Final Year Project

Name: Eimear Lyn O' Byrne

Student Number: 120370981

Title: Digitally analysing the societal impact of vaping

Supervisor: Dr Orla Murphy

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Abstract

In recent years, Vaping has become increasingly popular as there has been an exponential rise in the use of vapes especially amongst young people. Misleading information, the ‘healthy’ and less harmful perception of vaping, has been portrayed in society compared to traditional cigarettes, are the main reasons for the widespread use amongst society. The misinformation surrounding Vaping is an important factor to its increasing popularity, ultimately creating a public health crisis as individuals are unaware of the potential health risks and the immense risks Vaping can have on an individual and their environment. On account of this, this project aims to investigate the impact Vaping has on society and individuals, both qualitatively and quantitatively, and help to inform and educate individuals using key insights found throughout the analytic process of the project.

Throughout the gathering of statistical information and data from a research questionnaire carried out as part of this final year project, an informative hand-coded website was created to display data and text analytics from all questionnaire responses. Users can view the self-developed website and find important key insights gathered throughout the duration of the research process. This analysis was undertaken using Pandas and Python coding, additionally the analysing of the text was carried out using Voyant and a scholarly informed perspective. The analytics and further information gathered and created throughout the research process were hosted on a website for easy accessibility.

Introduction

For this final year project, the objective was to employ data analysis techniques by first collecting data through a distributed questionnaire and subsequently analyse this data using tools such as Pandas, Matplotlib and Seaborn to uncover trends and patterns. Vaping is outlined as a method ‘of inhaling and exhaling an aerosol produced by an e-cigarette, vape pen or personal aerosolizer.’(Bonner, E. et al, 2021). The goal was to demonstrate the efficacy of data analysis in addressing this burgeoning health issue, providing insights that could inform and enhance public health campaigns. The core objective of this project aimed to understand the societal impacts of vaping through the lens of data analysis.

The necessity for this project arises from the increasing prevalence of vaping across diverse demographics as 68 million vapers are found worldwide, within this the largest concentration, approximately 20.1 million, are located in the European region (Jerzyńreowski, T. and Stimson, G.V., 2023). Understanding the rise of vaping and its implications on public health was a prime task to uncover through the analysis of the data gathered from this project. The scope and choice of undertaking the questionnaire was crucial as it integrated and gathered quantitative data for the analytic process and gained qualitative insights for textual and ground theory analysis, helping this project to offer a multifaceted view of the societal impact vaping is operating in today’s society. This approach not only helped further the robustness of the findings but also facilitated a deeper understanding of how different societal segments interact with vaping.

Through this report, the aim of showcasing data analysis in tackling health-related challenges is outlined in great depth and detail. By translating complex data into actionable insights, this project underscores the potential for data-driven strategies to inform and optimise public health campaigns. This report is a detailed discussion on the methodologies and tools employed, the analysis conducted and the in depth breakdown of the findings collected through the analysis process, which can help further implicate stakeholders in public health and policy making if adapted.

Literature review

This literature review examines the swift increase in e-cigarette usage among individuals, its effects on society, and the successful incorporation of technology to enhance its assistance. As specified by (Bonner, E. et al, 2021) vaping is a method ‘of inhaling and exhaling an aerosol produced by an e-cigarette, vape pen or personal aerosolizer.’. There is a range of terminology for e-cigarettes including ‘‘e-cigs’, ‘e-hookahs’, ‘mods’, ‘vape pens’, ‘vapes’, ‘tank systems’ and ‘electronic nicotine delivery systems (ENDS)’ (Klein, D.E. et al, 2020). The structure of each e-cigarettes consists of three primary components within a stainless steel shell: a battery, a cartridge and an atomizer (Fuoco, F.C et al, 2014). The exponential rise and prevalence of electronic cigarettes (e-cigarette) use is increasing, as they are perceived to be less harmful than traditional tobacco cigarettes (Chapman, S.L.C. and Wu, L.T., 2014). The rise in electronic cigarettes and the evolution of technology, in the undergoing growing digitalisation era, creates an valuable opportunity for engaging individuals regarding their well-being via e-health (Skinner, H. et al, 2003). As the field of e-health further elucidates, there has been only a single attempt to define the field by Gunther Eysenbach, founder and executive editor of JMIR Publications. Eysenbach established e-health as medical informatics, public health and business, encompassing health services and information augmented and delivered through the Internet and associated technologies (Eysenbach, G., 2001).

The introduction of a public smoking ban in 2004 in Ireland, the introduction of health warnings on cigarette packs and investment from the Irish government in smoking cessation programs collectively contributed to a decline in tobacco smoking rates. This progress was undone as the rapid emergence of electronic cigarettes introduced new challenges, notably exposing a younger demographic to a range of potential health risks (Bhalerao, A. et al, 2019). Findings from an recent study undertaken in 2023 by (Byth, J. et al, 2023) in North Texas, which was identified as having the highest vaping usage in America, revealed that nearly half of participants specially vaped because they perceived it as benign or beneficial for managing their stress levels as an alternative to traditional cigarettes. Similarly, recent studies conducted in 2022 to find the geographical distribution of vape users, have estimated that there are 68 million vapers worldwide, with the largest concentration, approximately 20.1 million, located in the European

region (Jerzyńreowski, T. and Stimson, G.V., 2023). Multiple variables, including age, socioeconomic status and geographical differences are crucial in comprehensively understanding the impact of vaping on individuals. Age significantly influences vaping behaviour, as research has demonstrated that ‘e-cigarette use is now prolific among youth’ (Overbek, D.L. et al, 2020), this is primarily because adolescents are more inclined than older adults to experiment with e-cigarettes (Harrell, P.T. et al, 2019) .

Socioeconomic status is pivotal in understanding the societal impact of vaping, as health disparities, which are significantly influenced by socioeconomic factors, are a major determinant of an individual’s health outcome within society. The socioeconomic status of an individual, which can be defined as ‘a measure of one's combined economic and social status’ (Baker, E.H., 2014) has an important implication on health behaviours and awareness. A significant component of socioeconomic status is financial resources, in regions with constrained economic resources, (Hartwell, G. et al, 2017) contended that e-cigarettes markets are gaining increased momentum in middle-income and low-income countries, furthermore in 2016 the World Health Organisation also indicated greater prevalence in e-cigarette usage among individuals with lower socioeconomic status through analysing multi-countries surveys (World Health Organization, 2016). In contrast to low socioeconomic status, (Laverty, A.A., Filippidis, F.T. and Vardavas, C.I., 2018) established that e-cigarettes have become a well–established product across numerous high-income countries before gaining traction in middle-income and low-income countries. This is largely attributable to e-cigarettes substituted as a cost effective and socially acceptable alternative in society to traditional tobacco products (Rom, O. et al, 2015).

Additionally serving as an economically viable and socially acceptable substitute, e-cigarettes were originally introduced as a ‘healthier’ tool to assist adults in quitting smoking, to date, there is no conclusive evidence supporting this assertion (Douglass, B., Solecki, S. and Fay-Hillier, T., 2020). Paradoxically, the perspective that e-cigarettes are a safer alternative, decreased traditional cigarette smoking in the US population from 15.8% in 2011 to 8.0% in 2016 and increased e-cigarette use from 1.5% to 11.3% in the same time period (Clapp, P.W. and Jaspers, I., 2017). This shift underscores the complex public health dynamics associated with vaping and

how it has created a preferred gateway for adolescents with no prior tobacco experience to begin using tobacco and nicotine products (Galderisi, A. et al, 2020).

Vaping poses significant health risks that can be detrimental to individuals of all ages in society. Health implications for individuals who use vaping devices have risen, as the vaping market has experienced exponential growth, a concerning number of individuals affected and a nationwide outbreak of severe, occasionally fatal, lung dysfunction have emerged abruptly in otherwise healthy people (Bonner, E. et al, 2021). Among these health implications, the most severe health conditions linked to vaping is EVALI, the American Lung Association has defined EVALI as ' e-cigarette or vaping use-associated lung injury'(*E-cigarette or vaping use-associated lung injury (EVALI),* (no date)). The Centers for Disease Control and Prevention (CDC) documented 2,558 hospitalisations related to non-fatal instances and 60 patients with fatal cases associated with e-cigarettes use, specially lung injuries such as EVALI (Galderisi, A. et al, 2020). The rapid increase in hospitalisations and growing usage amongst individuals led the Centers for Disease Control and Prevention to declare vaping a public health epidemic in 2020 (Byth, J. et al, 2023).

(Bonner, E. et al, 2021) expressed the dynamic evolution of vaping technologies including their diverse product offerings due to the rapid innovation by technological advancements. Vaping is dynamic not only in terms of technological advancements but also in the extensive variety of flavours available, among these flavours fruit, sweet and menthol/mint are particularly favoured by adolescents and young adults (Klein, D.E. et al, 2020). Additionally, (Galderisi, A. et al, 2020) noted in their research that flavoured e-cigarette liquids and aerosols contain substances that irritate the airways and include toxicants, which have led to an increased prevalence and exacerbation of asthma among adolescents. A recent study undertaken in 2020, by (Galderisi, A. et al, 2020) indicated that adolescents with asthma exhibited a higher prevalence, 12.4%, of flavoured e-cigarette usage in contrast to their peers without asthma which accumulated for 10.2%. Similarly, (Choi, K. and Bernat, D., 2016) analysed the Florida Youth Tobacco Survey which concluded that e-cigarettes are greater in asthmatics than in non-asthmatics, primarily in asthmatic youths.

Amidst the rapid expansion of e-cigarette usage, (Overbek, D.L. et al, 2020) and (Bonner, E. et al, 2021) articulated the necessity that both consumers and regulatory authorities require a deeper comprehension of toxicity dependent on specific constituents, additionally both noted the urgent need for assistance programs to be developed to aid current e-cigarette users in cessation efforts, to help combat the growing public health crisis. In attempt to address the escalating public health epidemic regarding e-cigarette usage, the World Health Organisation (WHO) collect data at regular intervals from 28 countries using their Eurobarometer survey, this helps to gain an insight into e-cigarette use and attitudes of individuals in European countries (World Health Organisation, 2018). Recently, the expanding accessibility of data generated through health surveys, along with the monitoring of disease incidence and outcomes has helped revolutionise the research landscape (Benchimol, E.I., 2015). To bridge knowledge gaps and gather data, the WHO has added questions to the Global Adult Tobacco Survey (GATS) to help guide regulatory bodies and frameworks such as the Framework convention on Tobacco control (FCTC). The online availability of health data overall, enables researchers to use it as a comparative tool in their studies, while also aiding in the development of guidelines for countries to regulate e-cigarette products (World Health Organisation, 2018).

In conclusion, this literature review has underscored the multifaceted nature of the rise in e-cigarette usage, its societal effects and the use of data collection to enhance health monitoring and regulatory practices. While e-cigarettes were introduced as less harmful alternatives to traditional smoking and embraced widely across different demographics and geographies, the understanding of their health effects remain insufficient (Bonner, E. et al, 2021). This lack of conclusive evidence poses a challenge for accurately assessing the long-term impacts on public health. Furthermore, results from recent studies, such as those conducted by (Byth, J. et al, 2023) indicate that the public health messages currently disseminated, do not always align with the concerns or needs expressed by young people who vape. This disconnect highlights the need for more targeted health communication strategies that resonate more effectively with the younger population, particularly those who are most at risk for adverse health outcomes associated with vaping. It is imperative that future research continues to explore these gaps, and that regulatory bodies refine their approaches based on robust, data-driven insights to mitigate the health risks associated with e-cigarette use such as this project.

