant's thoughts about concluding digital storytelling, here are a few comments.

I really enjoyed the digital story assignment once I figured out how to navigate my way through Openshot. I did get a few headaches from concentrating for so long. But I happy with my finished product. I know my way around Openshot now, Thank you so much for this KU program.; Phase 5

OK I may have to edit my submission. I am still playing around with OpenShot. I imported my 10 pictures and it shut down on me (computers, go figure) so now I'm going to start a new project named "Final for Phase 5 part 2." Please bear with me. I really want to learn this stuff. Maybe we can do some more of this in class where I can work with my teacher. I appreciate you and thank you all for being so supportive in letting me go at my own pace and not giving up on me. God Bless!; Phase 5

I first would like to say I loved doing this. I never thought in a million years I

could do this. I know for sure I will continue to explore this.; Phase 5

This was a fun phase for me! I will use the tools I learned to create fun and exciting content! I also enjoyed learning from Matt, He is a great teacher! Thank you and God bless.; Phase 5

Hello, this Phase was very challenging for me. I couldn't get into open shot, and I had to have help from Matt Personally 1 on 1. I was very happy to have the help from Matt and I thank him a lot. After him helping me complete my story Digital Storytelling is very interesting and you can say a lot through pictures. I love the education about just learning how to take a perfect picture. Thank you, Matt.; Phase 5

4.3.4 Summary

Our NSF-AISL project has impacted a number of women 121 women enrolled in the program. Among them 58 participants completed at least one phase and 2 of the participants who completed all the phases earlier in 2022, we employed as peer mentors. we are planning to arrange more employment for other participants. Some participants found jobs or have been promoted after completing phases. We collected feedback from the participants in each phase to understand the standpoint of our program and to improve it better. We used mixed methods to analyze our technology education program which includes quantitative analysis and qualitative analysis. In our study, we have shown the diversity of the comments we received from the participants. We are planning to utilize the feedback and make the technology education program sustainable. In the future, we are planning to make an acceptable approach to technology adoption by municipal governments (e.g., technology adaption for law enforcement), we also want to extend technology education programs for other under-served populations.

Table 6: Sample Course Topics

<i>Level</i>	<i>Area</i>	<i>Sample Topic</i>	<i>Sample Hands-on Exercise</i>
L1: Introductory (online security, information search, and verification, etc.)	Searching on-line	Privacy and security settings with web browsers	Managing web browsing history, browsing in Incognito mode, etc.
		Content search	Searching health/employment information, news articles, pictures, video, etc.
	Assessing online information credibility	Information verification	Checking author's reputation and reliability, the publication's reputation, sources cited and their credibility, publication date, and one's own bias
L2: Intermediate (website building, using social media for professional development, computational thinking)	Digital Media and HTML	How to use digital media for professional development; Introduction to HTML	Developing a foundational vocabulary, exploring relevant resources, etc.
		How to create a simple web page	Exploring syntax rules for reading and writing HTML files, incorporating basic website elements (attributes, headings, paragraphs), etc.
L3: Advanced (data format and style description coding, computational thinking, etc.)	CSS	CSS syntax	Exploring syntax rule-set (Selector and Declaration), incorporating fundamental style sheets (Internal, External, Inline), etc.
		Set up web pages with CSS	Creating a website with three different CSS style sheets.
		CSS styling text, font and properties	Managing CSS fonts, text, links, colors, borders, etc.

Table 7: Course Participation

<i>Education Phases</i>	<i>Completed</i>		<i>In Progress</i>		<i>Non Complete</i>	
	<i>n</i>	<i>%</i>	<i>n</i>	<i>%</i>	<i>n</i>	<i>%</i>
Phase A - Computing Introduction	4	7%	12	10 %	0	50%
Phase 1 - Technology for Employment	27	47%	57	47 %	1	50%
Phase 2 - Online Personal Branding	12	21%	20	17 %	1	50%
Phase 3 - Business Website Building Using WordPress	2	3%	13	11 %	0	0%
Phase 4 - Advanced Spreadsheet	4	7%	7	6 %	0	0%
Phase 5 - Digital Storytelling	5	9%	8	7 %	0	0%
Phase 6 - Advanced Digital Storytelling	2	3 %	2	2 %	0	0%
Phase 7 - Business Communications	2	3%	2	2 %	0	0%
Total participants in all phases	58	100%	121	100%	2	100%

Note: Completed indicates certificate earned; In Progress includes women who enrolled in a phase since the onset of the educational program (May 2020) that have not yet earned their certificate of completion, and non-complete includes (a) women who are incarcerated and (b) asked to not be contacted anymore from the program.

