Algorithmic Awareness Among Computing Science Students: Exploring Perspectives on Responsible Design and Use of Social Media

by

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Abstract

Computational literacy and awareness have emerged as significant public and academic concerns. Implementing robust algorithm systems on social communication platforms may have positive and negative consequences on all age groups in society, particularly on the most frequent users, young adults. While more research, education, and policy work on algorithmic implications are urgently needed, this study focused on identifying patterns of awareness about the issue among computing science students, a unique group of individuals who are both young adult consumers and future designers of the system. It specifically investigated how their awareness might impact their behavior in ways that lead to more positive outcomes when utilizing social media. It also investigated how they perceive recent education and training patterns regarding responsible algorithm design while learning to design such platforms. It gathered a significant dataset from relevant literature reviews and qualitative interviews, analyzed it with a qualitative data analysis approach, and tested the findings against various sociological theories and practices. Most of the young adults interviewed are aware of the effects of algorithms and tend not to use social media actively to avoid its harmful effects. However, they argue that the institutions and agencies responsible for the platforms' existence must do their part to address the issue. The process begins with educational institutions developing curricula for computing science programs to ensure that when those students learn to design algorithms, they learn to do it responsibly, and for all other students to raise algorithmic awareness, followed by employers acting under their social obligations, and, most importantly, the government intervening by enacting rules and regulations to make the changes happen.

Keywords: algorithms, awareness, young adults, social media, responsible design.

Preface

This thesis is an original work by Md Oliullah Al Mizan. No part of this thesis has been previously published. This research received ethics approval from the University of Alberta Research Ethics Board; Project Name "Algorithmic awareness among computing science students: Exploring perspectives on responsible design and use of social media" No. Pro00117460, March 9, 2022.

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1. Introduction

Users of social media experience both positive and negative consequences. Any restraint on social media platforms contradicts the value of online freedom (Gillespie (2018, P. 47). Developing such social communication platforms as for-profit companies is to leverage users' psychological and cognitive vulnerabilities to maximize time spent on the platform. (Andersson, 2018; Bosker, 2016; Harris, 2016; Oulasvirta, Rattenbury, Ma, & Raita, 2012; Salehan & Negahban, 2013 as cited in Literat & Brough, 2019). To illustrate a clear vision of what the researcher mean by the harmful effect of social media, an example by Crouse (2021) may be presented that illustrating how the recommendation algorithm is creating mental as well as physical health hazards for a girl instead of helping her who was simply pursuing content to get help losing weight to be healthy.

> Say you're a 23-year-old girl who is beginning to feel anxious about her appearance and has followed some diet influencers online. Instagram's algorithm might suggest more extreme dieting accounts with names such as "Eternally starved," "I have to be thin," and "I want to be perfect." In an interview with "60 Minutes," Ms. Haugen called this "tragic" that "as these young women begin to consume this eating disorder content, they get more and more depressed," she said. "It actually makes them use the app more. And so they end up in this feedback cycle where they hate their bodies more and more. (Para. 3)

However, to be successful self-regulating organizations (SRO), social media companies will need a high level of organizational transparency and accountability, as well as trade-offs between competing values of various industry stakeholders such as consumers, government

representatives, small tech companies, civil society organizations, and advocacy groups (Hemphill, 2019).

1.1 Purpose of this study

Humans are generally born with an equal capacity to learn how to be creative and progressive in life (Robinson et al., 2009). However, persons exposed to harmful, violative, and emotionally charged content are more likely to adopt those traits through individual socialization, defined as "a process of learning to participate in social life" (Mortimer et al., 1978, p.422). Because such forms of social communication and engagement are increasingly occurring on digital social media platforms, while these platforms provide tremendous opportunities for growth, they also pose significant risks due to the "substantial degree of self-socialization" (Arnett, 1995). Nonetheless, those aged 20 to 29 are the most frequent social media users worldwide (Kemp, 2022), and thus young adults may be the most vulnerable, as this is also an important time for them to graduate and focus on their careers.

The researcher's prior experience working at the IDA-World Bank-funded Bangladesh Research and Education Network (BdREN) had a big impact on his interest in this subject. BdREN has been facilitating internet connection by deploying DWDM (Dense Wavelength Division Multiplexing) based transmission network over 3000 KM of OPGW (Optical Ground Wire) and connected 34 public universities with 1Gbps end-to-end data connectivity (BdREN, 2020) so that the students and instructors connect, collaborate and innovate. However, despite six years of massive bandwidth consumption, primarily for social media, Bangladesh remains at the bottom of the Global Innovation Index (2021) report, just as it did six years ago when Bangladesh lacked any research and education network infrastructure. Since beginning to work for BdREN, the researcher has been intrigued by the question of whether social media algorithms

are distracting young adult university students from doing research and innovative work in order to keep them on those platforms.

When current literature discusses how young adults are affected while participating in online social life, it lacks insights into the pattern of their awareness that may allow them to do it responsibly. As a result, the broad objective of this research is to determine how aware the young adult users are and to what extent that awareness allows them to change their usage behavior, resulting in more positive outcomes. However, average young adult users were not expected to be algorithmic aware at the time of this research. Thus, this study focused on a specific group of people, computing science students who are algorithmic aware and also fall into the young adult age bracket, as well as both consumers and future producers of the system. As a result, exploring their perspective from the dual roles of consumer and future designer yields some intriguing insights. Furthermore, this unique group makes it easier for this study to investigate how such awareness might lead computing science students to evaluate the training and education they received on the responsible design of algorithms.

It will be a significant study because, even if users believe they are simply having fun on social media, interacting with such amusing things may impact their growth positively or negatively. Many sociologists, including Cooley (1902), claim that any form of social interaction impacts personal and economic growth. Since education and awareness may help solve social problems, the findings of the study may aid in determining whether curriculum inclusion of algorithmic awareness education for all students and responsible design education and training for students who wish to design it once they enter the workforce could solve the problem.

1.2 Preview of the Related Literature

A large body of literature reveals several factors attributing various positive and negative effects to social media platforms. The role of algorithms was the most effective for those

outcomes. However, most of the literature highlighted broader critiques of platform design that affect average users today, with only a few focusing on young adult users. Ronald J. Deibert (2020), a technology and security expert, investigates the scope and magnitude of social media's personal, social, political, financial, and ecological effects. Zuboff (2019) describes that none of these (business & tech) companies care about proper user engagement in their development; they only care about how they can maximize their profit by using users' information against them. Srnicek (2016) also identifies platforms as the new business model.

Van Dijck (2013) depicts social media platforms as six distinct microsystems that, when combined, form an ecosystem of "connective media," explaining the newly emerging platform society and their culture of connectivity. Gillespie (2014) emphasized the importance of algorithms and the public relevance of analyzing them to understand them. He also examines community guidelines and the issue of using AI and machine learning for moderation (Gillespie, 2018). A recent study in Canada also revealed that inadequate awareness of AI and algorithms contributes to exclusion from online spaces, discrimination enabled by technology, exposure to harmful content, and various privacy risks (Brisson-Boivin et al., 2021).

While almost all these studies focus on how platforms are designed to achieve their goals, only a few characterize the pattern of awareness among young adult social media users and the level of understanding with which they evaluate algorithm design techniques regarding responsibility issues. Bucher (2017), however, depicts spaces where people and algorithms collide and situations where people become aware of algorithms. She also demonstrates how users ultimately experience and make sense of these algorithms and how that awareness of algorithms affects the experience of using these platforms.

Although this study does not delve into the code of conduct for algorithmic design, transparency is the most important meaning of "responsible design" for this study: specifically,

not hiding the engagement component so that users have choices while engaging. The idea of transparency may elevate user awareness and designer responsibilities. Additionally, it also encompasses social responsibilities in "contexts of care [for users], nurture [for positive connection], and help [to develop] ensuring social welfare" (Hagendorff, 2019, p.4). Even though "codes of ethics (and laws and other regulations) are frequently developed in response to disasters or scandals," this study investigates how visible the effects of social media are to users, which may allow users to avoid harmful effects and encourage designers to develop it under society's moral standards and guiding ideals (Boddington, 2017, p. 49).

1.3 Preview of Research Design and Methodology

This study uses a qualitative approach to explore whether those platforms' users (as well as the prospective designers) are aware of those impacts. This study, however, does not focus on algorithm designers currently working in a professional setting but rather on individuals who are trained in computing science and could be expected to have higher levels of awareness and understanding of the role of algorithms in social media platforms. The primary justification for selecting this demographic for this study is the desire to understand young adults' current social media experiences and awareness. As a result, using purposive sampling techniques and network connections made with computing science students at the University of Alberta, it was hoped to recruit at least fifteen volunteers for the study who could be expected to have a heightened sense of algorithmic awareness and can envision themselves in the designers' position. The researcher carefully guided a conversational partner in an extended discussion to conduct a semi-structured in-depth qualitative interview (Rubin and Rubin, 2005: p.4). It then analyses the finding using the qualitative content analysis technique.

1.4 Summary and Introduction of Research Questions

It is impossible to advise young adults to stop utilizing social media platforms to avoid the consequences of algorithmic implications, as society is already shaped by those technologies (Mauthner & Kazimierczak, 2018). They require those incredible communication platforms for more information, connectivity, and productivity; however, it is necessary to research how the harmful effects could be reduced or eliminated. This section describes how the Research Question (RQ) started and was updated throughout the study to explore their awareness and to what extent that awareness can assist them in thinking critically, making social media usage more beneficial.

The study first seeks to understand how young adults experience both positive and negative consequences on social media and how aware they are of the algorithmic implications on the platforms. In order to do so, the following two questions were formed:

Provisional research question 1 (PRQ1): How are algorithms implicated in the meaningful and harmful effects of social media consumption among young adults?

Provisional research question 2 (PRQ2): How do young adults perceive and understand the role of Algorithms in their social media consumption?

First, this research conducted a comprehensive literature review on PRQ1 and PRQ2 and discovered numerous literary works on how algorithms are used to manipulate average users, which addresses PRQ1. However, the systematic search did not yield a complete answer about PRQ2 in the existing literature; specifically, how do the most frequent young adult users understand social media algorithms, allowing them to use those platforms wisely? Thus, interviews were required to find the answers. It used the following research questions to do so:

RQ1: How do young adults with training in computing science perceive and understand the role of Algorithms in their social media consumption, and to what extent that awareness changes their users' behavior?