Environmental Scan

In September, e-health was selected as the focus of this project due to its breadth and complexity, there was a need to refine to a more specific area for the research question for this project. With the objective to leverage information and communication technology to enhance understanding of a health topic, prism flow diagrams were created to identify a gap in existing e-health literature. The prim flow diagrams, attached in the appendix, review articles that discussed socioeconomic influences and unhealthy habits, yet all articles appeared to have a shortfall in how researchers disseminated their findings to individuals effectively. This gap suggested a need for strategies that better communicate research findings, prompting individuals to reconsider their detrimental health behaviour which ultimately led to the establishment of this project's goal.

Undertaking an environmental scan was a crucial step for my project as scanning studies allowed me to gain an overview of external and internal factors influencing a study, which allowed and prepared strategic planning for this project. The environmental scan identified emerging trends and opportunities for research gaps which was essential to gain an unique project question. Conclusively, an environmental scan facilitated better risk management as noting risks and challenges faced by other projects prepared this project in advance, as solutions for problems were gathered from analysis of reviewed studies.

Study citation	Title
(Amin,S.et al , 2023)	A Systematic Review of Experimental and Longitudinal Studies on E-cigarette Use Cessation
(de Haro, D. et al, 2023)	Impact of Digital Platforms on Exposure to Tobacco and New Smoking Devices: A Survey Approach
(Saab, M. M., Landers, M. and Hegarty, J. ,2017)	Exploring men's preferred strategies for learning about testicular disorders inclusive of testicular cancer: a qualitative descriptive study

Table 1: This table is an overview of projects found throughout my environmental scan, highlighted below in greater detail

A Systematic Review of Experimental and Longitudinal Studies on E-cigarette Use Cessation

This study aimed to consolidate existing research on e-cigarette cessation by reviewing literature through databases like PubMed, MEDLINE and EMBASE as of November 2022. The focus was on understanding the intentions, attempts, and success rates of quitting e-cigarette use by carrying out a narrative synthesis of data and evaluating the risk of biases with the studies.

The review of literature in this study was a selection of 12 studies, comprising seven experimental and five longitudinal studies. This methodology is similar to this final year project as there is a varied approach to research design and analysis in both the study and this project. Among the trials, one trial specifically looked at the cessation as an outcome with employing mobile technology as part of the intervention strategy. Similarly, this study is parallel to this final year project as both leverage technology to enhance the intervention's effectiveness or to gather and analyse data more effectively. This study approach to data-driven content, identification, modelling of intervention techniques and evidence- based recommendation provided a foundation to my knowledge for this project.

Impact of Digital Platforms on Exposure to Tobacco and New Smoking Devices: A Survey Approach

This study evaluates how digital exposure to tobacco and new smoking methods affects Spanish youth and its association with increased usage. The data gathered throughout this study suggests a strong link between digital exposure to smoking and actual usage. Key finding from this study was to strengthen safeguards for youths against the marketing and emerging smoking technologies.

Similarly the methodological blueprint conducted for this study was undertaken for this project, the use of surveys/questionnaires were utilised for field research to accumulate both quantitative and qualitative data for analysis. The conclusion from this study about the need for regulatory measures to protect youth is a direct cause for the creation of this research question and project. By analysing the societal impact, this final year project could also identify potential areas where

policy interventions are necessary, which was undertaken in this study by the group of researchers.

Exploring men's preferred strategies for learning about testicular disorders inclusive of testicular cancer: a qualitative descriptive study

The study on men's awareness of testicular disorders and their preferred learning strategies for health information provides valuable insights that relate closely to this final year project, which analyses the societal impact of vaping through digital analytics. Both projects emphasise the importance of tailored communication strategies to effectively reach and engage specific demographic groups.

Furthermore, the conclusion that educational campaigns should be frequently updated and customised to maintain effectiveness informs how educational vaping initiatives could be designed and implemented. This parallels the need in this final year project to continually refresh digital content based on analytics to keep it relevant and impactful. Overall, the study underscores the necessity of strategic audience -specific health communication, a principle that is central to this final year project work in vaping impact analysis.

Tools and Methods

Selecting the right approach for analysing the societal impact of vaping is crucial to ensure the validity and effectiveness of the findings. A robust methodological framework enables accurate data collection and analysis, which is essential for uncovering interesting insights into how different demographics perceive and engage with vaping. Employing a variety of analytical tools, outlined below, allows for a comprehensive understanding of the issue from multiple perspectives. This thorough approach not only enhances the reliability of the research outcomes but also supports the development of targeted, evidence - based interventions that can effectively address the identified challenges and influence public health policies.

A mixed- method approach was used in this project to integrate quantitative data from analytics with qualitative insights, from a questionnaire undertaken as part of this project. This mixed method helped to provide a richer understanding of the societal impact of vaping. This combination allowed for access to findings, ensuring more robust conclusions were found by validating trends observed in the digital data with personal experiences and perceptions documented through qualitative methods.

A range of tools were implemented in this project to develop the analytics and website which was created for easy accessibility. A website was used for users to access insights and important information gathered in the research and development stages of this project. The range of tools used for this project are outlined and sub headed, throughout this section of the report:

HypeText Markup Language (HTML) and Cascading Style Sheets (CSS)

HyperText Markup Language (HTML) and Cascading Style Sheets (CSS) are fundamental in building websites. HTML and CSS have extensive functionalities which allows websites created with both languages to be accessible, visually appealing and highly customisable to users, this ensures that specific user needs and design preferences can be tailored as needed. HTML structures the content of the web page such as headers, paragraphs, links and images, this helps to create a structured and logical layout for easy navigation. Complementarily, CSS controls and enables the presentation and visual appearance elements of a web page such as style, interactivity and responsive design. CSS style elements create a cohesive visual experience across a website

as CSS uniformly applies design elements, this ultimately enhances usability and aesthetics for users. HTML and CSS have generated an immense diverse community who collaborate and share knowledge about key aspects of HTML and CSS, this community is a valuable resource for support and gaining further knowledge into the two languages.

A hand-coded approach using HTML and CSS was chosen for this project, instead of employing a Content Management System (CMS), as manually working with HTML and CSS offers several advantages to website developers. In this project, the benefits of hand-coding the website included the ability of complete control and customisation by directly manipulating HTML and CSS in the code editor. These languages helped to facilitate performance optimisation and allow for the opportunity to showcase and enhance skills gained throughout my degree in Digital Humanities and Information Technology. Content Management Systems are limited and restrictive to developers as they depend on pre-existing themes and plugins, these constraints create unparalleled opportunity for creativity and innovation in both design and functionality when hand-coding, that pre-existing CMS themes and plugins cannot match. Additionally, the cost-effectiveness of a hand coded website was a significant factor, as opposed to using a Content Management System (CMS) such as WordPress. The charge for a domain name, custom themes and plugins increases the cost significantly compared to the publicly accessible use of HTML and CSS. Furthermore, the 835 million sites across the web that use Wordpress (Ansari, M. , 2024), create a potential cyber security target for Wordpress users with the risk of personal data being leaked. A study has found that ‘ web servers running WordPress and Joomla are more likely to be hacked than those not running any CMS’ (Vasek, M. and Moore, T., 2014). This created an additional decision for this project to be hand-coded as this minimises and reduces the points of entry for a possible security breach.

Ultimately, the decision to hand-code the website was driven by the desire for optimised performance, the application of specific technical skills, and several other factors outlined above, making it the preferred approach for this project.

Visual Studio Code

Developed by Microsoft, Visual Studio Code is a robust and versatile code editor that supports a wide range of programming languages including Python, HTML, CSS and C++. The investment from Microsoft has enabled continuous enhancements to the tool such as the ability to provide language support to users and ensured its compatibility across multiple operating systems such as MacOS and Windows which helps to foster the widespread adoption of this platform. Visual Studio Code, released in 2015, is freely available as an open-source software, appealing to a broad spectrum of developers across different platforms. Visual Studio Code is renowned for its rapid performance and extensive user community it has cultivated, the diverse community has established a vast pool of support materials for users to benefit from. Although Sublime Text was considered, it was ultimately not selected due to the associated licensing fees and its less intuitive file management compared to the user-friendly interface of Visual Studio.

In this project, Visual Studio Code was found to increase productivity and code quality with the help from key features such as syntax highlighting and IntelliSense playing a crucial role. The syntax highlighting feature helps to identify potential errors throughout the coding process as immediate feedback is given to the user. This helped to prevent numerous problems that could have had serious repercussions later on. In addition the IntelliSense feature, provides intelligent autocomplete suggestions such as variable types and functions, which was very beneficial for the coding process of this webpage.

Visual Studio Code was selected due to its ability to streamline the development process, improve code quality and provide collaborative aspects. The selection of VS Code as a code editor was instrumental in maintaining high efficiency and for accommodating quick modifications during the project lifecycle.

Python, Pandas and Colab

Python is a high-level programming language renowned for its readability, simplicity and broad applicability across different fields such as data analytics, web development, and artificial intelligence. Python facilitates rapid application development due to its dynamic system and the extensive standard libraries it entails, this creates Python as an invaluable tool for this project.

Pandas, a critical component of Python's extensive library, is essential for data manipulation and analysis. Data visualisation graphs generated using Pandas create clear clean representations of complex datasets which help individuals understand and compute trends and patterns found within datasets. For visualising data, Pandas can be integrated with libraries such as Matplotlib and Seaborn, enhancing its graphical capabilities. This integration was pivotal in this project for creating insightful visual representations of analytical findings.

Although JavaScript was considered as an alternative, the programming language lacks direct support for extensive computing libraries such as Seaborn and Matplotlib, which were integral to this project. While JavaScript can manage similar tasks, the built -in functions in Pandas help streamline the process significantly, reducing the need for custom coding which would need to be undertaken with JavaScript. Ultimately, Pandas and Python were more suited for the dedicated data analysis tasks needed to be undertaken in this project, which could be undertaken with the supportive community and the integration of the broad array of scientific computing libraries Pandas offers.

In this Project, Python and Pandas were chosen for their efficiency and effectiveness in handling complex datasets. The prior knowledge and ease of use of Python and the powerful data manipulation capabilities of Pandas allowed for quick deployment and sophisticated data analysis. Complex data analysis questions were effectively addressed using Python and Pandas for exploration and modelling. The integration of Python and Pandas enabled meaningful insights to be gathered without the need for data management tasks and additional tools. The flexibility of Python, combined with the extensive capabilities ensures for comprehensive analysis and reporting. Colab was chosen to facilitate the creation of the data analytics, as Colab is a Google cloud-based platform, it integrated easily with the CSV file on Google Sheets that contained the gathered questionnaire responses.

Filezilla

FileZilla is a powerful and widely- used File Transfer Protocol (FTP) client, essential for managing files on remote servers. FileZilla is an open-source tool which offers an user-friendly interface with drag and drop capabilities, which simplifies the process of uploading and

downloading files between the local machine and the server. The versatile platform allows for the accessing and managing of files securely as FileZilla has robust security protocols in place to protect from potential threats including cyber attacks and data breaches. Furthermore, the use of passwords and keys for authentication further enhances the safe security of file transfers and management.