APPENDIX-A

Appendix for Human Factor: Residents' Voices in SCC, Understanding what Residents ask Cities from 311 calls

According to Open Knowledge Foundation [41] 43 cities has online free data, 36 has up-to-date data, 34 has open licensed, 19 types of datasets (Budget, Business Listings, Code Violations, Construction Permits, Crime Reports, Emergency Calls, Employee Salaries, Lobbyist Activity, Parcels, Police Use-of-Force, Procurement Contracts, Property Assessment, Property Transfers, Public Facilities, Restaurant Inspections, Service Requests, Spending, Traffic Crashes, Website Analytics, Zoning). For collecting data we have used codes to read from JSON files, or CSV files.

Following 19 Cities have 311 JSON Data:

- New York, NY
- San Francisco, CA
- Austin, TX
- Chicago, IL
- Kansas City, MO
- Santa Monica, CA
- Pittsburgh, PA
- Baton Rouge, LA

- Salt Lake City, UT
- Dallas, TX
- Buffalo, NY
- Chattanooga, TN
- Cincinnati, OH
- Evanston, IL
- Gainesville, FL
- Nashville, TN
- Naperville, IL
- Little Rock, AR
- Los Angeles, CA

Following 24 cities have 311 data in CSV format:

- Baltimore, MD
- Cape Coral, FL
- Bellevue, WA
- Detroit, MI
- Gilbert, AZ

- Johns Creek, GA
- Las Vegas, NV
- Louisville, KY
- Minneapolis, MN
- Oakland, CA
- Pittsburgh, PA
- St. Louis, MO
- Syracuse, NY
- Washington, DC
- Birmingham, AL
- Boulder, CO
- Houston, TX
- Milwaukee, WI
- Lincoln, NE
- Miami, FL
- Philadelphia, PA
- Asheville, NC

- Providence, RI
- South Bend, IN

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APPENDIX-B

Appendix for Human Factor: Learners - Teachers in Smart Education, Opportunities and Challenges Induced by COVID-19 Pandemic

Survey Questions

Here are the survey questions we have used for this study.

- **Background**

- Which group do you belong to?
- What kinds of learning mode experiences have you had so far in your current degree program?
- What kinds of learning mode experiences have you had this semester?
- Where did you do most of your learning this semester?
- What is your main Internet connectivity at home for online learning?
- Do you feel you have had a sufficient Internet bandwidth for online education?
- How comfortable are you with technologies used for your learning?
 - * Learning Management System (Canvas)
 - * Proctoring System (Smarter Proctoring, Respondus Lockdown Browser, Proctorio, etc.)
 - * Online Meeting System (Zoom)
 - * Video Recording System (Panopto)

- **Online vs. Face-to-Face learning**

- Comparisons between Face-To-Face vs. Online Courses

- * Overall Satisfaction
 - * Presentation Of Course Material
 - * Student-To-Faculty Communications
 - * Student-To-Student Interactions
 - * Scheduling Flexibility For Students
 - * Ability of Students to Work at Their Own Pace
 - * Support For Students With Different Learning Styles
 - * Learning Outcomes

- **Online Synchronous vs Asynchronous learning**

- Comparisons between Online Synchronous (e.g., through Zoom) vs. Asynchronous Courses (e.g., through Panopto Recordings): Between synchronous and asynchronous online lectures, which do you think is more helpful for your learning in the following aspects?