RQ2: How do young adults with training in computing science evaluate the responsible design aspects and the training and education offered to prepare them to design algorithms responsibly?

It also pursued the third question in order to make the research more significant:

RQ3: What are the views and recommendations of computing science students regarding responsibilities to solve any emerging problem and make algorithmic systems better aligned with human development?

The study's findings help to understand how algorithmic awareness may enable people to use the platforms more effectively and responsibly, reducing harmful effects. The outcome also included valuable recommendations on how everyone could contribute to solving the emerging problem and what power could help speed up the entire process.

2. Literature Review

Social media users confront both beneficial and detrimental effects. While the platforms have substantially improved connectivity prospects, they have also been a tool for disseminating misinformation contaminating public discourse and widespread surveillance of populations (Deibert, 2020). However, several factors might impact how individual users behave on social media, but algorithms are of particular importance in this study. The social impact of algorithms is highly crucial since individuals are wired to seek social validation and status, and the bulk of decisions are made by algorithms when they anticipate them. Therefore, the users spend an unhealthy amount of time looking at their devices, "socializing," yet living in solitude and disconnected from nature (Deibert, 2020).

This chapter begins with an overview of the most relevant literature for this study, followed by a description of the strategic literature search methodology. Then it presents the results of the literature review by first exploring the body of literature on the general effects of social media on young adults, followed by various thoughts on its design and effects, with a

particular emphasis on the social shaping of technology as a general conceptual framework. Finally, it intends to focus more on the roles of algorithms, awareness, and responsibility concerns in social media design. Findings are analyzed at the end to determine the context and necessity of this research, which includes a synopsis of critical issues discovered and gaps in the literature to examine and assess the current state of the field critically and to inform the research question and design for this study.

2.1 Overview of the Field of Study

In recent years, a growing number of studies have been conducted looking at the effects of social media. This research, however, is an interdisciplinary study that draws on literature from several fields, including computing science, sociology, and psychology. It focuses on the emerging problem of using algorithms in platform design and its awareness and responsibility concerns. This study first aims to identify the larger area of social media's meaningful effects on young adults. Then it traces the harmful effects of platform design on that age group and different thoughts as conceptual frameworks. Finally, it concentrates on how algorithms are used in that design to influence young adults' social media consumption and how aware those users are regarding the issue.

While exploring how algorithms are linked to both positive and negative effects of social media consumption among young adults and how the age group perceives and understands the role of algorithms reveals a significant gap in the literature, which assists in establishing the purpose and context for this research.

2.1.1 Literature Search Methods

Multiple disciplinary searches have been approached (Booth, Papaioannou & Sutton, 2016), considering that the perspective of this research is not only computing science-based but also sociological. Based on Pew Research Findings (Greenwood, Perrin & Duggan, 2016), the

major social media sites were determined to be Facebook, Instagram, Pinterest, LinkedIn, and Twitter, the top five platforms utilized by Americans. In Canada, 69% of people use social media platforms such as Facebook, and 63% use video-sharing websites such as Snapchat, Instagram, YouTube, and Pinterest, whereas only 23% and 22%, respectively, use (micro-)blogging sites including Twitter, Tumblr, and WordPress, and business networks such as LinkedIn (Kunst, 2022). Therefore, this study focuses on social media and video-sharing platforms that are mostly used by Canadians.

Context-Specific, as well as essential alternatives of keywords and terms were searched in two schemes. Firstly, to establish the research context, whether algorithmic social media design has any meaningful or harmful impact on young adults or not, a range of categorized keywords such as 'social media or social media algorithms,' 'meaningful effect or positive effect or benefits,' 'harmful effect or negative effects or bad effects and 'young adults or youths' were searched in different combination putting one keyword from each category. Secondly, keywords, including 'algorithms or role of algorithms,' 'social media or social media design,' and 'awareness of young adults or youth,' were used to find how young adults view and comprehend algorithms' function in their social media consumption.

This search also examined and identified additional relevant articles from the reference lists of the articles found in the database. The EBSCO database and Google Scholar were used for this study through the University of Alberta Libraries during this literature search process. Google Scholar alerts were also set up with essential search phrases to keep up with any new information discovered after the initial search.

2.1.2 Eligibility Criteria

Since social media only began to become extensively utilized and popular in the last ten years, most of the literature evaluated was from the last seven to ten years, with some earlier

supporting concepts serving to establish the framework. Peer-reviewed publications and a strong citation track record were preferred. Only sources of gray literature that provide a glimpse of the policy literature and relevant government records were considered. Regarding origin, nation, and cultural setting, Canadians and those from North America, Australia, or Western Europe were considered.

2.1.3 Search Result.

Although a significant amount of pertinent literature was found through the systematic search, 96 articles were selected and imported to Zotero; 18 of them were meaningful effects, 32 of them were on the design and its harmful effects, and 46 of them were investigated to determine the function of algorithms in causing those impacts, as well as the pattern of awareness among young adults regarding the issue. Furthermore, developing summaries of each source relevant to the research assisted in identifying the most useful one. In the end, therefore, they were subsequently narrowed down to 51 articles using the eligibility criteria.

Finally, the literature was organized using the reference management tool Zotero. Most pertinent material was recorded and imported to manage the literature search. They were further organized by creating categories that included: meaningful effects, harmful effects, conceptual framework, and the role of algorithms. Any articles that did not fit into one of these categories were omitted.

2.2 Review of the Literature

2.2.1 Meaningful Effect of Social Media

Numerous research studies suggest social media can benefit average users substantially. Since the goal of this study is not to find previously published literature on general consumers, this section explores the platforms' different benefits for young adults. The search result, however, was substantial; only the most significant one is highlighted here as an example of how it can facilitate many opportunities for young adults. Thus, it focuses on previous research on

how it has become a popular means of connectivity, information, and resources for that age bracket (Khatoon, 2015; Kim, 2016). In addition, it also investigates literary works on informed media literacy as emotional support for young adults (Ozcinar & Tanyer, 2016; Wolfowicz et al., 2021).

The most significant literature for this study on the meaningful effect of social media on young adults is a wide range of instant, meaningful resources for information and connectivity. Kim (2016) investigated the effects of digital media use on college students' social engagement and discovered that students' social belonging was positively related to this communication, which may facilitate their broader social engagement. Meier and Schafer (2018) discovered that social comparisons on Instagram result in positive motivation, which can be beneficial even when mediated by jealousy.

Several other studies also suggest that social media offers young adult users the powerful feeling of being socially connected with a broader spectrum of individuals. In addition, knowing how to interact quickly provides them with emotional support. Ozcinar and Tanyer's (2016) work, for instance, suggests that media literacy allows children and youths to develop their skills. Their research also revealed that "censorship is less supported among the students who spend more time on the internet and who have high media literacy levels" (Ozcinar & Tanyeri, 2016, p.167). On the other hand, Talpur and O'Sullivan (2020) developed a supervised machine learning system for cyberbullying detection, and the results show that the proposed framework is a viable solution for detecting cyberbullying behavior and severity in online social networks.

These study findings, taken as examples from several studies conducted to identify the beneficial impacts of social media, show that social media platforms promote and lead to excellent results and may undoubtedly positively impact young adults' personal and socio-

economic development. However, it is also possible that it has a lot of detrimental impacts, which will be reviewed in the following sections.

2.2.2 Harmful Effect of Social Media

Despite exploring the studies on those positive effects, this research also searches for the studies that look at the harmful effects of social media and found a range of literature on different vital issues, including the health of adolescents and youths, both psychological and physical, self-objectification and envy, poor academic and self-development, and finally the advertisement issues. Although numerous studies highlight the pattern of capitalizing on users' psychological and cognitive weaknesses (Andersson, 2018; Bosker, 2016; Harris, 2016; Oulasvirta, Rattenbury, Ma, & Raita, 2012; Salehan & Negahban, 2013, as cited in Literat & Brough, 2019), this part of the literature review only contains the findings that focus on young adults' online experiences.

Numerous studies have been undertaken to determine the negative impact of social media on the health of adolescents and youths. In that body of literature, psychological issues were frequently examined. One most remarkable study on a representative sample of 1033 German Internet users (14–20 years) found that a higher rate of online sexual victimization experiences was linked to a "sexy" self-presentation, which in turn was linked to increased loneliness, decreased life satisfaction, and worse mental health (Festl et al., 2019). Several studies also draw the relationships between screen timing, mental health issues, behavioral problems, academic performance, sleep habits, and peer relationships.

The most significant studies in this context found that extra screen time is reasonably related to worse mental health issues causing increased behavioral problems, poor academic performance, and sleep deprivation, but it helps better peer relationships (Paulich et al., 2021; Liu et al., 2020). The study by Paulich et al. (2021) conducted a series of correlation and regression analyses. However, the study by Liu et al. (2020) measured it by self-reporting and subject tests

in Chinese adolescents. The article by Gangneux (2019), however, asserts that, while young adults managed social media platforms on an individual level (via "tactics"), their understandings and negotiations of the platforms were significantly shaped by the platforms' designs and features, and "embedded within the asymmetrical power relations of platform capitalism" (p.01).

Several other studies look at the impact of self-objectification on social media platforms in the context of young people's social connections. Rollero (2016) finds that internalization of media norms is linked to increasing self-objectification, which is associated with authenticity and eventually leads to self-alienation and reliance on others' domination. One study discovered that women who took and shared photos on social media felt more anxious, less confident, and less physically attractive afterward than those in the control group (Mills et al., 2018). Another study by Barron (2021) discovered a link between viewing idealized (envious) images on social media and body dissatisfaction: the more social media algorithms promote those contents to get young people's attention and keep them scrolling, the more vulnerable their behavior becomes in terms of social norms, values, and consumption. A study conducted by Livingston (2020) on this account concludes that even self-disclaimers are ineffective at protecting young women from the possibly detrimental impacts of unrealistic appearances on digital social media. However, the young are more vulnerable to such exposures since, according to Mujcic and Oswald (2018), levels of envy decrease as people grow older from an early age.