In this project, FileZilla was used to transfer files to the public_HTML directory on my individual UCC server account. FileZilla's reliable performance ensured files were transferred quickly which minimised downtime throughout the development phase of this project. The choice of FileZilla as an FTP client was chosen due to its well-established reputation for stability and the accessibility of extensive support documentation available for users, this designated FileZilla as an indispensable tool for effective file management in this web development project.

Timeline.js: Interactive Timeline Tool

Timeline.js is an open-source tool that enables the creation of visually engaging interactive timelines. Timeline.js has the ability to integrate seamlessly with various multimedia types such as images, videos and audio. This key feature allows Timeline.js to create timelines that are both engaging and informative to viewers. The ease of use of this tool consists of users simply filling in a Google Spreadsheet template provided by Knight Lab, developers of Timeline.js. This allows for timelines to be customised easily and eliminates the need for long hours of coding it.

In this project, Timeline.js was employed to illustrate the chronological progression of the creation and development of vaping in an informative and interactive manner. The tool helped to display important milestones that were pivotal to understanding the project's significance in society. The use of Timeline.js in this project was selected largely due to its capability to be responsive in design and interactive, therefore enhancing the user experience of the website. The use of Timeline.js significantly contributed to a deeper understanding of crucial milestones vaping has endured since its inception.

Canva

Canva is a user-friendly online graphic design platform that enables users to create high-quality visual content. Canva has a vast library of templates, fonts, images and design elements including presentations, flyers, posters and infographics. Canva is designed as a cloud-based platform which ensures the easy accessibility and ability to work on designs at any given time when connected to the internet. The high level customisation offers flexibility of designs to be integrated by the users, in addition the ability to export creation in different formats including PDF, PNG and JPG allows for compatibility across various media.

In this project, Canva was employed to create visually appealing infographics on important topics vaping is significantly affecting including health and the environment. The decision to use Canva was based on its capacity to enhance the project's visual quality greatly as materials were able to look professionally and cohesively presentable on the webpage.

Google Forms

Google Forms is a straightforward web-based application that allows for the creation of custom surveys and questionnaires in a timely manner. The tools ease of use and various powerful features make it an ideal and instrumental tool for collecting and organising information efficiently. Key features of Google Forms made it a desirable tool to collect data for the questionnaire undertaken in this project. The customisation and ability to have question types as multiple-choice, checkboxes as well as open-ended responses enhanced the richness of participants' responses. Google Forms allows for responses to questionnaires to be collected in real time which was beneficial for this project, additionally responses could be viewed automatically in generated spreadsheets as the integration with Google Sheets facilitates instant data analysis for the questionnaire distributor.

For this project, Google Forms was selected to gather participants' responses on a questionnaire regarding vaping to digitally analyse the results to be included in the webpage. The simplicity and flexibility of Google Forms enabled the ability to modify questions if needed, this helped to ensure the relevance and accuracy of the information gathered. An alternative tool that could have been utilised in distributing the questionnaire is Microsoft Forms, this tool was not chosen because it does not allow for the inclusion of an information and consent sheet prior to the

questionnaire. This feature is crucial as informating the participants about the nature of the study, how their data would be stored and handled is an important requirement in accordance with UCC policy. Utimaley, the use of Google forms facilitated efficient data collection and analysis in a cost-effective and user-friendly way which allowed for the high participation result in this questionnaire.

Voyant

Voyant is a web-based text analysis environment with capabilities and functionalities to provide text visualisations to make it easier to easily interpret texts, identify key themes, frequent terms and break down the structure of content. In this project, Voyant was employed to conduct detailed textual analysis of qualitative open-ended responses from the questionnaire carried out on Google Forms. Voyants visualisation capabilities allowed findings and new insights emerged during the analysis to be presented in an engaging manner.

Key features that compelled the use of Voyant in this project were similar to Google Forms, the capability of the real-time analysis, this ensured for the ease of changes and adjustments of submitted texts that were being analysed to be adjusted in real-time. Furthermore, Voyant updated the visualisations and statics instantly which allowed for the dynamic exploration of texts throughout the process of textual analysing results. The use of Voyant in this project significantly improved the quality of further analysis and discussion of qualitative questionnaire findings, making it a crucial component of this project's research methodology.

QR.io

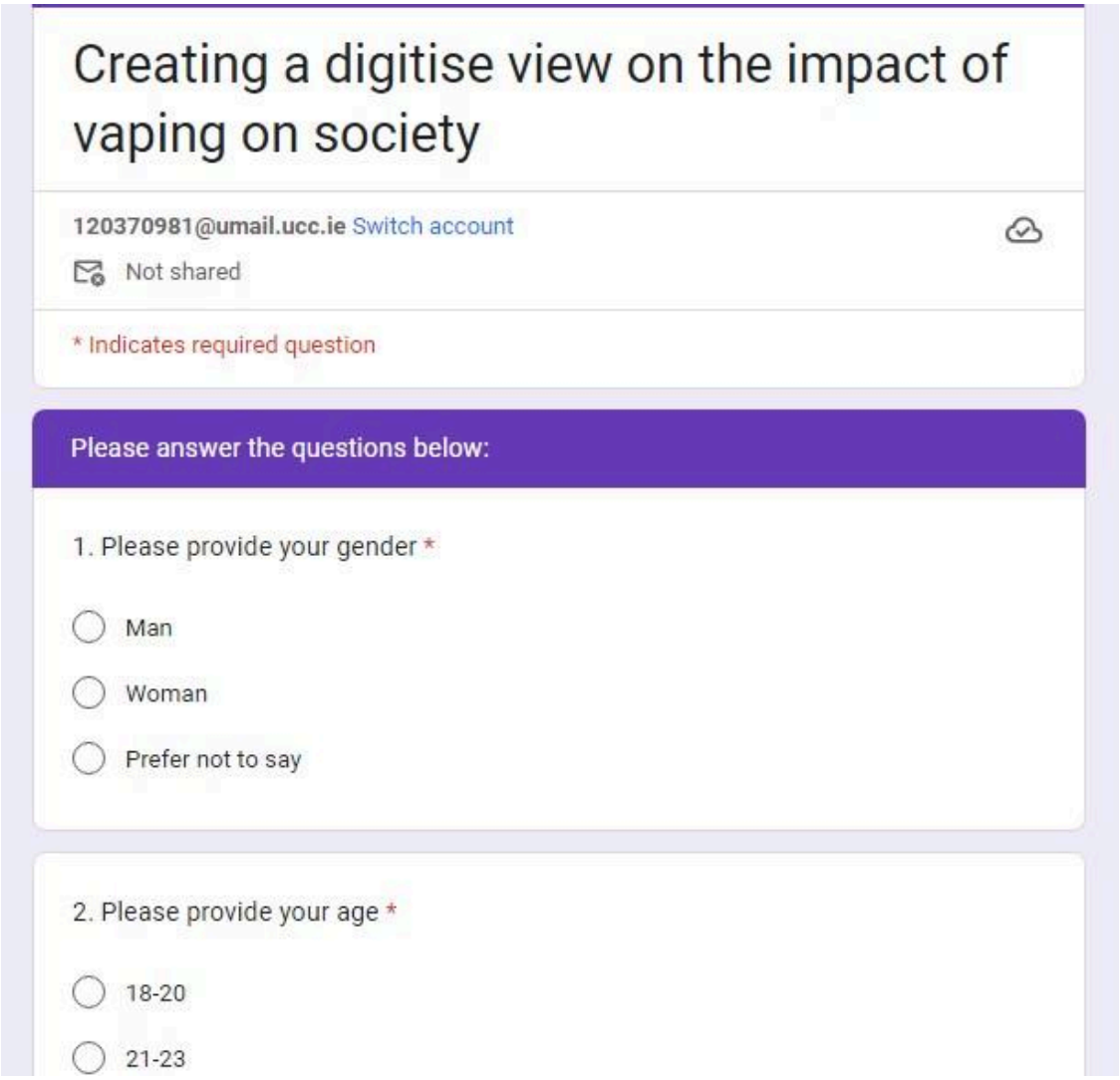
Qr.io is a comprehensive open-source tool designed for generating and managing QR codes that connect to digital content. The dynamic tool offers users flexibility and provides detailed analytics to help track the usage of each QR code; such insights are invaluable for managing the engagement and effectiveness of QR codes. In this project, QR.io was employed to heighten the website's interactivity for users, the ability to link educational and informative resources throughout the site, and facilitated seamless access to additional content. Furthermore, QR.io’s capability to create dynamic QR codes allows for real-time updates to the linked resources without the need for the developer to replace the QR code themselves.

Additionally a specific QR code was strategically placed on the last page of the website to receive user feedback. The QR allows users to share their experiences and opinions anonymously, the user input plays a crucial role for the decision making of possible new developments to be integrated into the website's functionality and content.

Implementation

The primary objective of this project is to digitally analyse vaping by conducting a questionnaire to gather research data, identify trends and pinpoint topics on which society needs to be educated. Initially before implementation of the digital artefact could be undertaken, field research was necessary to gather empirical data directly from individuals to enhance the validity and depth of this project's findings. In order to undertake and distribute a questionnaire, a successful ethics approval application from the Social Research Ethics Committee (SREC) was needed. The project ethics approval, attached below in the appendix, outlines the known implications, self-evaluation and description of this project, ethics played a crucial role in this project as it fostered credibility by demonstrating adherence to ethics standards and safeguards were in place while gathering personal data from individuals.

Once approval was obtained, assembling of the questionnaire could be completed, allowing the project to progress to the build stage. Initially, Microsoft Forms was selected as the online platform for conducting and distributing the questionnaire; however it lacked the functionality to incorporate an information and consent sheet before accessing into the questionnaire. Including an information and consent sheet is crucial, especially in this project as personal data and topics such as health are being explored in the questionnaire, the information and consent sheet ensures that participants are fully informed about the implications of their participation and aware of how their data is being stored. An alternative to Microsoft Forms used for this project, which is equipped with the absent variable, is Google Forms. The questionnaire was formulated on Google Forms, with diverse answer options used such as multiple choice and text box to gather qualitative feedback from participants, the questionnaire was disseminated across various social media platforms for participant completion. Utilising social media allowed for a diverse range of respondents and enabled a rapid dissemination of the questionnaire. Additionally, Google forms enabled the seamless integration with other Google tools used in the creation of this artefact such as Google Colab, Google Sheets and Google Drive, this allowed for uninterrupted data collection and analysis processes.



Pic 1.0: The picture above gives a overview of the form format seen by participants

After the questionnaire was available for a considerable duration, in an effort to maximise participation from individuals and collate responses, facilitating analysis of the data could occur. Prior to commencing data analytics, several preliminary procedures had to be undertaken, encompassing both data cleansing and preprocessing. These essential tasks are imperative for enhancing the accuracy and reliability of the data gathered throughout the questionnaire as it allows for the optimisation of the analytical process to derive the most insightful outcomes. Data cleansing tasks including scanning for and eliminating duplicates entries and identifying errors, while data preprocessing tasks entailed the ensuring of the consistency of data across different

variables were taken place as part of the build phase of the project. These tasks were undertaken by employing Pandas, as the library is enabled with data cleansing and preprocessing tasks..