- * Overall Satisfaction
 - * Presentation Of Course Material
 - * Student-To-Faculty Communications
 - * Student-To-Student Interactions
 - * Scheduling Flexibility For Students
 - * Ability of Students to Work at Their Own Pace

- * Support For Students With Different Learning Styles

- * Learning Outcomes

- If synchronous online instruction was given (Zoom), did you still watch the recording of the lecture?
- If you had an asynchronous online course, but synchronous instruction was given optionally (Zoom), did you attend the synchronous online lecture?

- **Online Exam related**

- Have you taken any online exam on any courses? (Either remotely or in the classroom)
- Challenges and comfort levels of online exams
 - * How comfortable are you to give online exams with available online tools? (Screen recording, web camera, Sound recordings etc.)
 - * According to your experience, do you think online exams can ensure academic integrity?
 - * Did you find online exams have enough flexibility of different types of assessments?
 - * Do you think online proctoring tools are functional and reliable enough?
- Which type of exam you preferred the most?

- **Avatar related**

- What were your communication methods to interact with classmates this semester? (Write all the methods you used.) (e.g., Canvas Discussion, Email, What's App, Discord, Phone messaging, Phone call, etc.)

- Have you ever used avatar filters (e.g., Snap App Camera) yourself during online-synchronous classes or meetings?
- Have you ever seen other people using avatar filters (e.g., Snap App Camera) during online classes or meetings?
- If you have used or seen the use of avatar filters in meetings or classes, what do you think of its use in online classes?

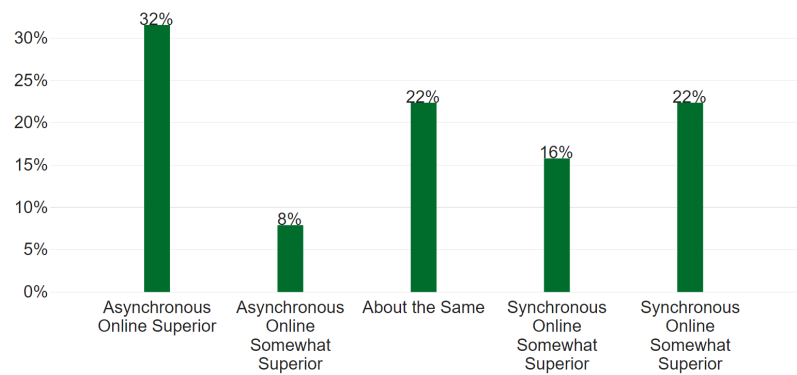
- **Mental Health related**

- Do you think that online classes impact your mental health (e.g., Lack of interaction, loneliness, lack of or more motivations; lack of or more interactions; more time with family, etc.)?
- What is your ideal learning environment you wish to be available for your courses?
- What is 'preferred' mode of your learning if there are options of in-person and (a) synchronous online (b) asynchronous online?
- Among online classes you had, how do you find the course variations in the use of technologies (e.g. tools and platforms used for the course)?

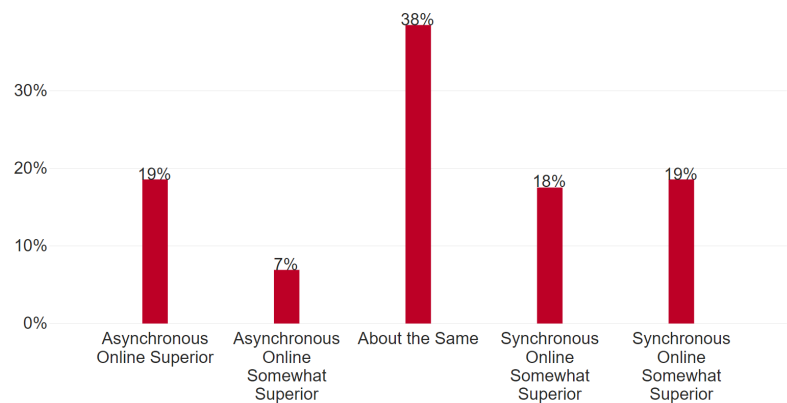
Synchronous vs Asynchronous learning

Here we have posted all figures related to synchronous, asynchronous learning related study. Figure 43 and 44 shows learning outcome and support for different learning styles are almost equal in both synchronous and asynchronous in both 2021 and 2022. Figure 45 and 46 shows student to student interaction and student faculty communication

are superior in synchronous learning in both years. Figure 47 and 48 shows in both 2021 and 2022, online synchronous learning is superior for scheduling flexibility and ability to Work at their own pace, respectively.