The responsibilities of business entities in terms of engagement with various stakeholders while advertising have received significant attention in the expanding corpus of academic work on social media. For example, one significant study by Montgomery (2015) found Facebook's marketing and data collection practices, in particular, more aggressive. Moreover, the research focused on youths, who are more susceptible to this manipulation. The whistleblower of Facebook's marketing strategies through tracking and collecting user's personal and behavioral

information, for instance, suggests that these "targeting operations are especially attuned to key aspects of adolescent development, both tapping into young people's needs and taking advantage of their unique vulnerabilities" (Montgomery, 2015, p.771).

Although many of the findings (Schmuck, 2020; Paulich et al., 2021) suggest that adolescents should be advised to limit screen time in order to reduce its adverse effects on sleep, mental health, and academic performance, none of them, however, address the pattern of their awareness of the problem.

2.2.3 Conceptual Framework

The section will specifically focus on the design of social media platforms exploring independent conceptual frameworks found admissible in the context of social media design. Then, it will link those together to establish the final framework for this study. This review already found evidence that despite having numerous positive effects, social media also has some harmful effects, which increases the curiosity to know how Technology and society shape each other and how these scenarios could be described to draw an understanding. The four conceptual approaches by Mauthner and Kazimierczak (2018) and the discussion of "social shaping of technology" (SST) by MacKenzie and Wajcman (1985) illustrate important accounts to address the core of this study.

MacKenzie and Wajcman (1985) invented the SST concept in their 1985 edited collection, The Social Shaping of Technology: How the "Refrigerator Got Its Hum." They noticed that Social scientists have traditionally focused on the "effects" of Technology, specifically the "impact" of technological change on society. The concern is valid, but it leaves a previous, possibly more critical, question unasked and thus unanswered. What factors have shaped the Technology that has "effects" on people? What has caused and continues to cause the technological changes whose "impact" we are witnessing?

Technology is not neutral; it is shaped by society's dominant social, political, and economic ideals, and changes in values lead to different technological outcomes, and in turn, social science considerations can be used to shape technologies (Kidd, 2012, pp. 509-522). Technologies have pervaded contemporary society and become integral to corporate organizations and social institutions to inform governance processes and animate the mundane technologies of daily life. For example, it shows users advertisements, news, and other content based on the personal information they collect from them.

Mauthner and Kazimierczak (2018) brought four conceptual approaches together to understand the relationship between Technology and society. First, Technological Determinism (TD) addresses the existing materials that shape society. These changes, however, come whether the social beings welcome them or not. It is the "autonomous force or entity independent of social process" (Mauthner & Kazimierczak, 2018, p. 22). Smartphones, for instance, steamroll many aspects of young adults' daily activities. The second conceptual approach they depicted is social constructivism, also known as Social Construction of Technology (SCOT), the opposite of technological determinism, where Technology becomes a social process. Bijker (2015) evaluated SCOT as "a theory about the relationship between society and technology" utilized to "study the technical change in society" (p. 135). SCOT developed as a criticism of technological determinism, and whereas TD focuses on Technology as the agent of change, SCOT focuses on stakeholders as agents of change. To oversimplify both arguments, TD takes structure as its starting point and SCOT takes agency as its starting point.

However, when it is commonly agreed that Technology and society shape each other, then comes the implication of the most important one of the four, the Actor-Network Theory (ANT), where networks of human and nonhuman actors shape outcomes. It helps to understand how Technology and society combine independently and create a balance between the offer of

Technology and its usage. Moreover, ANT focuses on the relationship between human and nonhuman actors and uses the metaphor of the "network" as a structure that shapes agency and vice-versa.

The majority of the study results summarize that those invisible codes collect and filter information for users. As a result, their worldview becomes narrowed and molded by those decisions, and this adverse effect is becoming unavoidable as it shapes today's society. Willson (2017) raises questions about understanding agency and power, altering worldviews, and our complex connection with Technology. Christian (2020) also demonstrated why and how the users invite those technologies to shape their surroundings, pointing out that today's "machine-learning" systems trained by data collected through algorithmic manipulation are so effective that we have invited them to see and hear for us and to make decisions on our behalf, nonetheless, he asserts that "the alarm bells are ringing" (p. 01). Finally, Zuboff (2019) claims, "there was a time when you [users] searched Google, but now Google searches you [users]" (p. 262).

Geib et al. (2021) state this regards that as it describes personalized information environments that filter out attitude-inconsistent and amplify attitude-consistent messages, leading to more extreme opinions and intensified opinion expression, the echo chamber metaphor has been omnipresent in the discourse about the societal and political effects of social media (p.675-677). Furthermore, the users' searches, clicks, likes, comments, and shares are generally tracked and fed into a system that determines what they see and do not see. Therefore, the intentional design of the platforms to engage and keep them engaged often uses tactics that are tapped into human cognitive weaknesses. The following discussion may make more sense of these design practices.

2.2.4 Role of Algorithms

The book by José Van Dijck (2013) serves as a milestone, perhaps even a paradigmatic work for future scholarly projects. Her frameworks help to make sense of that design policy and practices as she breaks down the platforms into six microsystems. The six microsystems – "Technology," "User and usage," "Content," "Ownership," "Governance," and "Business model" — as she described, constitute the socio-technical context for digital platforms (Van Dijck, 2013, p. 26). She contends that these six microsystems can be used to analyze platforms. She developed a theoretical framework to examine the culture of connectivity from the viewpoint of modern social sciences and from the possibility of disassembling individual microsystems and reassembling the entire ecosystem of the platforms, which aid in understanding how Technology reshapes society by negotiating sociality (Van Dijck, 2013). She also claims that 'every tweak in a platform sends ripples down the entire ecosystem' (p. 26). To put it more bluntly, she argues that 'making the web social' can be translated into 'making sociality technical' (p. 12). Van Dijck (2013) also explains it further from ethnocultural and socio-economic perspectives exemplifying the business model of iTunes: how it changed the system of selling music in the music industry by selling individual songs people like. The model offers users more flexibility because they can now purchase only the songs they like most instead of the recorded CD, which increases music sales but changes the consumers' musical taste and purchasing behavior.

Srnicek (2016) states, which also supports the thoughts of Van Dijck (2013) that platforms are essentially the new business model that emerged as an "efficient way to monopolize, extract, and analyze data" (p. 24). Thus, many new business models have been developed based on different theories and marketing strategies that evolve with the spread of that new digital social communication media. The existing businesses also become significantly dependent on it. Li et al. (2021) proposes a mobile social network influence model concerning multiple roles to examine a user's role in different contexts and found that information

dissemination is a new business strategy in e-commerce. The platforms, therefore, arose "as a means of organizing markets" (Mansell & Steinmueller, 2020, p.21).

Bucher has published extensively on algorithms. In particular, her article demonstrates that the traditional concept of friendship does not apply on social networking sites, where software increasingly aids users in making friendship decisions independent of who will and will not be their friends (Bucher, 2013). She also claims that "there is nothing to disconnect from in the digital world, and that the logic of machine learning provides the most obvious empirical case for this" (Bucher, 2020a, p. 01). She contends that there is a chance to reconsider the ethics of dis/connection more fruitfully (Bucher, 2020a). Her studies also pointed out that algorithms have a powerful effect on our imagination and how we use this. Thus, her work advances the idea of the algorithmic imaginary to comprehend the areas where humans and algorithms interact. She claims that the algorithmic imaginary - ways of thinking about what algorithms are, what they should be, and how they work - not only generates distinct moods and sensations but also plays a generative role in shaping the Facebook [social media] algorithm itself (Bucher, 2017, p. 30)".

Bucher (2020b) also claims that the concept of "right-time" provided in platforms such as Facebook's mission statement reflects not only the algorithmic workings of the platform but also a new temporal regime generated by an increasingly algorithmic media environment. In order to make a case for the existence of an "Eigenzeit" of algorithmic media, her study draws on social theory, media studies, rhetoric, as well as a variety of empirical materials like patent documents, media industry documents, and public discourse, and this argument is based on the traditional Greek concept of "kairos," which is understood as an appropriate time, timeliness, or even the "right-time." (Bucher, 2020b). Finally, she concluded that in order for individuals to comprehend their social power, it is essential that they examine how algorithms make them feel (Bucher, 2017).

Gillespie (2014) stresses that algorithms are essential as they "manage our interactions on social networking sites" (p.168). His works come early on helpful to understanding algorithms and draw attention to six political implications of public relevance algorithms:

1. Patterns of inclusion: decisions that decide what goes into an index, what is omitted, and how data is rendered.

2. Cycles of Anticipation: the ramifications of algorithm providers' attempts to properly know and foresee their consumers and how the conclusions they derive can matter.

3. The evaluation of relevance: the criteria by which algorithms assess what is relevant, how those criteria are disguised from humans, and how they execute political decisions regarding pertinent and valid information.

4. The promise of algorithmic objectivity: how the algorithm's technical nature is positioned as an assurance of impartiality and how that claim maintained the face of opposition.

5. Entanglement with practice: how people modify their behavior to fit the algorithm they rely on, how they can utilize algorithms as arenas for political conflict, and sometimes even how they might question the politics of the algorithms themselves.

6. The production of calculated publics: how the algorithmic presentation of publics back to themselves shapes a public's understanding of itself and who is best placed to gain from that knowledge. (p. 168)

This framework points to these six specific moments when the designers' vision shapes algorithms. Ultimately platform design decisions are made in those critical six moments to get them socially shaped. Thus, Bucher's (2020a, 2020b, 2017) works paved Gillespie's (2014) frameworks to help to understand how algorithms are socially shaped.

Deibert (2020) demonstrates that there are deliberate efforts to design social media platforms to keep users engaged so that misinformation, disinformation, and fake news may grow and thrive.

He refers to the system as "attention-seeking algorithms." He claims that since humans are naturally drawn to sensational, emotional, or conspiratorial content, the platform's algorithms select, prioritize, and propel that material forward by design. He also identified it as "roadblocks to effective reasoning and rational public discourse" and a "dark money-making venture" (Deibert, 2020, p. 135) and concluded that the once socially valuable and amusing platform has devolved into a sewer where authoritarian tactics may flourish unchecked. Finally, Deibert (2020) reveals social media's disproportionate effect on all aspects of life, from harm to society and humanity to the point that humans urgently need a complete transformation in their lives by significantly revising the culture, work, and politics that exist in their surroundings.