After concluding the data cleansing and preprocessing steps, data analysis was conducted on Google Colaboratory (Colab), due to its seamless integration with the CSV file, allowing direct access to the raw data from the questionnaire stored within the Google Sheet. For this project Colab was implemented to use Python and its Pandas library to manipulate the data and uncover intriguing trends and patterns within the data collected as shown in pic 1.1.

```
from google.colab import drive
drive.mount('/content/drive')
```

```
Mounted at /content/drive
```

```
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
df=pd.read_csv('/content/drive/MyDrive/dataset/vaping.csv')
df.tail()
```

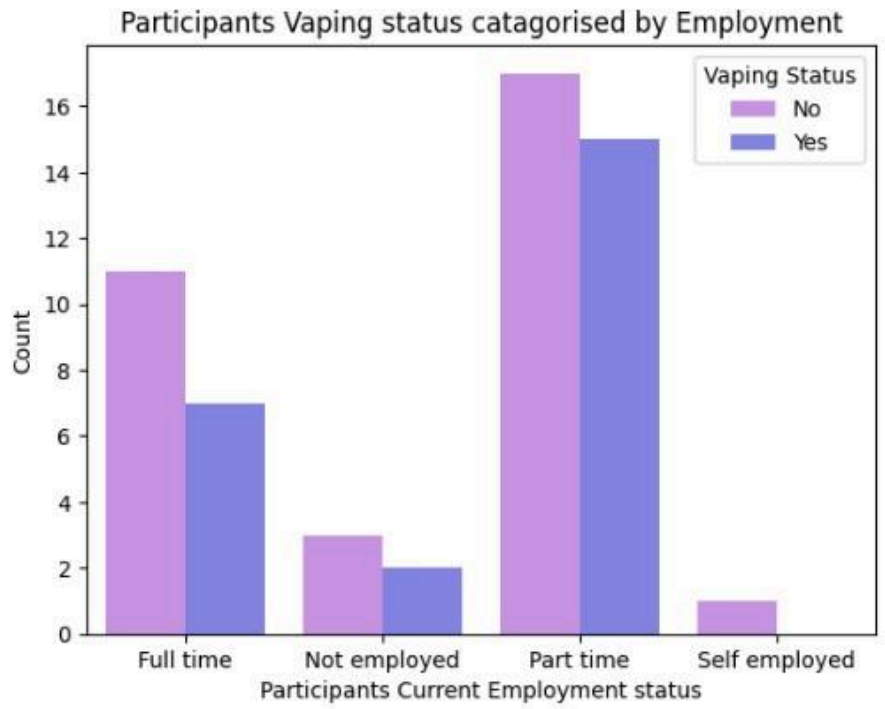
Pic 1.1: This picture shows a overview of importing the integration of google drive and uploading the csv data set, stored within Google Sheets, into Colab

In-depth analysis of the quantitative inquiries posed in the questionnaire was carried out using Python, as the ability to leverage the powerful capabilities of libraries such as Pandas, Matplotlib and Seaborn. For this project, technical expertise was applied to integrate Matplotlib into the Colab environment, further technical skills were implemented to craft the requisite code to generate graphical representations, as exemplified in pic 1.2 below. Mathplotlib facilitated the creation of complex visualisations, allowing for the exploration and representation of interesting data relationships with precision and clarity to the viewer. In addition, Seaborn was utilised by importing the library into Colab seemingly to Matplotlib, the execution of Seaborn in the analytical process of this project played a pivotal role to instrument the graphs generated using Matplotlib were presented in an accessible and compelling manner, as shown in pic 1.3.

```
bar_color= ['#ce85f2', '#7373f0']
sns.countplot(x='3. Are you employed?', hue= '6. Do you vape? (if no, skip to question 11)', data = df, palette = bar_color)
plt.title('Participants Vaping status catagorised by Employment')
plt.legend(title='Vaping Status', loc='upper right')
plt.xlabel('Participants Current Employment status')
plt.ylabel('Count')
plt.show()
```

Pic 1.2: Captures the code needed to create the graph in pic 1.3

In this project, the decision to employ bright colours, shown in pic 1.3, in the graphs was made to enhance the visual appeal and effectiveness of the data representation. Bright colours are particularly good at capturing attention, which is crucial for engaging stakeholders who may not be familiar with the data. Furthermore, to draw attention to the graphs, the use of bright colours is employed as a strategic element similar to e-cigarettes. As researched by Marissa J Smith and Shona Hilton in 2023, their study demonstrated the e-cigarette usage of vivid hues to captivate and entice users (Smith, M.J. and Hilton, S., 2023). Further in-depth analysis of each graph generated from the questionnaire is outlined in the analysis section of this report.



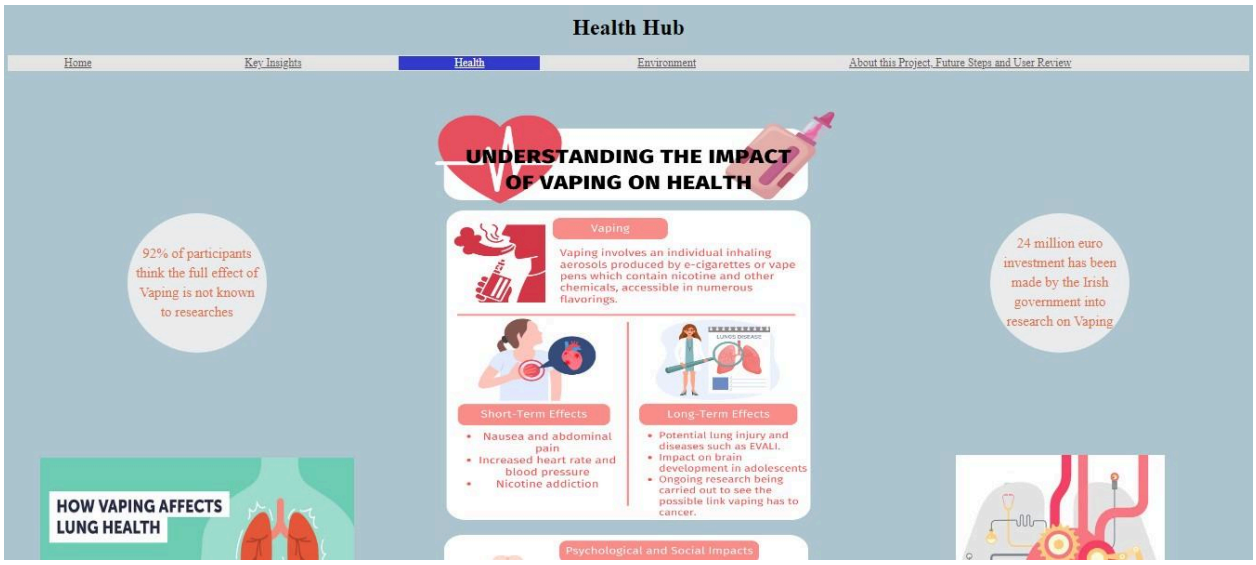
Pic 1.3: This picture shows a graph categorising Employment by Vaping status generated by Pandas, Seaborn and Matplotlib in Colab

In contrast, analysis of the qualitative queries within the questionnaire was carried out by deploying Voyant. This tool requires a detailed understanding of textual data and its interpretation, this use of this tool demonstrates the technical skill in handling sophisticated digital humanities tools. Voyant was employed, as shown in pic 1.4, which outlines the qualitative response of participants to the question regarding: Does the packaging and extensive flavours attract you? . The ability to visualise data word clouds and various other exploration tools helped to gain a deeper insight into the qualitative data. The technical adaptation of Voyant helped to effectively uncover patterns, themes and correlations that are not immediately obvious, this showcases an adeptness in both qualitative research methodologies and digital data analysis techniques.

Pic 1.4: Visualisation created using Voyant for question 9: Does the packaging and extensive flavours attract you?

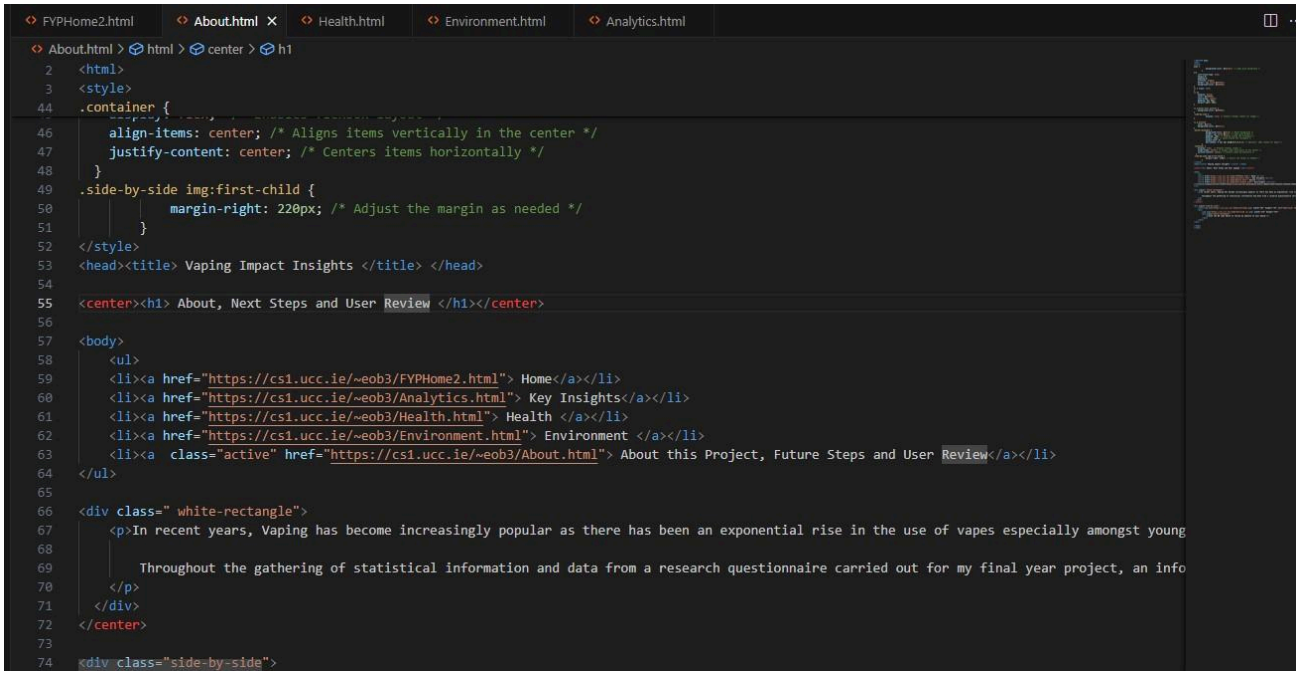
The analysis conducted using Voyant is explored in depth in the subsequent section of this report. Through the utilisation of Voyant, coupled with an examination of the questionnaire responses in a Google Sheet, it was evident that there is a significant participant interest in understanding the societal impact of health and environmental issues. This insight was instrumental in guiding my decision to develop dedicated pages on the website to these topics. These pages were designed to

educate users about the environmental and health consequences associated with vaping by creating infrogaprics and linking resources to highlight the effect on individuals and society.