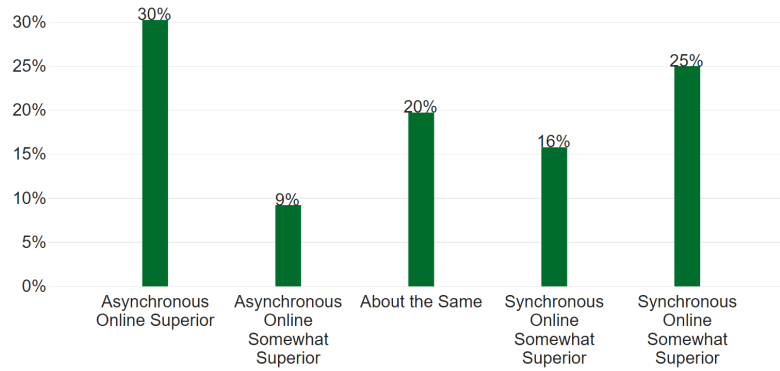


(a) 2021

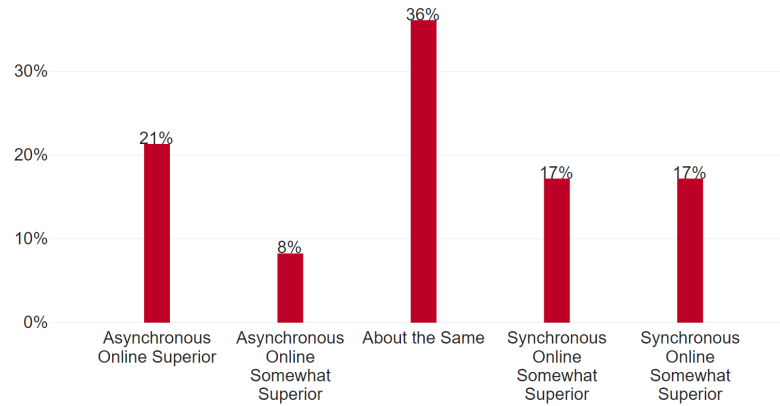


(b) 2022

Figure 43: Learning Outcomes-Synchronous vs Asynchronous.