2.2.5 Algorithmic Awareness

MediaSmarts conducted focus groups with young Canadians aged 13 to 17 to learn more about how they perceive the relationships between artificial intelligence (AI), algorithms, privacy, and data protection where the participants played a game prototype created by MediaSmarts' education team, and a scaffolded learning experience allowed for in-depth discussion following each of the three gameplay phases (Brisson-Boivin et al., 2021). The study result indicates that while youth understand and appreciate the benefits of recommendation algorithms, they are concerned about algorithmic data collection and data sharing practises, indicating a need for more algorithmic literacy tools and resources to enable them with the knowledge they need to protect themselves and their data in digital spaces (Brisson-Boivin et al., 2021). Similarly, another study found that while some users may be oblivious to the role that algorithmic processes play in their lives, very few comprehend the fundamental operations of algorithmic platforms and the impact these platforms have on their lives from a critical and rhetorical standpoint (Koenig, 2020). However, while many studies have focused on how aware young people are, very few have addressed how that awareness helps them to use it positively.

Furthermore, responsible algorithm design and implementation are critical, as it has been argued that algorithms have a direct impact on democratic societies (Alvarado & Waern, 2018).

2.2.6 Responsible Design and Implication of Algorithms

Although no studies directly linked the responsible design practices of algorithms, it was frequently discovered from the existing literature that algorithms are critical enablers of the digital ecosystem that facilitate many positive opportunities for young adults to grow. However, the harmful effects it causes are still concerning as the designers of algorithms may be doing this harm when the users are unaware of their vulnerabilities, which ultimately becomes a severe responsibility concern.

A large amount of literature presents how digital Technology and social media, indeed, change the way people communicate and how dependency on it seems to only deepen with time as they decide to them "highlight the news of one friend while excluding another's" (Gillespie, 2014, p.168). Unfortunately, there is insufficient research on whether or not young adults who use social media sites are aware that it may harm them. However, one exploratory study undertaken by Gran (2021) explores levels of awareness and attitudes regarding algorithms among the people of the highly digital country Norway and discovered significant demographic differences in the extent of people's awareness of algorithms based on their attitudes toward algorithm-driven newsfeeds, recommendations (e.g., YouTube and Spotify), advertisements, and content (Gran et al., 2021). The study finds that "41 percent of the Norwegian population believes they are unaware of algorithms, 21% have low awareness, 26% have some awareness, 10% have high awareness, and only 3% have a very high awareness of algorithms" (Gran et al., 2021, Para-25).

However, this finding does not present whether the young adult users from Norway and the people from other countries worldwide understand their vulnerabilities before encountering

them. Even though numerous literary works demonstrate how their personal information is used against them, causing harm to their lives, it is unclear whether users are aware of it or not as the number of users continues to grow. It is not even clear from the existing policy and features of social media as some noticeable practices that are supposed to make the users aware include users' privacy, and data collection policies "often serve more as liability disclaimers" than proper informed consent for protections (Kitchin, 2017, p. 8).

2.2.7 Analysis of Findings

This literature review discovered that social media has positive and negative effects, typically built with business models based on user engagement, where algorithms play the most crucial role. The commercial intent behind social media implies a specific imperative in the design to ultimately support that business model to make money, which may stand reasonable as long as it is not causing any harm. However, it is now known from the literature that the business model or the "addiction machine model" that uses algorithms can lead to unhealthy engagement. Gillespie's (2014) frameworks provide a unique perspective on how the social shaping of Technology influences how algorithms are presented. Moreover, how social media impacts young adults positively and negatively demonstrates how social media shapes society. Therefore, this establishes the SST theoretical framework for this study that Technology and society shape each other. It means that social media may have the potential to benefit young adults if they can be aware of and reshape the Technology according to their positive needs. Although this literature review reveals that the design of algorithms impacts the experience of young adults on social media, and even at some point they become algorithmic awareness but none of them discussed how that awareness lead them to think and use it wisely during a crucial moment in their lives to be appropriately informed, connected, and socialized.

2.2.8 Summary of the Literature Review

The literature review investigates relevant literature on how algorithms are implicated in both the meaningful and harmful effects of social media consumption in young adults. It found that social media has both positive and negative effects on young adults, and the society they belong to has become shaped by it. Many factors have been discovered to be involved in shaping behavioral outcomes on social media usage, and this study becomes particularly interested in algorithms. The algorithm was the most important because it acts as an actor to reshape the consumption and behavior of young adults on social media in a techno-social manner. However, the results were less apparent when the search was narrowed to users' awareness and concerns about using algorithms responsibly in design practices.

The most significant result of this literature search includes Van Dijck's (2013) six microsystems and MacKenzie and Wajcman's (1985) Social Shaping of Technology as well as Srnicek's (2016) and Zuboff's (2019) thoughts. Their findings conclude that surveillance capitalism and the business model prioritize profits and engagement as the primary design goal, and algorithms play an essential role in achieving the same. It is also found in Deibert's (2020), Bucher's (2020a, 2020b, 2017), and Gillespie's (2014) works that often, the easiest way to engage the users is to use content that may reinforce negative behavior. The growing concern in the literature is that algorithms are used to drive those unhealthy behaviors online because they appear to be the most accessible and powerful tools.

However, even though there is very little literature that directly focuses on the pattern of social media algorithmic awareness among young adults, some of the existing literature focuses on the awareness of young people users, but none of them addresses how that awareness prompts them to perceive responsible design and use of social media in terms of reshaping those algorithmic experiences. Therefore, this study is interested in exploring how aware the young adult users, who have been taught and trained about algorithms, are and to what extent that

awareness helps them to use the platform in a way that brings positive outcomes reducing its harmful effects. At the same time, it is also curious to know how they perceive the education and training they receive to build that awareness as prospective designers of those algorithms systems. Eventually, the young adult computing science students who are about to graduate from post-secondary instruction fall into that category. Exploring their perceptions and experiences of social media design and effects, as well as the academic training and education they received regarding the responsible design of those platforms, stands significant for this research because it has been rationally discovered that education level is strongly related to algorithm awareness (Gran et al., 2021. Para.25). On top of that, education is vital in order to navigate digital divides (van Deursen & van Dijk, 2014). Despite everything, the responsibilities of designing algorithms may demand the ability to examine the societal impact before executing it for the general public because algorithms do not understand what is good or bad for the users, but their designers may do.

Although Gillespie (2018) ended such an argument by suggesting that "Reject the economics of popularity" (p. 201) when it is doing harm, research and discussion about awareness and responsibilities may be helpful to solve this ever-increasing problem as, in this new social media communication era, it is not possible to tell young adults not to use social media in order to ensure their proper socialization and positive development. Therefore, while this research agrees with the literature that there are vast benefits of the new digital social media for young adults, the harmful effects it creates need to be eliminated to get the most out of those revolutionary communications and content-sharing platforms. Christian (2020) thus suggests that movement is essential when things go wrong in the design process and implication of algorithms, especially in AI systems. He defined it as the alignment problem's "first-responders" and suggested learning their ambitious plan to solve it before our hands are entirely off the wheel

(Christian, 2020). Thus, this study result may contribute to the general users by examining awareness patterns of future designers.

Interestingly, this study population may significantly be able to evaluate the responsibility aspects of designing algorithms from their own social media experience as they might know how the algorithms are designed to work and also have experiences of using that design. Therefore, keeping that in mind, the following research questions for this study were developed:

RQ1: How do young adults with training in computing science perceive and understand the role of Algorithms in their social media consumption, and to what extent that awareness changes their users' behavior?

RQ2: How do young adults with training in computing science evaluate the responsible design aspects and the training and education offered to prepare them to design algorithms responsibly?

RQ3: What are the views and recommendations of computing science students regarding responsibilities to solve any emerging problem and make algorithmic systems better aligned with human development?

The subsequent chapter will introduce the proposed research design and methodology, sampling strategy, and data collection process used for this research project to answer the above research questions.

3. Research Methodology

The literature reviews revealed numerous reasons social media users experience positive and negative consequences. Algorithms play a vital role in influencing their experience (Van Dijck, 2013; Gillespie, 2014; Srnicek, 2016; Zuboff, 2019; Christian, 2020; Bucher, 2020; Deibert, 2020). However, the concern grows when it is unclear how aware young adults are of the design and implications of algorithms in their social media consumption during a critical period for staying focused and building a career (Gangneux, 2019, p.01). Since it is not yet viable to

expect average users to be aware of algorithms now, this study interviewed computing science students who are considered algorithmic aware and fall into the young adult age group. The goal of this study was to document their algorithmic awareness, and the moral practices they believe are essential based on their academic and personal experience with social media algorithms.

On top of that, it explored whether they received education and training on the issue at post-secondary institutions. Finally, the study seeks recommendations for reducing the negative impacts of social media algorithms while increasing their positive effects. As a result, this study conducted in-depth interviews with only young adults who have recently graduated or are about to graduate while learning how to design algorithms in order to explore the following research questions:

RQ1: How do young adults with training in computing science perceive and understand the role of Algorithms in their social media consumption, and to what extent that awareness changes their users' behavior?

RQ2: How do young adults with training in computing science evaluate the responsible design aspects and the training and education offered to prepare them to design algorithms responsibly?

It also pursued the third question in order to make the research more significant:

RQ3: What are the views and recommendations of computing science students regarding responsibilities to solve any emerging problem and make algorithmic systems better aligned with human development?

An interview guideline with more detailed follow-up questions was developed to explore the above questions. Overall, the research was a qualitative descriptive study that required semi-structured one-on-one interviews, followed by qualitative data analysis to determine the results. This approach provided a valuable perspective to understand better how young adults in computing science perceive and understand the role of algorithms and the concerns in algorithmic

social media design that affects their social media experience. This chapter provides a more detailed overview of how those examinations were carried out, including the research design, sampling, data collection, and data analysis procedures.