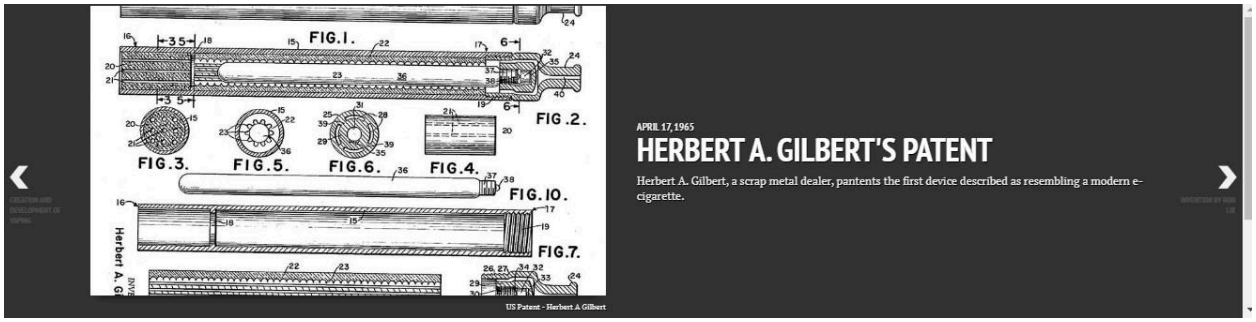
Pic 1.5: Health page of the website overviewing the important health implications and attaching necessary resources.

During the analysis phase of my project, the construction of a hand-coded website was simultaneously underway using Visual Studio Code, shown in pic 1.6, as it's equipped with syntax highlighting which was greatly beneficial for this project. A critical aspect of the hand-coding process involved initial planning, the flexibility of having full control over the design factor of the website layout allowed for rapid modifications to be implemented if needed. The coding began with the creation of the homepage, employing CSS for styling, laid out the groundwork for a great user experience. A search bar was employed to facilitate seamless navigation, allowing users to effortlessly switch between pages. Ensuring frequent and reliable saves of the html pages created on Visual Studio Code was important to maintain version control and prevent data loss. Uploading the coding pages and pictures integrated in the websites to the public_html directory using Filezilla was a crucial technical step. FileZilla's drag and drop functionality allowed for a seamless uploading process, uploading the pages into the public_html directory allowed for continuous review on different deceives not just locally which allowed for adjustments of the website to be completed if needed. This process greatly enhanced this project's technical aspects.



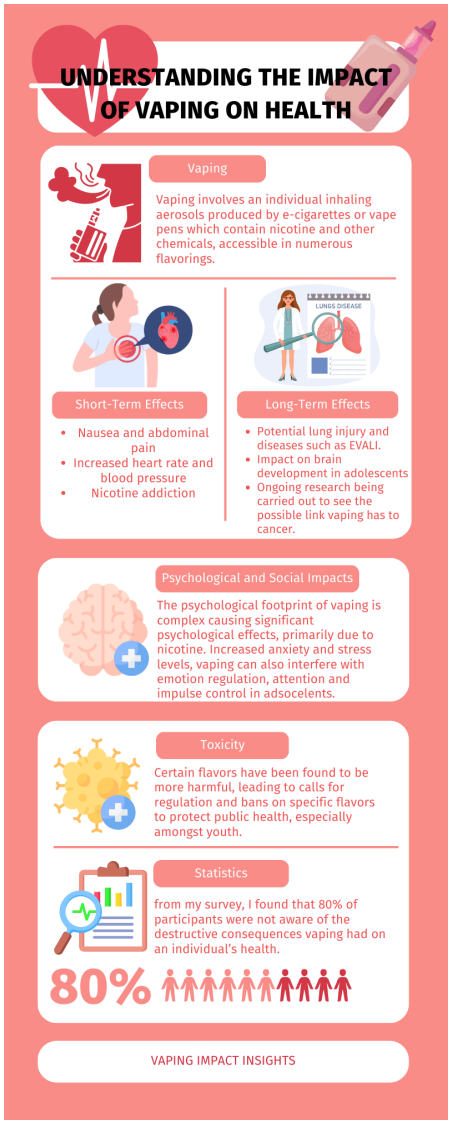
Pic 1.6: An overview of Visual Studio Code being employed to hand-code the website

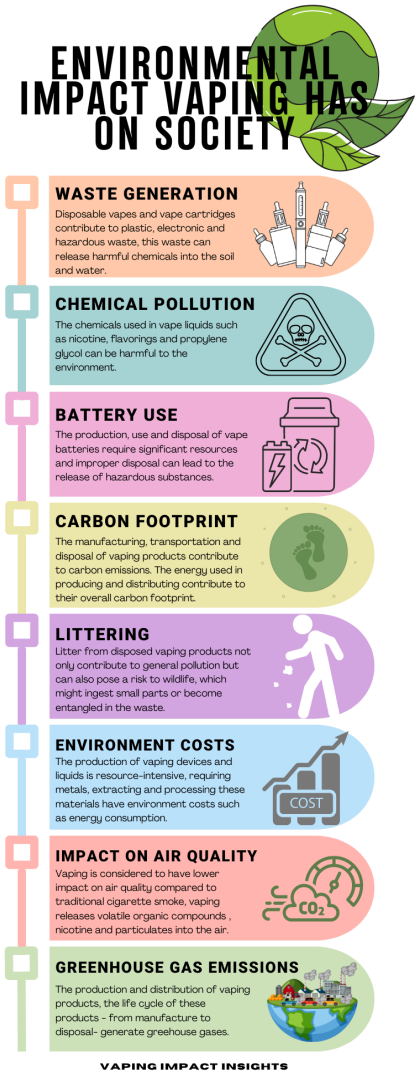
To improve the interactivity and user experience of the website, a timeline detailing the development and creation of vaping was constructed using Timeline.js, shown in Pic 1.7 below. This timeline was developed by initially conducting thorough research to identify key milestones in the history of vaping. Noteworthy events incorporated into the timeline include Herbert A. Gilbert's patent - the first patent issued for the e-cigarette- and the subsequent introduction of e-cigarettes to international markets. These elements were chosen for their significance in tracing the evolution of vaping technologies. By incorporating a timeline with Timeline.js, by embedding the code provided on Timeline.js showed an essential skill in modern software engineering was learnt as it shows the ability of integrating a third-party library into a web development project. Implementing the timeline helped to structure and present complex data in an accessible format which enhanced the project's strong user design principle. Creation of the timeline was undertaken by organising the most important milestones in a Google Sheet template developed by Timeline.js, attaching different media such as video and pictures acquired further technical assistance to create this timeline .



Pic 1.7: This picture shows the interactive and customisable timeline created to show the creation and development of vaping for the home webpage.

To serve as an informative hub to hold data-driven insights in data and textual visualisations, the project focused on incorporating visuals more, instead of text heavy articles and pages, as visualisation can be more informative and engaging for the user. The creation of infographics to show the health and environmental impacts were created using Canva. The infographics shown below in Pic 1.8 and 1.9 show the vibrate colours used to portray the information in an engaging way. Additionally, the use of CSS on the webpage enhanced the interactivity and accessibility of the website, ensuring users could navigate through complex information. This approach made the information more accessible and engaging but also showcased the technical skill in applying state-of-the-art digital tools to communicate data effectively.





Pic 1.8 and Pic 1.9: The infographics help portray valuable and informative information to users navigating the site.

In conclusion, the implementation stage of this project was marked by a methodical and in-depth approach to collecting and analysing data on the societal impact of vaping. The process began with securing ethics approval, which was pivotal to set up a foundation for transparent and responsible research practices in this project. The use of various digital tools such as Google Forms, Google Colab and advanced data visualisation libraries such as Pandas, Matplotlib and Seaborn enabled a rigorous analysis of collection of data for this project. These tools were a crucial part in identifying trends and patterns in the collected data, which was important for

developing a deep understanding of this project topic. Moreover, the project's strategic use of visual elements and interactive content, supported by the hand-coded process, significantly enriched the user experience. This phase of the project not only demonstrated a high level of technical proficiency and ethical consideration but also laid solid groundwork for the subsequent phases of the project, ensuring that the insights accumulated in the data are both credible and impactful.

Analysis

Data Analysis

To address this project's research question effectively, it was essential to engage in comprehensive data analysis from an academic viewpoint, while simultaneously incorporating a grounded theory approach into the analytical process. Grounded theory is a research methodology which focuses on developing theories that are directly derived from data systematically gathered and analysed (Noble, H. and Mitchell, G., 2016). Primary, the use of axial coding helped to analyse the data using the grounded theory approach, as axial coding helped to identify relationships and connections between categories to help gain a deeper insight into the raw data collected throughout the questionnaire. In response to the questionnaire distributed as part of this project, 66.1% of respondents identified as Female, 32.1% as Male and 1.8% of participants preferred not to say their gender. This section will thoroughly discuss the analysis of the collected questionnaire data, using a founded theory approach and scholarly perspective as outlined.

Fig 2.0, shown below, presents a visual breakdown of vaping status among participants, segmented by gender. Evidently, the graph clearly illustrates that a higher number of women reported not vaping in comparison to men. From a grounded theory perspective, the graph could be interpreted as using axial coding which helps to identify patterns, themes and concepts in the relation of to individuals vaping status by gender demographics found in the questionnaire. Conversely, a greater proportion of men indicated that they do vape or use e-cigarettes relative to women. This discrepancy is particularly noteworthy considering that the response rate of the questionnaire from women was more than double the participation from men. Similarly, a comparable research study undertaken using parallel data collection methods including questionnaires, found the same insight from their data analysis ‘that e-cigarettes appeal more to men than women’ (Dawkins, L., 2013). The insight gathered that men contribute to the rise in vaping more than women in this questionnaire can be influenced by different factors such as social, cultural and biological factors which is later discussed in fig 2.4. Given the addictive nature of vaping, it could be a contributing factor to the higher incidence of vaping amidst men observed in this graph. This is supported by research encountered during the preparation of this

project report, which indicated men tend to exhibit a higher propensity for developing addictive behaviours than women (Munno, D., 2016).

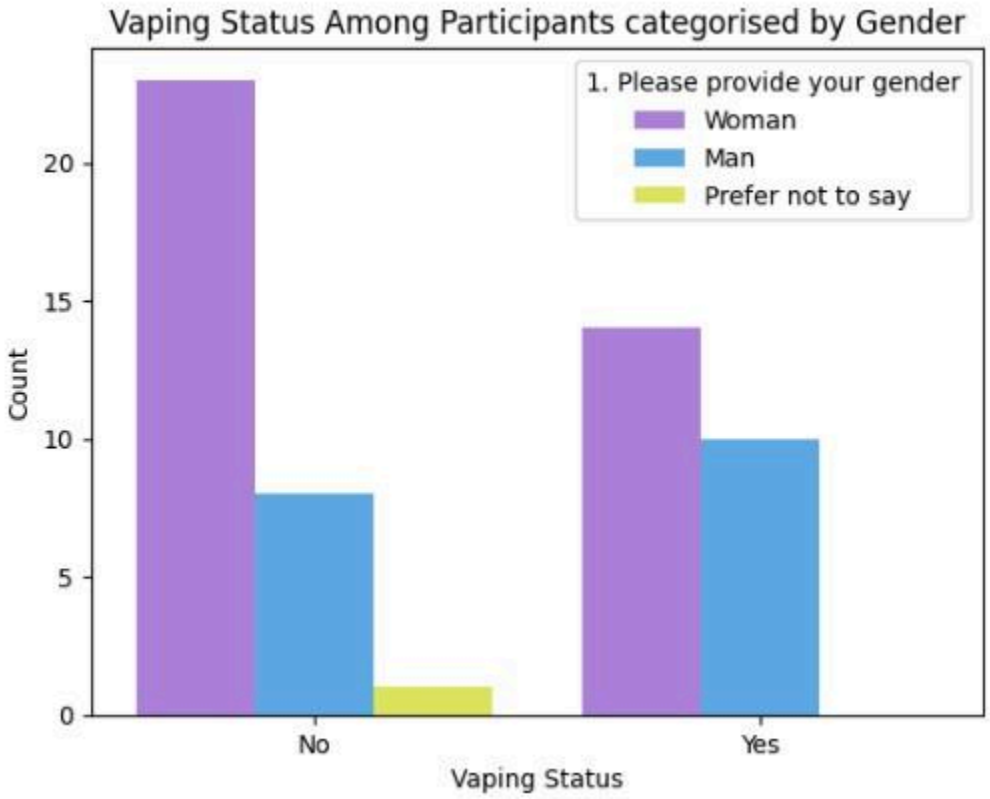


Fig 2.0: This graph shows the distribution of participants vaping status categorised by their identified Gender

Fig 2.1 offers a clear depiction of vaping prevalence across different age groups within the participant sample. The graph helps to depict that the age cohort 21-23 contains the highest count of individuals who both abstain from vaping and utilise e-cigarettes, this may be attributed to this age range having the highest response rate for this study. The prominent usage of e-cigarettes within this data collection is within the 18-20, 21-23 and 24-26 age range; this aligns with findings from a 2022 study analysing e-cigarette usage patterns, which suggested that adults between 18-29 year old are more inclined to use e-cigarettes compared to older age groups (Lin, H.X., 2022). As the graph indicates a gradual decline in non-vaping individuals within the advancing age categories. Using a ground theory approach in viewing fig 2.1, the observation of the decrease in vaping prevalent with increasing age, especially beyond the 27-34 age age

prompts further analysis to uncover underlying reasons that this may occur. Factors such as a shift in health awareness, lifestyle changes or social factors could contribute to the pattern emerging from the analysed data. Understanding these factors could help develop a substantive theory that could help explain why younger individuals are more drawn to vaping.