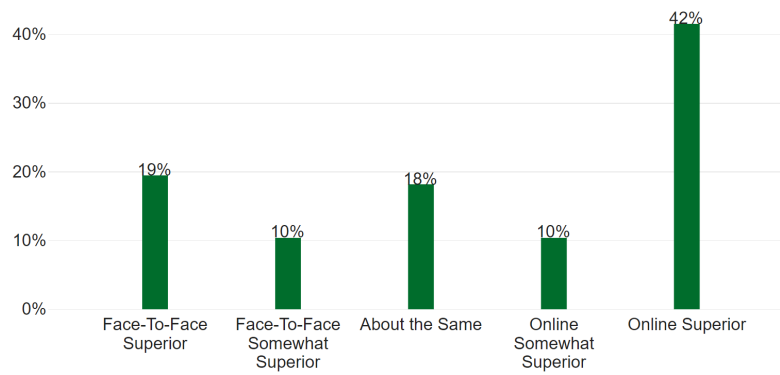


(a) 2021

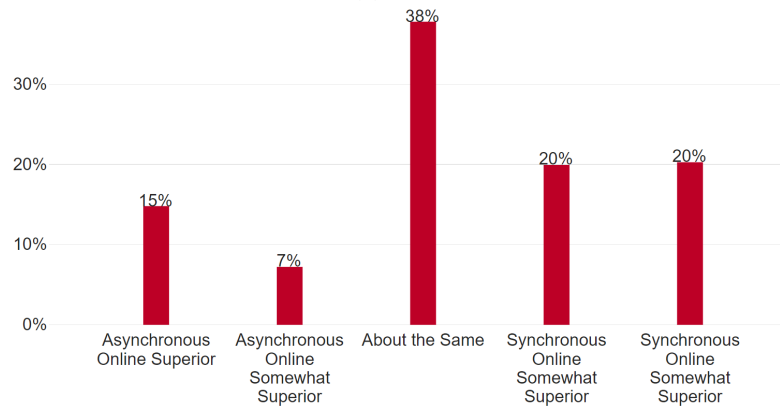


(b) 2022

Figure 44: About Support For Students With Different Learning Styles

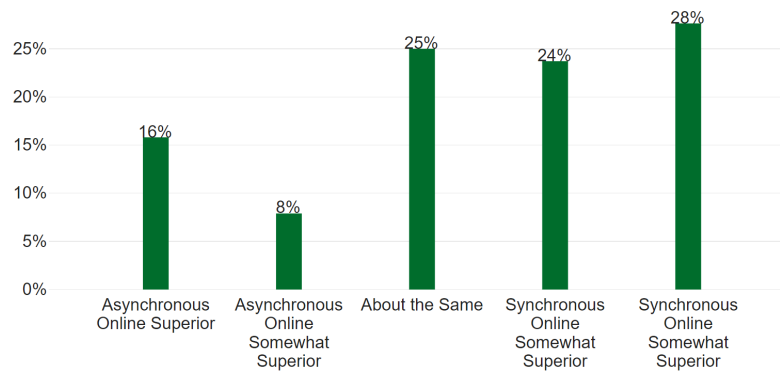


(a) 2021

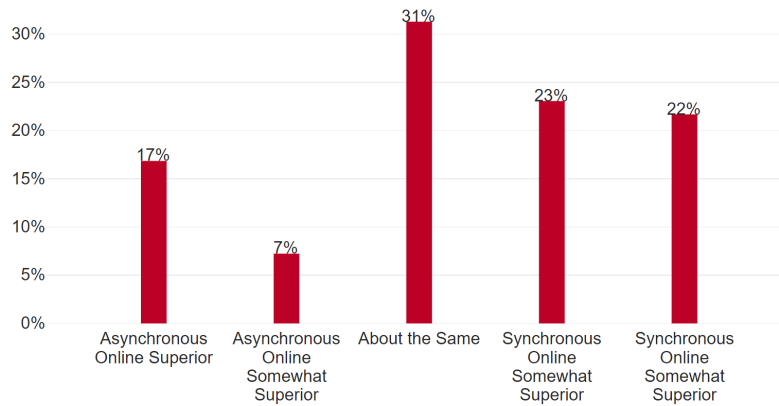


(b) 2022

Figure 45: About Student-To-Student Interactions

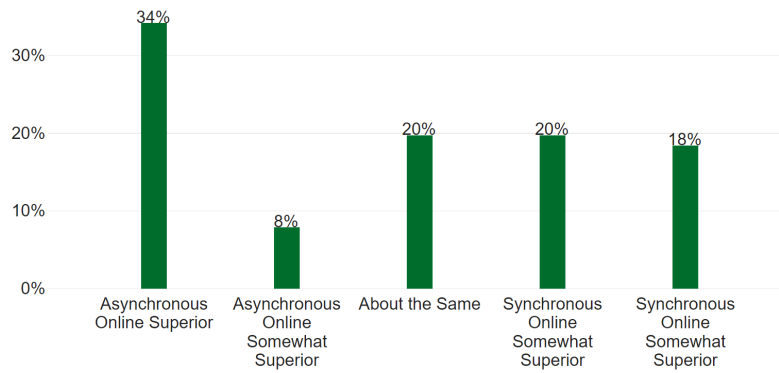


(a) 2021

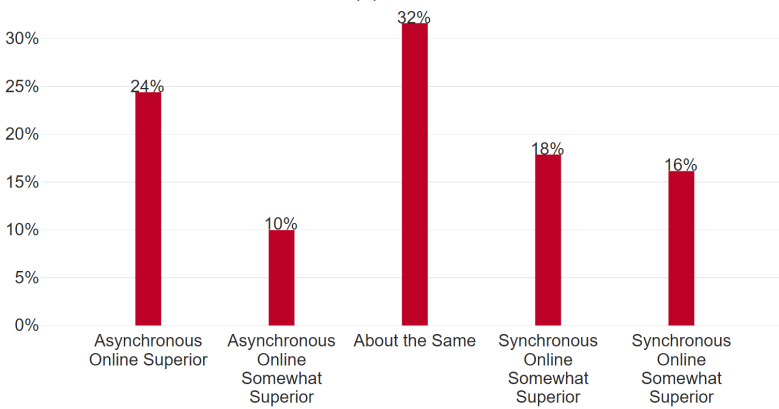


(b) 2022

Figure 46: About Student-To-Faculty Communications

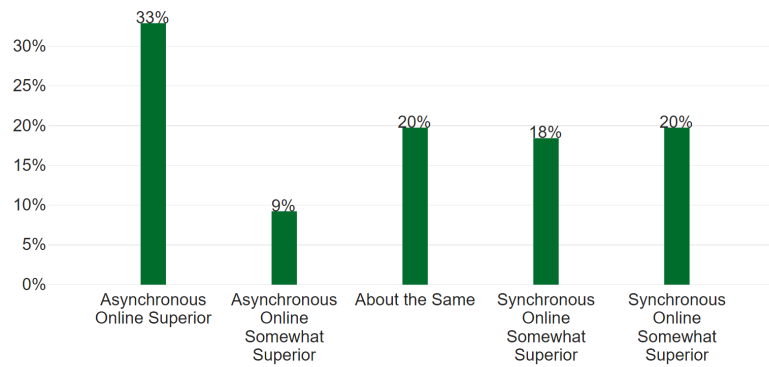


(a) 2021

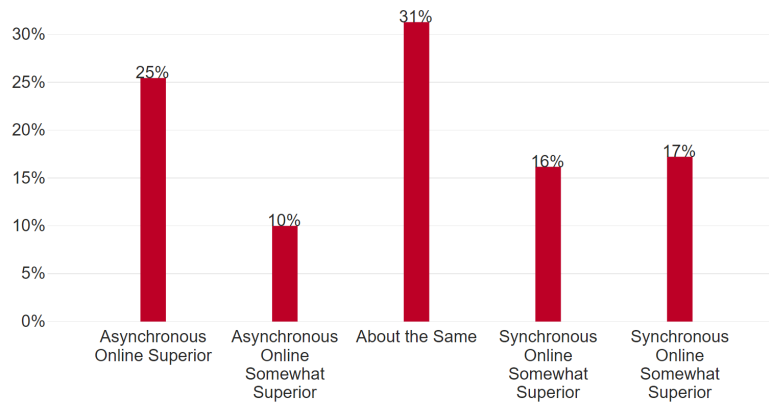


(b) 2022

Figure 47: About Scheduling Flexibility For Students



(a) 2021



(b) 2022

Figure 48: About Ability of Students to Work at Their Own Pace

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APPENDIX-C

Appendix for Human Factor: Under-served People in Technology Access, Informal technology education for women transitioning from incarceration

List of Candidate Question Ideas for Interviews with AISL Community Partners, 2022

- Please describe your agency/ organization.
- Do women recently released from incarceration need technology training? If there is a need, how important is this need, on a scale from 1 to 10?
- Would your agency/organization like to host or sponsor such training?
- What should such technology training include?
- Does online training work for this, or would it be better if it were in-person?
- Did your participants in our training generally express satisfaction or dissatisfaction with the training?
- In your perception, was the training we provided help the participants to be successful?
- How would you rate the contribution of the training to the participants overall success in transitioning?
- About what percent of your clients expressed an interest in the AISL courses?
- What could we have done to encourage more to participate in our classes?