3.1 Qualitative Research Design

Digital engagement has frequently been described solely from a capitalist standpoint to maximize profit for monopolistic tech companies. However, this project was precisely about young adults' awareness and perception of the responsible design of digital social media platforms considering their positive and negative engagement with them. Therefore, the study applied a qualitative descriptive approach that was a good fit for this study. The naturalistic approach is used in qualitative description research to understand a phenomenon by accessing the meanings that participants ascribe to it (Bradshaw et al., 2017, p. 01). Although the planning was to consider phenomenology, the qualitative descriptive study approach was found to be effectively providing some interesting insights into the subject.

Solutions for vulnerable populations can be assessed, formed, and improved using qualitative descriptive study (Sullivan-Bolyai et al., 2005, p. 127). The exploration was to know how young adults feel about their creativity, productivity, and mental peace (dignity), in terms of engagement in social media algorithms-driven content. Hence, the qualitative descriptive design was a valuable method of data analysis. It enables us to select a specific group of participants with rich experiences and knowledge about an area of research. Thus, qualitative content analysis and thematic analysis are classified under the qualitative descriptive design (Vaismoradi et al., 2016, p. 100)

Moreover, another reason why qualitative approaches were chosen is the background and objective of this research. This research was to find the data from a socioeconomic point of view of designing algorithms responsibly where different influencing units are involved. It was an

effective strategy up to that point, in which in-depth semi-structured interviews were used to investigate and produce richer data that captured, first and foremost, human experience. (Denscombe, 2010, p. 94).

3.1.1 Participant Selection and Recruitment

This study is interested in examining a distinctive group of young adults who have received algorithmic training and knowledge regarding the research issue. The group would have to be appropriate to understand to what extent this awareness enables them to use the platform in a way that produces positive results while minimizing its negative impacts. The research is also intriguing to learn how they view the instruction and training they receive to develop responsible design awareness as potential designers of those algorithmic systems. Eventually, the young adult computing science students in their final year or about to graduate from post-secondary instruction fall into that category. The following Figure 01 demonstrates the participant selection criteria for this study:

Figure 01

Participants and inclusion criteria for the study

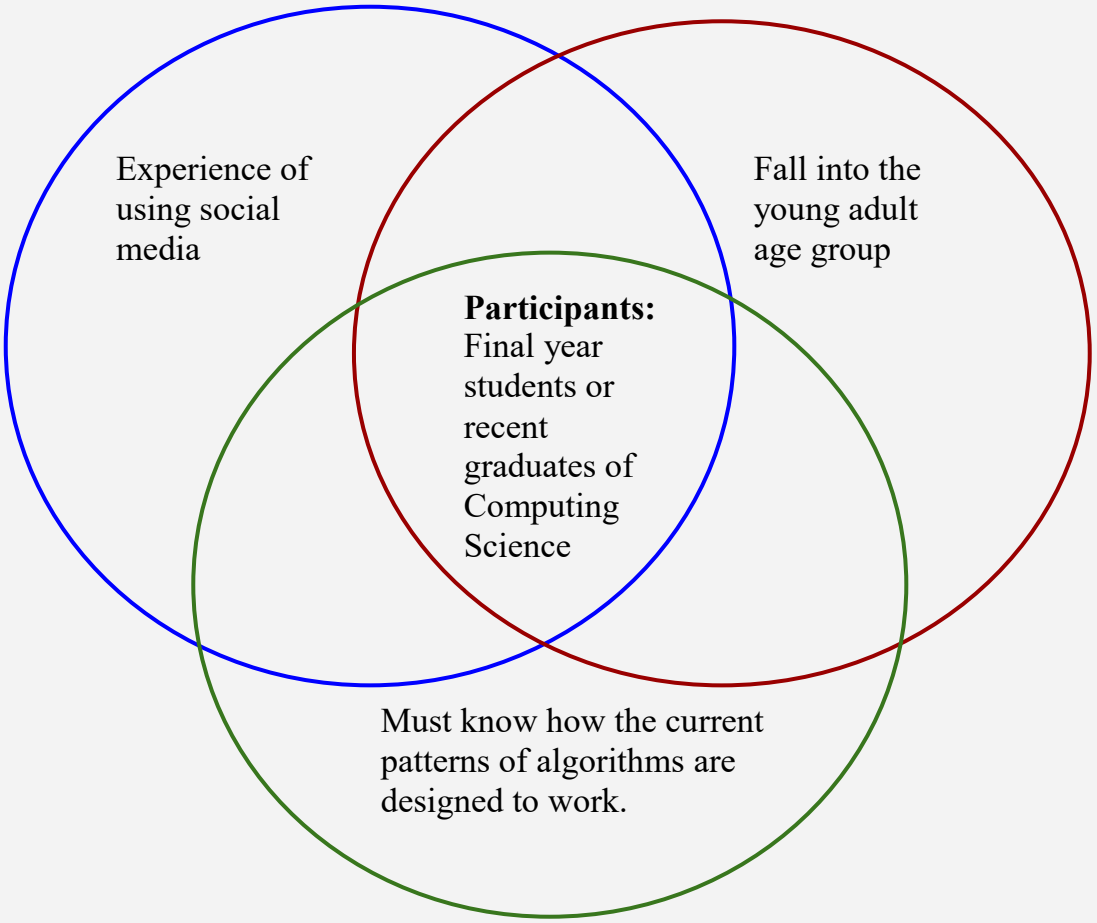


Figure 01 depicts that students in their final year or recent graduates of the computing science program are expected to know their curriculum, what they have been taught, and what they will be taught over the remainder of their degree. They are also in the young adult age range and may have significant social media experience.

This study chose a purposive sample size of fifteen, following Creswell's (2017) and Morse's (1994) recommendation of a minimum of five and a maximum of 25 participants. Despite their recommendation of six participants, a sample size of 15 was chosen to provide the best results and allow for participant variability while remaining a manageable number to work with (Creswell, 2017; Morse, 1994). In addition, the researcher joined various student community mailing lists to stay informed and meet with students, attended conferences, and collaborated

with some researchers who had done algorithm research locally to network with industry professionals who had recently graduated.

3.1.2 Sampling Method

Purposive sampling is typically used in descriptive research (Palinkas et al., 2015). However, throughout the study, discussion around the characteristics of the target group may already have expressed the importance of proper sampling to find the best results. Thus this study focused on a specific group of people, using a purposeful sampling strategy to define and focus on a target group. A purposeful sampling strategy is a non-probability sampling method that targets a specific group that can provide the best insights into a specific topic, and it would be best aligned with the research questions of this study (Etikan, Musa, & Alkassim, 2016). This technique was appropriate since the researcher wanted to select specific people to participate based on comparative meaningful data generation possibilities depending on the pre-existing knowledge and perception about the topic (Denscombe, 2010, p.35). The selection process began at the University of Alberta, where posters were placed on Bulletin boards for recruiting students from the Computing Science and Engineering department. The purposive sampling combined with a network or snowball sampling strategy, whereby person A suggests talking with person B played a role in the recruiting process, as did other factors, including geographical proximity and willingness to engage. (Etikan, Musa, & Alkassim, 2016). Due to time and budget constraints, this strategy was especially important in recruitment.

Therefore, the selected unique group meets the criteria for choosing participants and helps to achieve the study's goal as they also fall into the population targeted by the study, namely young people. Interestingly, those were the population that represented both designers and consumers of social media algorithms. Furthermore, there was no differentiation based on gender, origin, or disabilities and the approximate age limit for selection was between 18 to 35. These

criteria enabled the opportunity to interview male and female participants while not adhering to specific quotas.

3.1.3 Interview

The review of the relevant literature began in September 2021. By February 2022, the ethics application had been filed for approval. After receiving ethics approval for the research project by March 2022, many posters were placed. From there, many potential participants, who responded to the poster and put their email addresses in a google form, were contacted via email to see if they were still first interested and, second, available to participate in a one-on-one interview. The interviews were conducted face-to-face and accordingly taped upon their consent and availability. In addition, transcription software was utilized to create text-based notes that served as the foundation for qualitative content analysis.

Since this study was about people and their experiences and learnings, developing intimacy with the respondents to obtain rich information was a top priority. In-person interviews are the gold standard for qualitative research, and conducting an interview remotely is often "not a favored technique" (Johnson, Schietle, Ecklund, 2019, p. 2). Thus, the intention was to conduct face-to-face interviews on-campus where students received the education and training regarding designing algorithms to allow informal direct observation. Hence, conducting in-person interviews aided researchers in establishing and maintaining rapport with respondents throughout the interview process. The guided discussion with the respondents was open-ended and well organized. The interviewees were given a short passage by Crouse (2021) to provide a clear picture of what the researcher and participants would be discussing.

3.1.4 Data Analysis

The interview data was collected as digital recordings and then converted to text-based notes, which were then analyzed using qualitative content analysis techniques. The first step was

to conduct a preliminary analysis of the data from one-on-one interviews to identify common themes. The content analysis entails reading and coding texts to uncover themes and patterns that can be utilized to create valuable classifications and underlying patterns in data (Mayan, 2009). In order to gain accurate information and a deeper understanding of the topic under investigation, this analysis focuses on the features of language as communication, paying particular attention to the content or context meaning of the text (Hsieh, 2005, p. 1278). In each step, documenting participants' own words while minimally altering transcripts for clarity and removing any sensitive or identifiable details was critical, as the concept of being near the data was the key (Mayan, 2009). Excel Worksheet and taguette.org were valuable tools in this qualitative data analysis approach.

3.1.5. Rigor

Even though theme analysis is an effective method for this study, it has drawn criticism for the difficulties it creates for academic Rigor (Nowell et al., 2017). Inconsistent research question patterns and methods of finding the answer have also resulted from a general lack of literature (Nowell et al., 2017), as the focused demography of this research is young adults. Minimal literature was found around the responsibility issue of designing algorithms for this specific age group's social media experience. The following Table 01 contains four standards advised by Nowell et al. (2017) to determine the validity of a study using thematic analysis:

Table 01

Validity of the Study

Four criteria by Nowell et al. (2017)	What is required by Nowell et al. (2017)	How this study met that requirement
Credibility	"Addresses the 'fit' between respondents' views and researchers' representations	The data was presented as found directly quoting from the respondents and linked the theme with the

	of them” (p. 3).	research questions.
Transferability	“Generalizability of the inquiry” (p. 3).	Narrative description of the found data provided in the discussion section to generalize the identified issues concerns
Confirmability	“Established when credibility, transferability, and dependability are all achieved” (p. 3).	Data was proven to be generalized comprehensively in the analysis and discussion chapter
Dependability	"the research process is logical, traceable, and documented" (p. 3).	A detailed record of this research process was given with precise transformation between steps and modification of research questions and methodologies to do the data analysis.