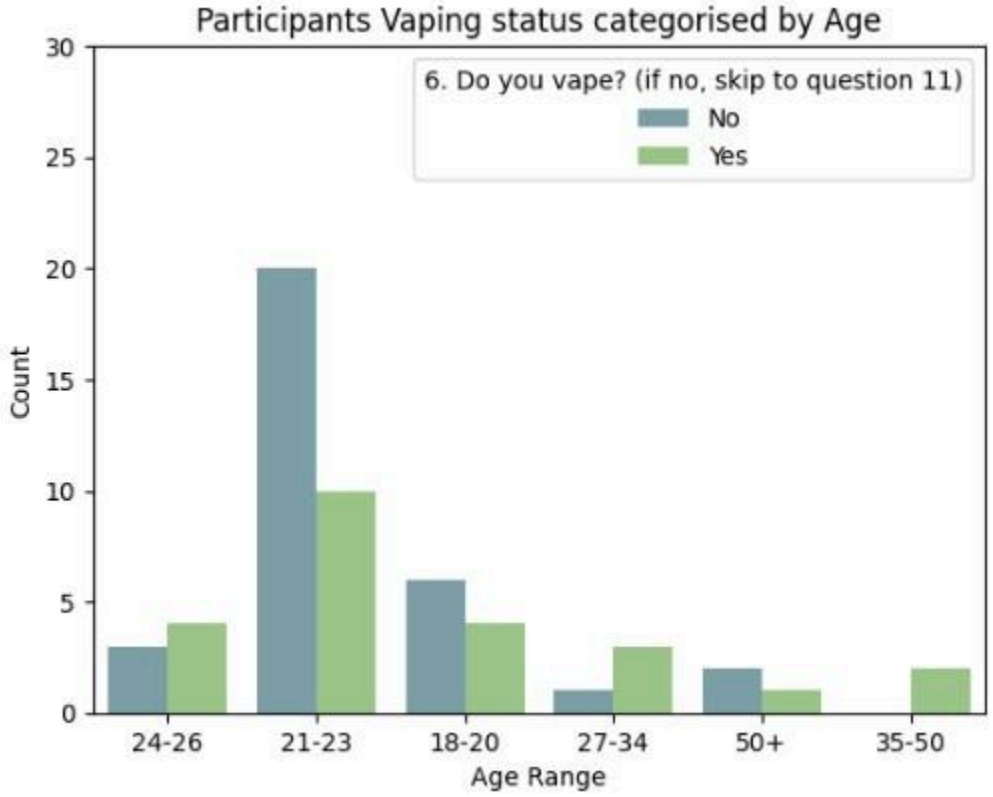


Fig 2.1: This graph shows the distribution of participants vaping status categorised by their Age range

The bar chart, in fig 2.3, provides an analytical portrayal of vaping prevalence among participants based on their current educational engagement. The data indicates that full-time educational participants constitute the highest number of both vapers and non-vapers, this observation aligns with (Lin, H.X., 2022) findings, which also observed a significant association between e-cigarette/vape use and engagement of high level full time education. A grounded theory approach suggests that the educational environment may exert a substantial influence on vaping behaviours. As evident in fig 2.3, individuals not attending an educational institution demonstrate a lower count in both categories, while part-time attendees show minimal representation in the data. Furthermore, using ground theory to investigate the low prevalence of

vaping among part-time students prompts more in -depth inquiry into various contributing factors, including social circles and time constraints, thereby offering a deeper understanding of these insights.

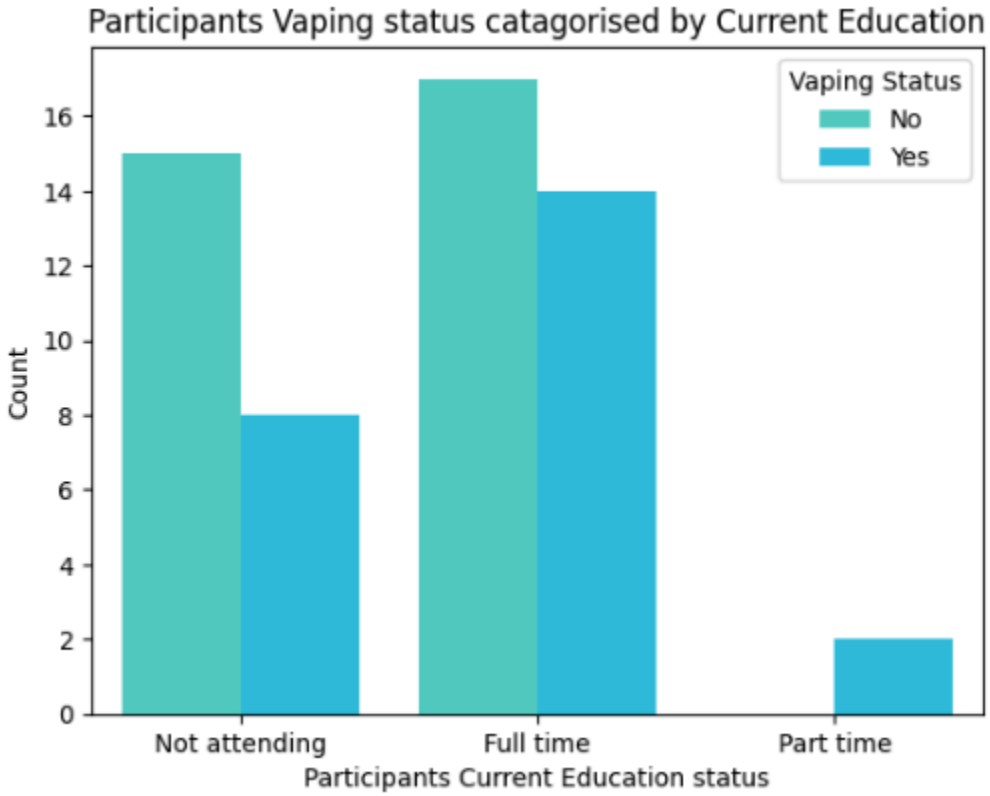


Fig 2.3: This graph shows the distribution of participants vaping status categorised by current education enrolment

The pie chart, shown below in fig 2.4, illustrates the motivations for vaping as reported in this project. The largest segment, comprising 32%, cites the social aspect as their primary reason for vaping, secondly 28% is enjoyment. A grounded theory approach could indicate that social factors such as peer influence and personal satisfaction play a significant role in the decision to vape. Following these, jointly 28% of participants, selected perceived health benefits and vaping as a substitute for smoking traditional cigarettes, as their reason for vaping eluding further into the belief that vaping is a safer alternative for traditional smoking which no evidence supports as noted by (Douglass, B., Solecki, S. and Fay-Hillier, T., 2020). The categories of marketing and advertising, habit, and other reasons each account for 4.0% of the responses, respectively.. These elements are overshadowed as primary motivators when compared to the social and enjoyment

factors. Grounded methodological approach to further understand this insight could be a subsequent phase of qualitative data collection, such as interview or focus groups, to further explore the nuances of these primary motivators and develop a comprehensive theory of vaping behaviour that is rooted in this raw data.

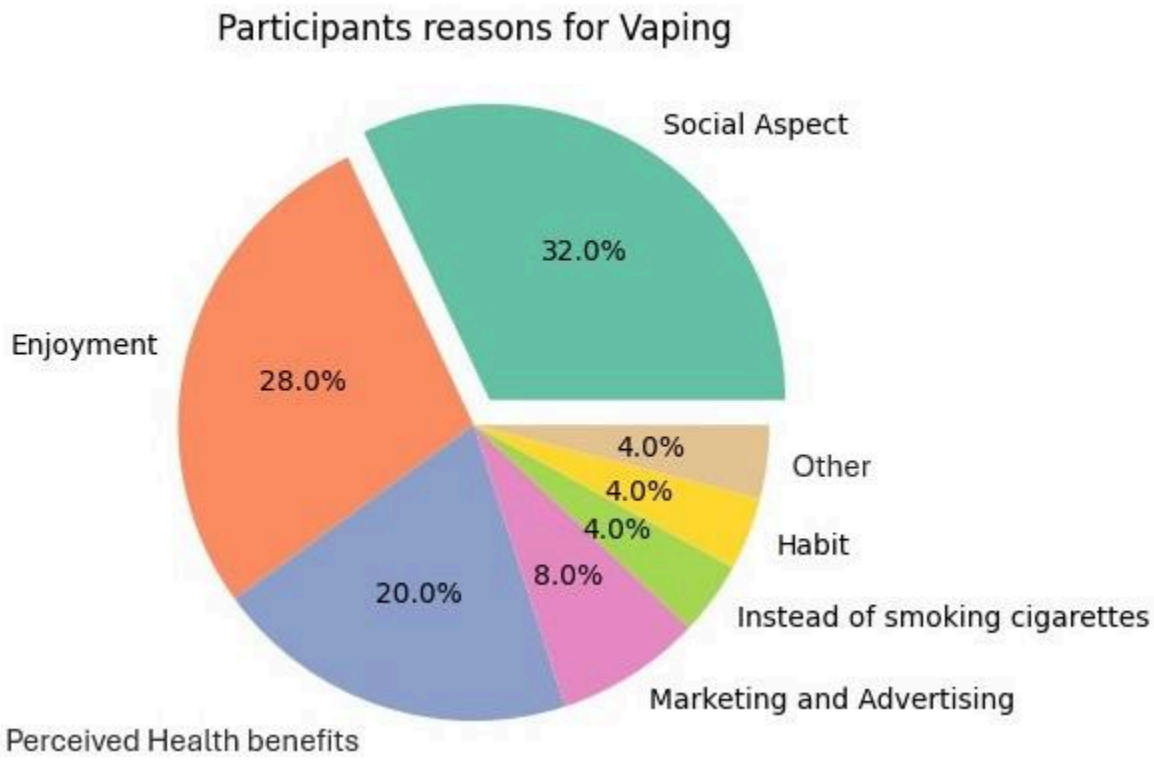


Fig 2.4: This graph shows the distribution of participants reasons for vaping

The bar chart below, in fig 2.5, details the vaping status of participants according to their current employment status, with categories including not employed, full-time, part-time and self-employed. The analysis of the data indicates that individuals who are not employed have the highest number of respondents who answered they do not vape, whereas the self-employed category shows a slightly higher count of vapers than no-vapers. The part-time category has the lowest representation among the data, showing fewer participants overall, and among them, non-vapers slightly outnumber vapers. Viewing the graph from a ground theory perspective, the distribution suggests a potential correlation between employment status and vaping habits, this invites for a deeper understanding into how occupational environments and work-related stress or culture may impact the decision to vape. In addition, using grounded theory, distinct

differences between each employment status group could reflect varying lifestyle choices, socio-economic status, or availability of leisure time, each of which might influence the choice to partake in vaping.