- What methods are used to inform your participants about the AISL classes?
- Would you recommend the AISL project, or one like it, to other community agencies/organizations?
- What improvements would you recommend for the AISL project?
- Please describe the programs or services that you/your agency/ your organization offers to women recently released from incarceration.
- May we have a copy of your strategic plan, vision statement, and/or mission statement? (If they donât have a strategy, vision, or mission statement, ask them to describe the organizations mission, and how the organizations see itself developing in the future.)
- How does your organization evaluate the success of its programs/efforts?
- Does your agency/ organization have an evaluation plan/program that it uses for self-evaluation?
- How is your program/agency/organization funded?
- Does your organization produce or distribute publications? (Can we get a list of the publications?)
- Does your program need help with applying for grants or with fund-raising?
- Please describe your agency/organizationâs board of governors and/or advisory board.
- Please describe how your agency/organization recruits and selects board members.

- How does your organization evaluate the impact of your program on its clients/participants?
- How do you collect feedback from the clients/participants?
- Does your program/agency/organization perform research? (Can we get a list of the research efforts?)
- What research would you like to see done to support or to refine the work your program does?
- What research do you think is needed to help women in transition from incarceration?
- Does your program provide your clients with access to technology or technology training (other than AISL)?
- How would you describe the effectiveness of what AISL has offered?
- What additional services or programs (beyond what they receive currently) do you think women in transition need?
- Do you think the women in your program are average or typical of women being released from incarceration?
- What additional populations (beyond women in transition) do you serve?
- What additional populations would your program or agency like to serve?
- What personal traits does a service provider need to work successfully with this population, women in transition from incarceration?

- Does your program/agency/organization have good support from the local community?
- What community partnerships does your agency/ organization have (and please describe how these partnerships work)?
- How does the local community benefit from your program/agency/organization's work?
- How does your program/agency/organization communicate with the community?
- Does your agency/organization provide women in transition with training or education other than technology training or education?
- What types of assistance with access to health services/care does your program provide specifically to women in transition from incarceration?
- What web presence does your program/agency/organization have (e.g., Website, FB, other social media)?
- How does your organization help the participants with job search?
- What feedback would you like to provide to AISL about the classes or about the AISL program?

Technology Curriculum Phases and Lessons

- Phase A - Computing Introduction (5 lessons)
 - Computer Components Overview

- CPU and Memory
 - Storage and File System
 - Ports and Monitors
 - Smartphone
- Phase 1 - Technology for Employment (6 lessons)
 - Microsoft Word and Google Docs
 - Microsoft Excel and Google Sheets
 - Microsoft PowerPoint and Google Slides
 - Building Resumes
 - Online Security
 - Microsoft Office Advanced
- Phase 2 - Online Personal Branding (5 lessons)
 - Social Media for Employment Opportunities
 - Personal Branding
 - Creating Content
 - Creating a Website 1
 - Creating a Website 2
- Phase 3 - Business Website Building Using WordPress (7 lessons)
 - Course Introduction

- Introduction to WordPress and Installation
 - Editing Your Webpage and Creating a Resume-Style Personal Blog
 - Creating a Restaurant Reservation Site
 - Creating a Product Selling Website
 - Transfer Your Website from Local Computer to Online Site
 - Becoming a Professional WordPress Developer
- Phase 4 - Advanced Spreadsheet (6 lessons)
 - Review to Excel, Entering and Editing Data
 - Basic Excel Functions
 - Inserting Image/Shapes in Excel and Creating Basic Charts
 - List Functions and Data Export/Import
 - Pivot Tables and Large Set of Data
 - Lookup, Text-based Functions, Automating Repetitive Tasks with Macros
- Phase 5 - Digital Storytelling (5 lessons)
 - Introduction to Digital Storytelling
 - Setting the Shot and Scene
 - Introduction to Post-Production
 - Advanced Post-Production Techniques
 - Concluding Your Digital Story
- Phase 6 - Advanced Digital Storytelling (4 lessons)