Table 01 shows how the study's credibility, transferability, confirmability, and dependability were all upheld. It outlines the requirements and explains how each was met.

In conclusion, this research was conducted using a qualitative descriptive study approach. However, the study question itself, theoretical perspectives and personal traits of the researcher, as well as practical issues such as time, resources, and access to participants, all play a role in determining a good research design. Despite the best efforts to foresee and account for these factors when conducting this research, it did not turn out as expected, and several changes were required.

4. Findings

The research questions developed with knowledge of the literature were well-adopted with the research methodology, which greatly aided in exploring the issue from the start of the interview. This section will provide an overview of key insights from the in-person interview. As qualitative research aims to generate Because qualitative research seeks knowledge rooted in

human experience (Sandelowski, 2004), this study conducted in-depth interviews with 15 young adult students in the computing science program who have either recently graduated or will soon graduate, and know-how algorithm systems are developed for social media platforms. This study assumed that participants with academic backgrounds would be more knowledgeable and aware of the social consequences of algorithm design. It also hoped to learn more about the participants' perspectives on the growing responsibility issue in designing algorithms. When analyzing data, the researcher assumes the role of the analytical tool and makes decisions on the data's coding, theming decontextualization and recontextualization (Starks & Trinidad, 2007).

Analyzing the transcript of 15 in-depth one and one interviews, a total of eight themes emerged. Codes were created for each of the eight themes, merging similar findings and highlighting crucial thoughts to aid the development and characterization of the interview content. The following table summarizes themes and codes, showing how many times they were mentioned and how many participants emphasized them, demonstrating the data's importance.

Table 02

Codes and Themes

Theme	**Code**	**How many times it was mentioned**	**How many participants mentioned**
Awareness and perception of the design of social media algorithms	Recognizing positive effects	08	07/15
	Concern about the harmful effect	26	15/15
	Not a active users being aware of harmful effects of the design	12	08/15
	Confused skeptical about design and effect	09	06/15

Awareness regarding personal and socio-economic development	Somewhat influenced by social media	11	10/15
	No influence at all	03	03/15
Evaluating the design of algorithms in responsibility perspective	Data collection and privacy	10	08/15
	Maximization of profit is the priority than its harmful effect	06	05/15
	Flagged recent pattern of recommendation algorithms as harmful	17	11/15
	Designed to manipulate	04	03/15
Defining responsible design of algorithms	Responsible design concern	16	08/15
	Letting the employer know	09	08/15
	Assessment of harmful effects	21	11/15
Training and education to design responsibly	Ability to do the proper Assessment	12	10/15
	No training and education	07	15/15
	Received certain training and education	12	15/15
	Making ethics education and training mandatory	03	15/15
Awareness and discussion among the students and instructors	Some conversation from now and then	04	10/15
	No discussion at all	06	10/15
Who is most responsible for resolving the issue and how	Recommendation around the curriculum inclusion responsibilities	15	10/15
	Employer's responsibilities	18	09/15
	Recommending government to be responsible	19	11/15

Thoughts on the potential solution and limitations.	Recommendation around responsible design	07	05/15
	Responsible algorithm design literacy for designers and awareness for all	08	04/15

4.1 Awareness and Perceptions of Social Media Use

4.1.1 Recognizing Positive Effects

Seven out of fifteen respondents acknowledged various favorable benefits of social media algorithms. One respondent highlighted it twice throughout the interview, once indicating that "it can lead to improved productivity." Respondent No. 2 (R2). Others who responded in this regard believed that it is beneficial in certain aspects since users can find the content they want to view, which is convenient if it does not have any negative consequences. If users want to learn something on YouTube, "algorithms may recommend more and more of such educational videos" (R1). Several respondents also indicated that it might be an excellent tool for communication to grow in arts, social science, engineering, and medical research. It can also improve and simplify an individual's life by providing different options to obtain information from around the world.

Although all respondents were asked about the algorithms, a few added the benefits of using Artificial Intelligence (AI) for social media, claiming that the power of AI and Machine Learning (ML) algorithms becomes even more valuable when "platforms use AI and ML to recognize things like suicidal posts" (R9). Almost all of the respondents eventually indicated that they are well aware of the positive effects that social media offers, despite its negative implications.

4.1.2 Concern about the Harmful Effect

Participants expressed numerous apprehensions about the negative impact of social media algorithms. Most of them frequently indicated that a lot of the algorithmically recommended content is not always beneficial. They often defined it as "addicting," "time wasting," and "easy to weaponize and carry out malicious practices." Many participants also voiced concern that people are becoming obsessed with their appearances and recognition on social media after posting a picture, which makes them feel worse about themselves now than they did before digital social media existed.

Despite being asked about the negative consequences of algorithms, many respondents expressed concern about the implications of AI and ML algorithms controlling their attention and interaction on social media. In terms of social aspects, they were particularly concerned about ML algorithms that rely on learning from the user's interactions with anything or anybody, regardless of the reasons for those interactions, which frequently misleads the users and infringes their freedom of social interaction. One participant cited that "we kind of feel like we stumbled into AI in a social context" (R3)

Regarding technical aspects, some respondents referred to AI algorithms as "dark patterns" because even designers do not know what decision they will make (R11). They argued that users only know what they put in but have no idea what they would get, which can sometimes be biased. Furthermore, one respondent commented that "these biases are being picked up on because everything found on the platform, including biased data, becomes the training data or the reward function for AI" (R13).

Many participants contended that because of the business-oriented design, most consumers do not benefit as much as they might. One participant added concerns about advertisements that "when I go on Facebook, it seems like it is not just trying to influence me

personally but financially" (R8). However, the vast majority concluded that the potential drawbacks outweigh its benefits, including entertainment value.

4.1.3 How Awareness Changes their Behavior on Social Media

Although most respondents began using it relatively early in their lives, most notably in high school, they do not use it actively due to the negative impacts. Most respondents stated to a certain extent that awareness prompted them to use it differently. They frequently try not to interact with all the content that algorithms recommend since they know the algorithm only feeds people things they watch more to keep them engaged on the platforms. One participant described not actively using the platforms that "purposefully, even if I found a video interesting, I would not click on it. If I am interested, I would open an incognito tab to check it there and then close it" (R8). Another participant also expressed having self-control over it, saying, "I do not chase news or stories on social media. On Reddit, for instance, when I am searching for one thing in particular – I do not usually look at anything else and do not usually go through the home base feeds on any platform" (R11).

Even though most of the respondents appeared to be well aware of cookie and app tracking policies and anything that monitors their web browser history, many of them believe that these are ineffective in keeping them safe on the platforms. Eventually, one participant raised concern that "technically, I can be anonymous by masking my little IP addresses, but I will be tracked by my browsing patterns and engagement with contents anyway, which is worrisome for me to use it" (R1) actively.

Some respondents do not use the platforms at all, fearing they may destabilize their personal lives and the community to which they want to belong. One participant said, "I guess the main concern at the time when I deleted my social media account was the amount of time I was spending on it, versus the actual value I was receiving" (R13). Some responders do not turn it on,

and others have reported uninstalling most of their social media accounts. Instead, they preferred reading books, seeing people in person, and watching movies on Netflix for entertainment.

4.1.4 Confused and Skeptical About the Design and Effect

The goal was to keep the conversation open to all possibilities, and at some point, roughly half of all participants expressed skepticism about the responsible design and role of algorithms. They frequently find the entire situation challenging because there is some helpful information and it is difficult to separate good and bad from such a large amount of content because they were urged to think about every aspect of their real life experiences on social media. One participant stated, "I guess it is the worse of two evils: Would you rather force somebody to do something they don't want to do for their good?" If they are not interested, they will not use the platform: a reality that can be argued with existing design practices." (R2). The participant stated, "I shifted from medical to computing science because of the flexibility to choose what I want to accomplish" (R2).

A few of the other 15 respondents acknowledged a quandary when they imagined being in a position where they could not help themselves by utilizing AI. They identified them as "powerful but drastically harmful tools" (R5). One worried respondent (R3) stated, "responsibility concerns are possibly going to be workplace challenges that we have already gotten into, and if this continues, then what could be the future?" However, one participant found TikTok algorithms more useful than Instagram algorithms. "Everything on Instagram is pretty much like highlight reels," said one participant (R5), "whereas platforms like tick-tock show more like a real side of people." Another respondent (R7) also believes that algorithms used in movie recommendation are not so harmful compared to the algorithm used on social media content moderation and recommendation.

4.2 Awareness Regarding Personal and Socio-Economic Development

4.2.1 Somewhat Influenced by Social Media

The perception of the respondents about the influence of social media on their personal and socio-economic development were mixed. Although most participants acknowledged that social media communication influenced how they made every decision in their lives directly, others claimed to be unaffected by it since they were not as active on it. A few claimed it influenced them indirectly. In reality, the data indicate that it depends on the platform they are using. One respondent claimed to have "no influence at all" and then added, "I use Twitter essentially for academic boot; I follow the people and get some idea what they are doing and maybe acquire some information or develop a private network with those people" (R12).

Although participants may not use social media to select a career path, they may wish to be something they are unfamiliar with, and this is where many respondents think the recommendation algorithms should come into play as they strive to establish some "self-learning intelligence on such platforms, which should be the goal" (R1). One responder (R2) stated that many factors influence when making a career decision and that social media is a crucial part of it when it pertains to information and communication.

In addition, one participant stated, "I feel like many people can get influenced by social media, not just in terms of economic or social aspects, but also in terms of religion, politics, and overall, the way people think and make decisions in their daily lives" (R15). The platforms also have a significant impact on personal development, owing to those "content creators for things like, how to go to the gym, get a trainer for the workout" (R7). One participant believed that it creates stereotypes, especially making a girl believe that she must work out, eat, and dress up in a convincing way to look like a model, even though she knows the model's picture is edited, posed, and recorded in altered lighting. (R5).