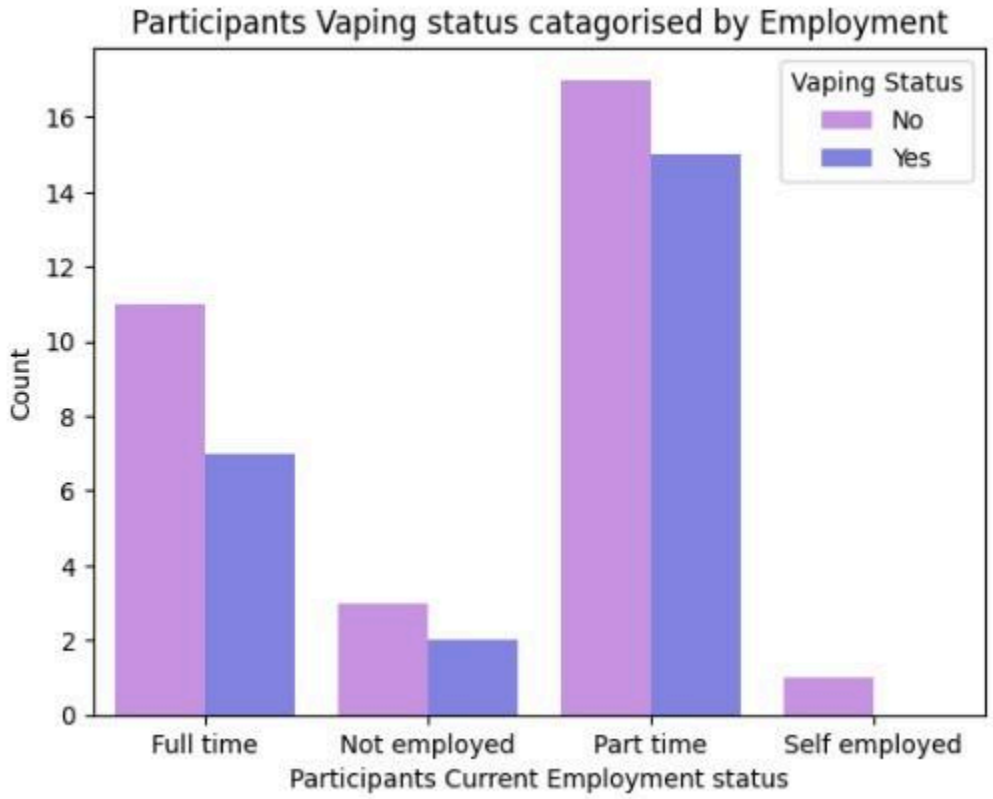


Fig 2.5: This graph shows the distribution of participants current employment status

Text-analysis

To enhance the comprehension of vaping within societal contexts, the survey included open-ended questions where participants could provide text-based responses. This qualitative method was employed to offer richer, more detailed data to inform the research question. As part of this project questionnaire to gather qualitative data from participants', questions below were employed:

9. Does the packaging and extensive flavours attract you?
10. Have you any concerns about the potential impact vaping has for your health?
11. Do you think the full effect of vaping is known to researchers?
12. What are your thoughts about vaping?

The word cloud, present below in Pic 2.6, clearly outlines a textual analysis of response of question 9 in the project's questionnaire. The word cloud shows the prominence of ‘flavours’ in bold and central of the image, indicating it as a primary factor mentioned in participants' responses. Adjectives such as ‘sweet’,’new’ and ‘extensive’ suggest that the variety and novelty of flavours are significant attributes that participants associate with vaping. Words like ‘attract’ and ‘choice’ are indicative of the appeal these flavours have and the preference users might have for selecting vaping products. The presence of ‘released’ could be viewed at participants discussing new vaping products entering the market. Meanwhile, smaller terms such as ‘taste’ and ‘smell’ point to sensory experiences importance to users. The overall analysis suggests that the sensory experience provided by the wide range of flavours is a key aspect of vaping’s appeal, as according to the participants viewpoints captured in the questionnaire. Additionally, analysing question 10, outlined above, participants were very concerned about their health which led to the creation of the health page on the web page created for this project.

Pic 2.6: This visualisation is a world cloud of key terms extracted from the questionnaire question : Does the packaging and extensive flavours attract you?

From textually analysing the questionnaire data accumulated on question 11 of the survey, 92% of participants didn't think the full effect of vaping is known to researchers. An interesting finding from question 11 was that a minority of respondents believed information was known to researchers but had not yet been disclosed, suggesting that the financial benefits accruing to corporations and governments from the increased prevalence of vaping might be influencing the publication of such data. Additionally, analysing question 12 of the questionnaire, shown below in Pic 2.7, shows central terms found from participants' responses including central terms like 'bad', 'habit','deadly' and 'dangerous', this suggests the predominant negative perception of vaping among respondents. The presence of words such as 'quit', 'disgusting' and 'addictive' further emphasises the challenges and negative attitudes associated with cessation and the addictive nature of vaping.

Pic 2.7: This visualisation is a world cloud of key terms extracted from the questionnaire question : What are your thoughts about vaping?

Overall Artefact

The overall artefact, structured as a website, serves to analyse the societal effects of vaping, presenting users with informative graphs from field research undertaken as part of the project

and the critical insights derived from the analytics. The uniqueness of this artefact lies in its function as a singular repository for analytics and educational content for users on significant findings obtained from the analysis. The specific methodologies and data interpretation is clearly outlined in this section of the report, through using data visualisations created with Python, Pandas, Seaborn and Matplotlib as well as a grounded theory approach to gather and analyse the data in great depth.

From a user experience perspective, the design and functionality of the website has room for improvement. The manual coding approach posed challenges in achieving a responsive design that adapts seamlessly across various computer interfaces. Additionally, the website's incompatibility with mobile devices represents a limitation to the user experience, restricting accessibility and convenience for users on smartphones. The implication of the project's findings can be used by stakeholders such as educators, policymakers and health professionals to create vital public health policies and investment for future research. Potential improvements for the website created for the digital artefact of this project could include regularly updating the content with fresh research to ensure the information remains current. Furthermore, conducting an annual questionnaire would allow for a consistent comparison and analysis of trends over time. Lastly, exploring partnerships with educational institutions or public health organisations could extend the utility of the artefact, transforming the webpage into a dynamic tool for both education and advocacy for vaping and public health.

Conclusion

In conclusion, this project and report has successfully explored the societal impact of vaping through robust digital analysis, integrating both quantitative and qualitative data to provide in-depth impactful insights. Utilising a range of advanced tools, from Google Forms for questionnaire distribution to Python and its Pandas, Matplotlib and Seaborn libraries for data analysis, this project set a high standard in terms of methodology and technical execution. The incorporation of hand-coded HTML and CSS web-page facilitated a tailored and secure web experience, which was essential for presenting the gathered data effectively and engagingly. The choice of HTML and CSS provided flexibility and full control over the design and functionality of this project's website; it was also a more secure and cost-effective solution compared to content management systems.

However, if more time had been available, further enhancements would have been made to broaden the scope and depth of research for this project. For example, expanding the demographic range of questionnaire participants could have provided a more diverse set of data, which ultimately would have offered a wider perspective on the varying impacts of vaping across different societal groups. Also, integrating more interactive elements and real-time data feeds into the website could have made the digital artefact even more dynamic and informative, this could have been included using JavaScript for coding the graphs to allow them to be interactive to the users. Moreover, translating this website into different languages would significantly broaden its accessibility, allowing non- English speakers to benefit from the valuable insights and educational content provided, this would thereby enhance the project's global reach and impact. This would be important as the vaping epidemic is escalating globally across diverse nations, therefore individuals worldwide would greatly benefit from accessing this information.

There are several avenues for future work to build upon the foundations laid by this project. Conducting annual updates and surveys would allow for the tracking of trends over time, providing ongoing insights into how attitudes and behaviours related to vaping evolve. Furthermore, leveraging newer web technologies and frameworks could enhance the website's

responsiveness and mobile compatibility, in order to reach a broader audience. Collaborations with health organisations and educational institutions could extend the impact of the research, turning the website into a central resource for public health advocacy and education.

Ultimately, while this project has achieved significant outcomes in analysing and presenting the societal effects of vaping, the continual evolution of digital tools and analytical methods present an ongoing opportunity to refine and expand this important work. This project undertook an approach with ethical and technical proficiency which contributed to valuable insights to public health discussions which were enhanced by the use of tools and skills acquired in the digital humanities and information technology degree undertaken. This project's foundation will undoubtedly facilitate further studies and intervention aimed at understanding and mitigating the impact of vaping on society as technology evolves.