- The Art of the Interview
- Producing a Podcast
- Getting Started with Vlogging
- How to Make an Animation
- Phase 7 - Business Communications (5 lessons)
 - Professionalism in Business Communication
 - Professional Email Communication
 - Digital Collaboration Sites
 - Video Conferencing
 - Business Communication Skills to Solve Problems

Evaluation Questions, 2022

- Evaluation Question 1: Did the project implement activities as designed?
- Evaluation Question 2: What implementation challenges were encountered and how were these challenges addressed?
- Evaluation Question 3: Did the project engage its intended population? What were the characteristics of the women who enrolled and persisted? What factors contributed to their enrollment, persistence, and satisfaction with the program? What factors contributed to their dropping out of the program?
- Evaluation Question 4: To what extent did the research team adhere to its research plan? What modifications, if any, did they make and how did this affect the quality of their research design?

- Evaluation Question 5: Was there evidence that the technology education curriculum was effective in reducing recidivism and enhancing employment for women in transition?
- Evaluation Question 6: Do the dissemination materials provide sufficient detail about the design and outcomes of the study (who participated, what was implemented, under what conditions) to inform use by other researchers and community partners?
- Evaluation Question 7: Is the technology education application and curriculum replicable?

Evaluation Question 1: Did the project implement activities as designed?

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VITA

Rafida Zaman has graduated from Khulna University of Engineering and Technology in Bangladesh, in May 2011. After Graduation she started working as a lecturer in a university named "America Bangladesh University" in the electrical and computer science department. After 2 years in fall 2013 she started her Master's in Electrical and Computer Engineering in South Dakota University of Mines and Technology, SD, USA. She completed her Master's program in May 2015. In fall 2015 she joined interdisciplinary Ph.D. program at University of Missouri - Kansas City. Her primary discipline is Telecommunication Networking and co-discipline is Electrical Engineering.

Rafida's area of research is Human Factors in Smart and Connected Communities that included three different parts, first part is understanding what residents ask cities from 311 calls, second part is learners - teachers in smart education with the opportunities and challenges induced by COVID-19 Pandemic, and the last part is about informal technology education for women transitioning from incarceration. She is one of the lead instructors in a NSF funded project AISL (Advancing Informal STEM Learning) from summer 2022.

She received multiple awards during her Ph.D. program. She received GAF (Graduate Assistance Fund) award in 2019, MINKWIC best poster award in 2019, AFCCE award for IWCE 2018 Expo, and AFCCE (IEEE BTS) award in 2017. She has also received several IEEE travel grants, and is a member of Institute of Electrical and Electronic Engineers (IEEE). She was in organizational committee and webmaster of IEEE International Smart Cities Conference (ISC2 2018). She also volunteered and attended in several conferences. She reviewed lots of papers in multiple conference and journals.

Rafida has joined UMKC as an Instructor position from spring 2022. She is teaching mostly core courses in Division of Computing, Analytics and Mathematics (CAM), such as Design and Analysis of Algorithm, Cloud Computing, Advance Operating System, Discrete Structures etc.

PUBLICATIONS

Conference Publications

- Rafida Zaman, Choi, Baek-Young, and Sejun Song. "Digital Transformation and Divide of Cities through the COVID-19 Pandemic." IEEE International Smart Cities Conference 2022.
- Choi, Baek-Young, Sejun Song, and Rafida Zaman. "Smart Education: Opportunities and Challenges Induced by COVID-19 Pandemic: [A Survey-Based Study]." 2020 IEEE International Smart Cities Conference (ISC2). IEEE.
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Journal Publications

- Seo, H., Altschwager, D., Choi, B-Y., Song, S., Britton, H., Ramaswamy, M., Schuster, B., Ault, M., Ayinala, K., Zaman, R., Tihen, B., Yenugu, L. (in press). "Informal technology education for women transitioning from incarceration." ACM Transactions on Computing Education.

Poster Publications

- Rafida Zaman, Baek-Young Choi, "Digital Inclusion for women transitioning from incarceration." CANSec 2022.
- Baek-Young Choi, Rafida Zaman, Sejun Song, "Learners Transition through the COVID-19 Pandemic", US-Korea Conference, 2022.
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