4.2.2 No Influence at all

However, three out of every fifteen respondents were unaware that social media impacted their life advancement. Two of them stated that they do not actively use social media but rather "simply to keep in touch with people." However, one respondent stated, "absolutely not." No, I only use it for fun" (R9).

4.3 Awareness Regarding the Design of Algorithms

4.3.1 Data Collection and Privacy

Most participants are concerned about how algorithms collect, keep, and use data against them. One participant stated, "I can't get off the grid, and 7 billion people could Google my name and find out a bunch of information about me that I don't really need everyone to know, so it is definitely a personal experience thing that makes me not want to collect data as a designer. If it signifies the termination of my career, so be it" (R1). Many other participants believed that the design jobs were not done responsibly because the system is not transparent. Users have no idea how their data is processed. One participant added, "it is like your own personal property being sold, and you do not know the value of it" (R11). Finally, they underlined the importance of legitimate ways to opt out of sharing personal information.

4.3.2 Maximization of Profit is Priority over its Harmful Effect

Most respondents believe that platform owners are only interested in making money, not assisting developing communities. One participant expressed concern about "increasing polarization in terms of economics: those who already have money, it gets easier and easier to take advantage of these platforms and make more (R4). Another respondent claimed that sometimes pointless, negative, and confusing content is fed to keep people interested and earn more money, which is terrifying (R1). Finally, most respondents expressed concern that even though designers try to construct algorithms responsibly, employers would not want it that way because they are only looking to make money.

4.3.3 Flagged Recent Pattern of Recommendation Algorithms as Harmful

Most participants believe that the recent pattern of recommendation algorithms is causing more harm than good. Almost all respondents agreed that because recommendation algorithms primarily offer content that would keep the user on the platform, the content could be biased, misleading, or full of misinformation. In addition, they realized the power of the recommendation algorithm to do its job without letting the user know. According to one respondent (R1), even if users do not provide any personal information to the platforms, apps such as TickTock will follow their location and begin to serve them addictive content. "These algorithms are intended to suck the users into a loop by generally moving towards more polarizing content that increases users' engagement" (R4).

Furthermore, the majority of respondents were aware that it kind of cuts the possibility of helpful content being shown: just because a user looked at something does not mean the person liked it, but unfortunately, users would not find anything new other than those types of content unless they scrolled through everything (R7). However, one participant stated, "I wouldn't be too concerned about it now because, in any case, if I realize that this recommendation isn't good for me, I can simply stop scrolling or manually search for something I want to see" (R9).

4.3.4 Designed to Manipulate

Most respondents expressed experiences of being caught in their own beliefs that are affected and formed by algorithms while using social media without stepping outside the box. One respondent demonstrated how a platform like TikTok manipulates even with 10-second videos that give viewers "a cheap laugh or lifestyle trick and as this seems like not so time-consuming, and there are so many of them out there, it becomes effortless to be trapped in that flow and end up wasting much time" (R8). Another participant noted that the user has no control over what they see, which is supposed to be curated. However, it is just delivered to them with

the objective of "keeping them on the platform as long as possible" (R2). Respondents felt that instead of information freedom, people are eventually deceived online.

4.4 Defining Responsible Design of Algorithms

4.4.1 Responsible Design

Respondents indicated significant ethical issues by identifying awareness, expectancy, transparency, and fairness patterns when asked what they think about responsible design issues. The majority of the 15 respondents highlighted the importance of transparency. However, they also thought it was "tricky" because if individuals were informed how the algorithm worked, they might purposely break it. Meanwhile, one member stated that "any obligation not to create damage is also directly in conflict with making profits" (R13). However, the respondents believed that openness might "allow people to know what kind of behavior can lead them to what kind of content" (R8), which may also promote the "fairness of algorithmic implication" (R12).

Many respondents recognized social media as a crucial social infrastructure, not just a place for entertainment but where people engage and spend a significant amount of time. However, most of them felt that people who design algorithms need to realize that people unfamiliar with how computers operate may never be able to use them responsibly. Two respondents referred to the system as "black boxes," implying that those who designed it must accept responsibility. Another respondent mentions the same concept with an example: "it's like you are showing a blind person to go somewhere and you are responsible for taking the person to the destination in the correct way" (R3).

Few respondents also stressed that ethical norms exist in every other field that has an impact on anyone and that professionals are academically trained to ensure that "it's [responsibility] a part of the job" (R20). They addressed that if every other profession is required to do it, why not computer engineers who develop software for general public use? One

respondent illustrated what the response design might entail and that some options are available to track the amount of time a user has spent on the social media platform through another application. The respondent felt, "why not make it more accessible and visual in the main user interface" (R15).

4.4.2 Let the Employer Know

Most respondents agreed that even if the designers are given the algorithm design task to complete autonomously to produce the best results, it is still their responsibility to inform employers about the potential danger. Most of them also believed that it should be a collective procedure to follow in order for everyone to participate, conduct research, and offer suggestions, and that "at the very least, this is the kind of culture that everyone should strive for, at least in computer science" (R3). However, during those discussions, the topic of "job security" arose. Three of the fifteen participants expressed concern about how difficult it would be because the algorithm designer's job is to "maximize engagement," hence "it is the work for them." If they try to design it based on their motivations, they risk losing their job. Another respondent stated, "It would be even more difficult for people like us who would be the new designer, easily replaceable for an employer" (R6). Nevertheless, another participant also stated, "How am I supposed to approach my manager and say: I don't want you to make as much money as you are making now?" I can't if the system remains unchanged" (R6).

4.4.3 Assessment of Harmful Effects

At this point in the discussion, most participants indicated that it is always vital for developers to consider all of the implications of the software they design because, even if they do not intend to harm anyone, that set may have adverse effects on some people. Most respondents did not believe there was any existing testing system that designers used before releasing it to the public. The assessment criteria they revealed begin with understanding the "intended goal: to

whom, what, and why it should be recommended" (R2) and testing while being aware of the potential negative consequences. According to one respondent, "the software must be optimized to do a better job of making profits without causing harm" (R5). Several other participants expressed concern about not having enough research opportunities. According to one respondent, "there is no ethical standard or code of conduct other than the general laws already in place: making the clients satisfied" (R2).

Many respondents also hope that "knowing the negative consequences makes it easier to avoid creating dark patterns" (R11). Another participant noted, "I couldn't help but think about its effects! However, I doubt that would be the case in a real-world workplace" (R2). A few respondents also argued that many things have come to light due to Facebook and Instagram whistleblowers, including algorithms that intentionally share information that is very harmful to users. Despite this, they continue to do so because it increases platform engagement. However, one optimistic respondent (R13) proposed that the system be tested with a controlled group while considering all aspects of potential harm before making it available to all people. These "codes of conduct are more of a company-wide thing than an individual designer" (R13).

4.5 Training and Education to Design Responsibly

4.5.1 Ability to Do the Proper Assessment

At this point of the interview, many respondents started to express their concerns about not knowing [having proper education and training] how to design it responsibly before even getting to that part of the conversation. "I feel like it would require its special role in that kind of intersection," one respondent said. "I don't believe we're particularly good at it because we've never been taught a specific code of conduct on how to design software responsibly," the respondent added (R8). One viable solution they proposed is for designers to learn it

independently and ensure that managers adhere to ethical standards. Another respondent stated, "honestly, without any background, I probably just do regular work" (R12).

4.5.2 Did not Obtain any Training or Education

Five of the fifteen respondents said they had no training or education regarding the responsible design of algorithms. Table 03 below shows how they said it all.

Table 03

Received no Education and Training on Responsible Design of Algorithms

Had no formal education or training.	"I believe the only harm we've learned to avoid is harm to the computer" (R1).
	"Not really, for us, I haven't really heard anything about it" (R5)
	"took research ethics training but not ethical algorithm design training" (R8)
	"No, I didn't take it because I believe it was only offered this year." (R13)
	"It has recently received a lot of attention. So, no, not that I recall. There was nothing like that" (R9).

4.5.3 Acquired Particular Training and Education,

Unfortunately, none of the participants reported taking an entire ethics course. "It is definitely something that we [they] could do much more of," they said. "The majority of the classes did not focus on ethics." The following table 04 summarizes the pattern of education and training received by respondents:

Table 04

Different Forms of Trainings

	Different forms of Trainings	**Description on how it went**

Received Certain training and education	Received few lectures:	"Compute 603, and a big part of that is algorithm design ethics" (R6).
		"Touched on ethics a little bit, and that was compute 250, a game design course" (R11)
		"There's been a brief lecture or two about ethics" (R14).
	Joined seminar	"It was one of the first times my mind had been opened to the possibility of danger" (R2).
		"on the social aspects of AI...how artificial intelligence affects society as a whole" (R12)
		"a seminar that sort of discussed ethics" (R3).
	Extra lecture and requirement from instructor and supervisor	"Not necessarily an ethics-focused course." a professor actually discuss ethics in machine learning algorithms" (R15)
		"My supervisor asked me to conduct some ethical analysis on a project, and I learned a lot from it." (R10)
	Ethics from other department:	"I guess, ethics 101, a course offered by the philosophy department, it's essentially just like an introduction to ethics." (R4)
		“took a course on computer human interaction” (R7)

Three of the fifteen respondents reported receiving a few lectures as part of a course, while three others reported attending seminars on the subject. Two of the remaining nine respondents reported receiving some lectures from the instructor even though it was not on the syllabus. The other two took ethics courses from other departments and believed they could be applicable in this case of responsible design. For example, although one participant took a master's-level course called "Social Media Algorithms," in which they studied the spread of rumors in networks such as social media, they did not find it particularly useful in learning to design algorithms responsibly. On the other hand, another respondent (R7) took a course called

"Computer-Human Interaction" and felt that, while not entirely focused on the responsible design of algorithms, the course offered a lot, including "making the programs user friendly and accessible, and not based on stereotypes like gender, race, age, or anything like that" (R7).

However, introducing the issue has been shown to increase awareness significantly. For example, in the first year of the master's program, one participant's instructor discussed "ethics in machine learning algorithms," and "it brought students' attention to the harmful effects that machine learning algorithms might have and some of the responsible ways that they can imagine mitigating those effects" (R15). In addition, the participant who reported taking an ethics course offered by the philosophy department was asked about the course's main takeaway. The response said, "Initially, we learn that there is a significant interplay between economic systems and the impact of technology on the population, but towards the end of the program, they kind of went off deep talking about things like the singularity and when AI could take over the world" (R4).