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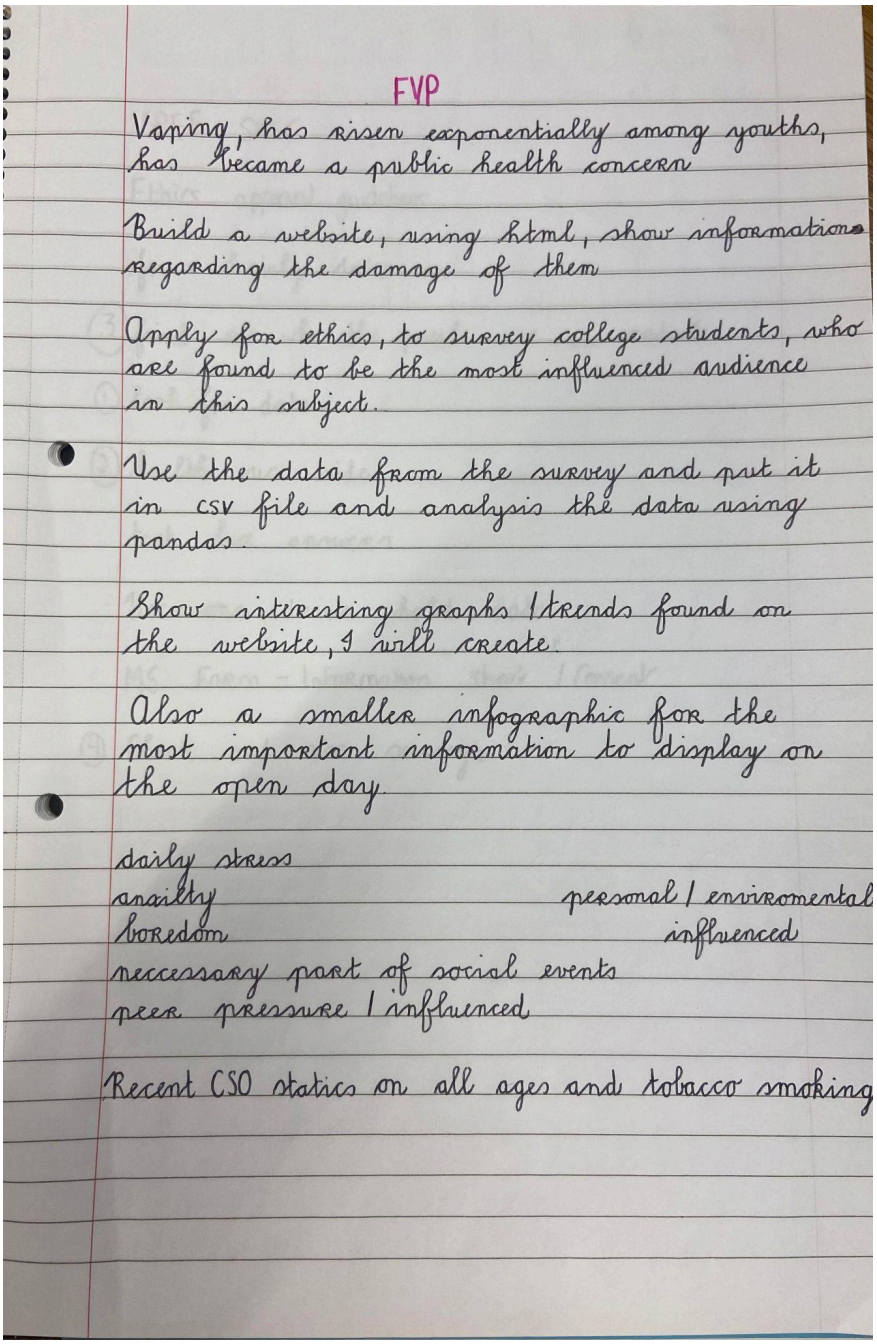
Appendix

[FYP2024 - 120370981 - ethics approval application.docx]



FYP

Vaping, has risen exponentially among youths, has became a public health concern

Build a website, using html, show information regarding the damage of them

Apply for ethics, to survey college students, who are found to be the most influenced audience in this subject.

Use the data from the survey and put it in csv file and analysis the data using pandas.

Show interesting graphs / trends found on the website, I will create.

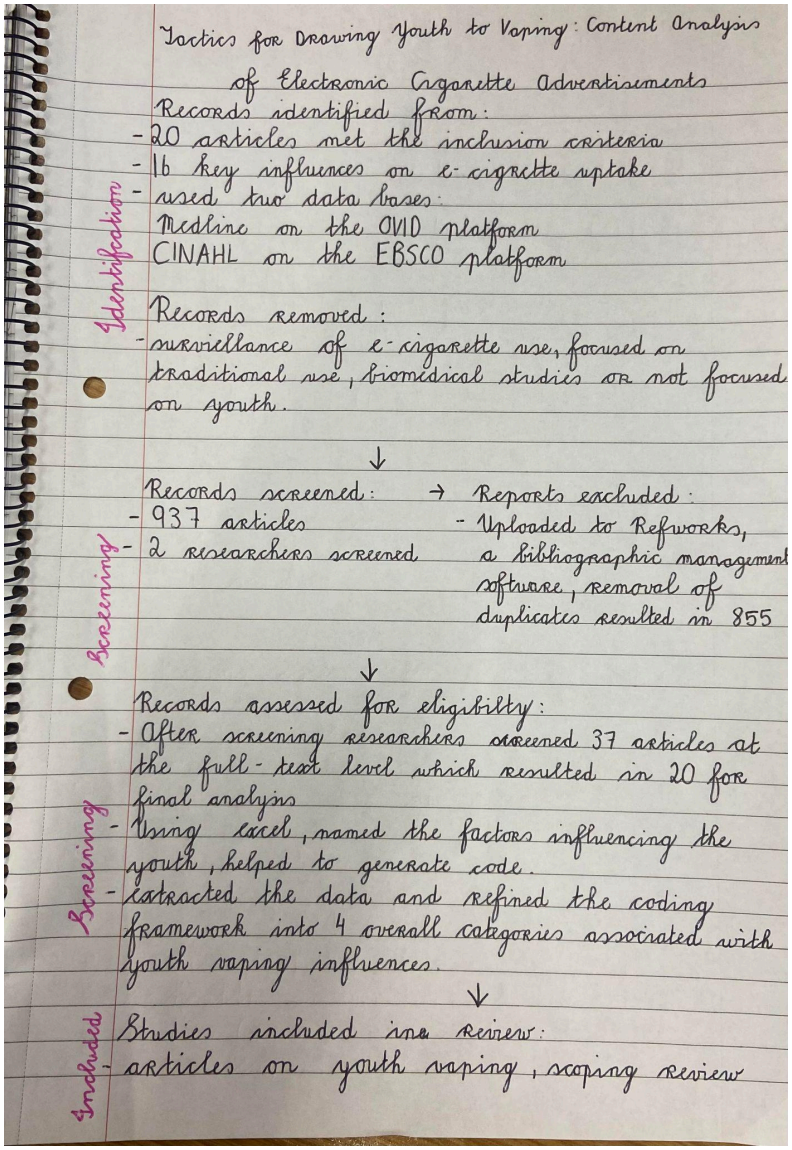
Also a smaller infographic for the most important information to display on the open day.

daily stress
anxiety
boredom
neccessary part of social events
peer pressure / influenced

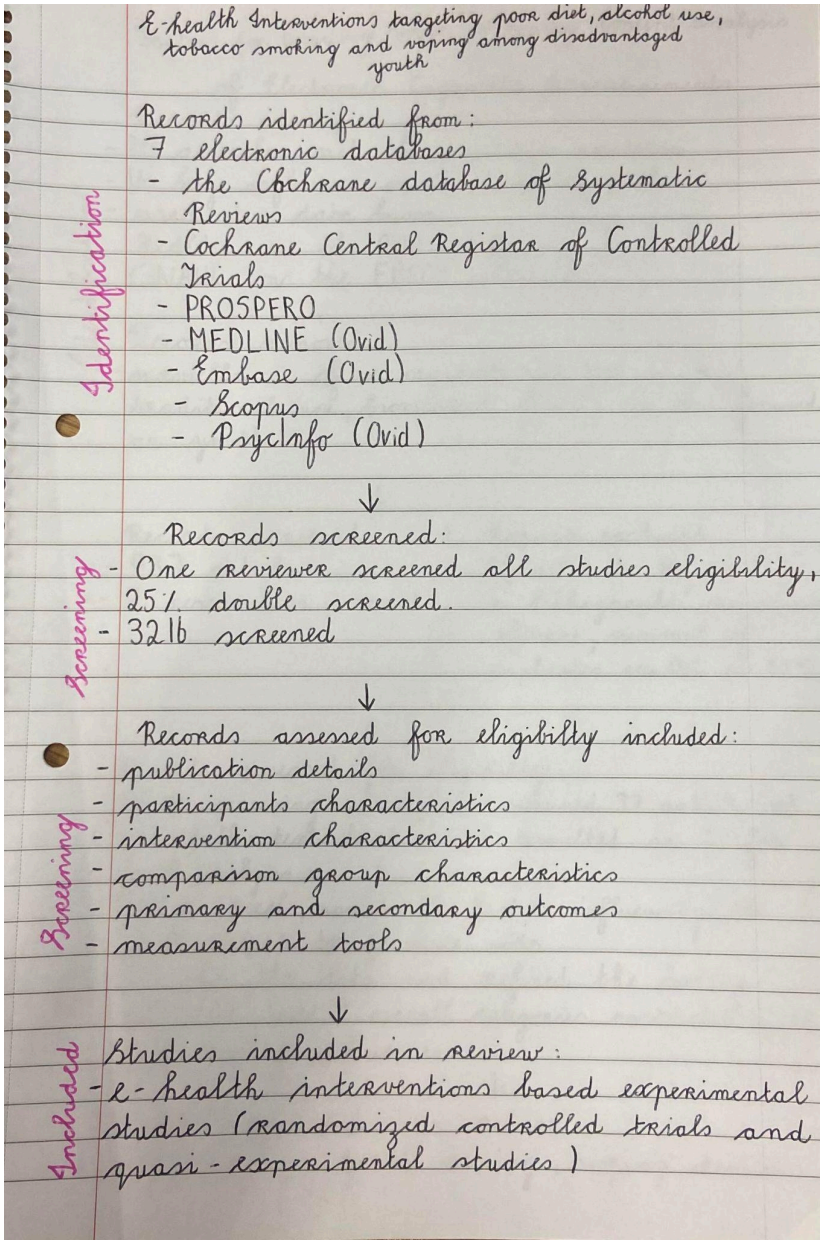
personal / environmental influenced

Recent CSO statics on all ages and tobacco smoking

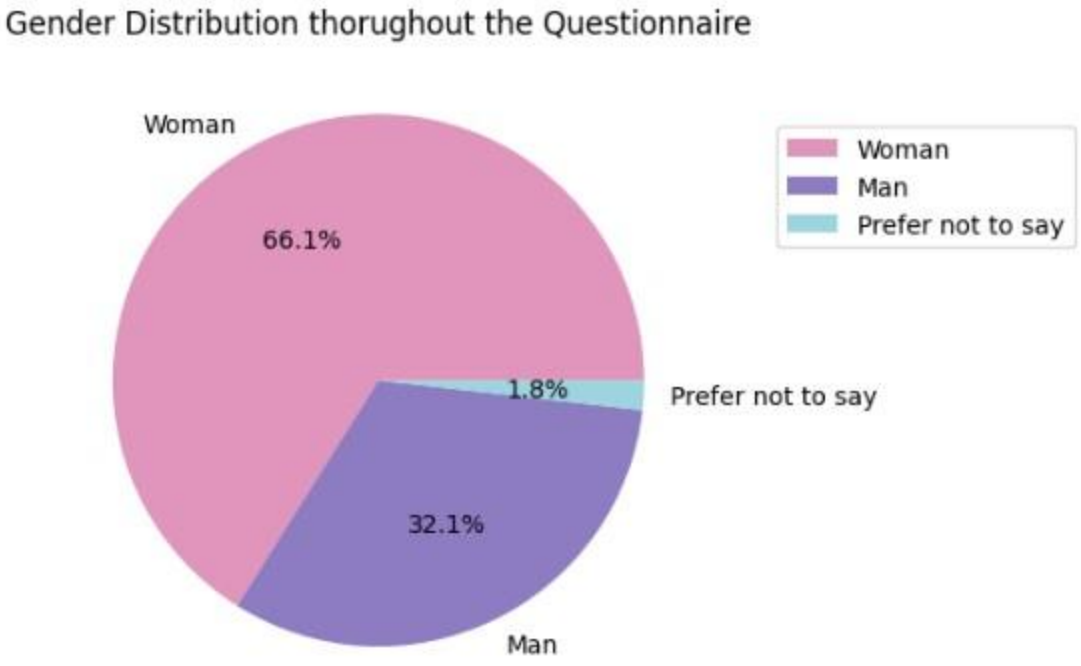
Initial brainstorming undertaken for a FYP topic



Prism Flow Diagram created



Prism Flow Diagram created


Gender Distribution thorughout the Questionnaire
Woman
66.1%
1.8%
Prefer not to say
32.1%
Man
Woman
Man
Prefer not to say