4.6 Awareness and Discussion Among the Students and Instructors

Although some participants reported having frequent conversations about the impact of algorithms, others were unaware of the responsible design of algorithms, and some even struggled to recall whether they had any conversation about the issue in their previous academic years. One respondent said, "I shouldn't have these discussions with my friends because I don't really like social networks at all" (R9). Another participant stated that no ethical issues were discussed because "what can we [they] do?" We [they] are all on it and need to get on it in order to connect with people" (R10). The participant also added, "I can get off the platform, but I'm just one person and can't control everyone not expecting me to be there to communicate with them" (R10). They saw it as "societal pressure, and there's not many consumers can do" (R11).

According to one participant, the concept that "an algorithm can have ethics and the designers would have to even think about it" was not adequately introduced during the academic

years (R11). "I think we have conversations within ourselves: how we can reduce our daily social media usage to minimize its harmful effect, but not about designing it ethically" (R15). Most remaining participants also agreed that they should have been introduced to this concept earlier when learning to design algorithms.

However, some participants revealed that they discussed the issue with their classmates. For example, one participant said, "my lab group works on fairness and misinformation" (R6). They also stated that although some instructors expressed concern about the issues, "it's difficult to gauge concern from instructors if the topic isn't brought up through curriculum" (R11). Finally, one participant said, "I'm not sure about everyone, but my supervisor is very active and concerned about it, and we discussed it a lot" (R12).

4.7 Responsibilities for Addressing the Issue

During the interview, three groups of people were identified as actively involved in developing those platforms. The level of initiative-taking responsibilities for addressing the issue also discovered during this study is depicted in Table 05 below.

Table 05

Who is mostly Responsible?

Who is involved in creating those platforms where responsible design issues have emerged?		Degree of initiative-taking responsibility	
		How many times it mentioned	How many out of 15 mentioned
The 3 Group of people found involved to create those service Platforms	Curriculum Designers	3	2
	Students and Instructors	1	1
	Employers and Clients	8	7
	Everyone:	5	5

Although each respondent mentioned it differently, the table shows how many times they mentioned it, indicating its importance. Most respondents believed that employers are crucial in this situation and should bear the most responsibility for the problem they have created. In contrast, a few others felt that education policymakers [curriculum designers] should step forward first to prepare students to design algorithms responsibly before they graduate because this is where it all begins. However, the consensus among all respondents' opinions was that if these two groups do not step forward first, students and instructors will be left with very little to do because students may have to get a job, and "instructors don't even get to choose what they're teaching but must follow the curriculum" (R4). The following is a detailed presentation of their responses to the responsibilities and recommendations to solve the problems.

4.7.1 Recommendation around the Curriculum Inclusion Responsibilities

According to most respondents, curriculum designers must act because simply teaching how to create computer programs without regard for ethics may be detrimental to their careers and the society to which they belong. Undoubtedly, the university has complete control over what students learn but "incentivizing, taking the ethics course over not taking, is always a good way to go" (R4). One respondent even suggested that "if someone is learning to design it, they must be learning to do it responsibly" (R2). At one point, most respondents felt they favored some mandatory ethics training because, in theory, people should educate themselves. Furthermore, some students found it interesting once they paid attention to it.

One Respondent (R3) made a comparison using the explanation and example of nursing students who begin taking ethics classes in their first year and continue to do so throughout their nursing program. The participant emphasized that "ethics" should be an "ongoing discussion throughout their careers" and that "it should be started as an ingrained part of the process of

becoming a computer scientist" (R3). Nevertheless, many respondents suggested some form of algorithmic literacy and awareness for all students in every other department. According to one respondent, "education is the most important way to raise awareness, and how algorithms work is not rocket science; they are everywhere, and anyone can learn about them and be aware of them" (R13). They also believed that the problem might be filtered out of the industry if educational institutions could do it. In summary, while a few respondents were undecided about academic inclusion of responsible design issues pointing to employers, almost all agreed that most responsibilities to bring the changes might lie with institutions, whether universities or businesses.

4.7.2 Responsibilities of Employer

Most respondents also stated that employers are primarily responsible for coming forward and accepting responsibility for the problem they created. They gave various reasons for their claims, as follows:

- "Process is only focused on optimizing the design for users' engagement" (R3)
- "Lack of research and experiment on the emerging ethical issues" (R5)
- "Designers are not free to address the ethical Issue" (R1)
- "Lack of obligation to the users" (R4)
- "Lack of users' trust" (R2)
- "Maximizing profits is the only goal" (R6)

The respondents also suggested that they can act by:

- "Continuous research, staying informed and keeping employees informed of how users find it beneficial as well as harmful." (R5)
- "Having standard code of conducts could help them be more successful because people will have faith in them if they do so." (R2)

Many participants believe that social media companies should have a theoretical and practical responsibility to protect their users: "If they ever break, they should be held accountable; if they keep it, they simply build trust" (R2).

Although employers are recommended to work with research, awareness, and transparency to solve this ever-emerging problem, one respondent pointed to the goal of maximizing profits and stated that "it's not necessarily a lack of ethical awareness, it's the company ordering the designers to optimize pure engagement for the advertisement revenue" (R6). They reasoned that if employers expect developers to act responsibly, even if they were not trained in ethics in school, it is a skill they can learn on their own. One respondent used Facebook as an example, saying, "I'm sure many of their employees are very ethical people, but if the employer does not encourage, it's sort of not going to go anywhere." Finally, many of them emphasized the importance of companies having "open discussion policies" (R12) and practical training to ensure that designers know the current and emerging responsibility issues concerning algorithm design and implications.

4.7.3 Recommending government to be responsible

Eventually, 11 of the 15 participants advised the government to take action to address this issue. They primarily believe that stricter top-down control would be the best course of action in this situation, which may also include conducting research, establishing ethical standards, regulating the platforms with solid and effective laws, and holding the responsible individuals accountable, just as they would if anyone committed any other offense in a state. Figure 02 below includes one comment from each of the 11 respondents who recommended the government take responsibility and act accordingly to solve the problems.

Figure 02

Direct quotes from respondents Recommending the Government to be Responsible

“The government should step forward and do some research.” (R1)	“Well, I think that's what governments are for, right? They must protect people” (R3)	“They might not care, even after knowing it’s doing harm to the users. So government regulations would help here." (R15)
“In general, the government is funded by user taxes. It is also perfectly capable of going up against the companies. And if they're [employers] told it's illegal by the government and they don't listen, there have to be some actual consequences, not just financial, but CEOs and anyone in high positions going to jail type of consequences, only then they will actually care” (R4)		“stronger top-down regulation, as well as audits of systems to ensure that they are prioritizing value for users” (R13)
“Certain [Ethical] standards must be in place for practices that prevent them from causing harm to users, just as other laws enacted by the government in general across communities to keep it safe.” (R5)		“Ideal solution would be the government being vigilant and making laws to safeguard citizens.” (R8)
“I suggest making laws and holding them accountable.” (R7)	“Simply put, I don't believe businesses will decide to regulate themselves. Yes, if they don't treat everyone fairly, there will have to be some sort of punishment. And the government would be the most likely source of those repercussions.” (R6)	
“I had to say that if a particular program or industry, in general, has real social issues, only government regulation can start the process of resolving those issues.” (R11)		“Government-mandated policies are required.” (R12)

Most respondents agreed that whenever something endangers the general populace, governments should act immediately to protect them. In this situation, it would be ideal if the regulations were developed following "proper research and experiments for the optimal solutions" (R11). One respondent said, "consider how beneficial it would be for the public if industry vendors take decisions under the code of conduct established by the government" (R3). Another respondent referenced, "China and many European countries are already heavily regulating social media. Perhaps a country like Canada shouldn't take that course, but in this case, the government must act under public affairs (R13). Finally, one respondent said that taxes fund

the government, and even if these businesses buy off specific politicians, they are still accountable to the general public rather than the businesses (R4).

The government should focus on people's protection and proper development (R4). Most of them recommended that some strong laws should require platform owners not to purposefully promote inflammatory content just because it is profitable for them. However, they added that the termination of those convenient platforms should not be subject to a government standard policy. Instead, a balance must be struck between the algorithm's potential for financial gain and its possibility to advance social welfare.

In a dramatic statement, one of the respondents added that unless everyone in the world agrees to stop using social media, it is unlikely that businesses will decide to regulate themselves. On the other hand, one respondent (R11) felt that it is not something that any individual can do and is similar to other laws that the government passed to keep communities safe. One respondent also cited that "users occasionally may not even be aware of the harm and even it is too much to expect from the general public" (R7).

Among the four remaining participants who did not discuss government responsibilities, three (R2, R10, and R14) described the issues with curriculum structures, and the fourth (R9) mentioned general users' awareness that "all users should learn how to use social media responsibly." The respondent also emphasized that people frequently disregard privacy policies and do not read a platform's 'terms and conditions while using it.

4.8 Thoughts on other Potential Solutions and Limitations

4.8.1 Recommendation around Responsible Design

Many participants also talked about laws and standardizing ethics based on culture, upbringing, and various social norms and values to promote responsible design practices. According to one respondent, "it all comes down to what we're willing to give up. For example,

because we could honestly abandon the concept of popular content in algorithmic suggestions, instead, it could identify what people are looking for on the platform, such as losing weight to be healthy and attractive and then steer them in the right direction rather than towards eating disorders" (R3). However, almost all respondents agreed that the design and implication of algorithms should be transparent because they are designed for the general public. Therefore, it should let the users know how the model works and make a recommendation. Furthermore, they advised that once the system is operational, it should be monitored regularly because these things can introduce unexpected problems anytime.

4.8.2 Awareness and Responsible Use of Social Media Algorithms

Many respondents discussed the importance of raising awareness among developers and consumers, emphasizing that it is always the first step in resolving social issues. They also expressed concern that people begin using social media at a young age and should be educated on how to use them responsibly. Furthermore, a few of them stressed that every social media user should learn how algorithms work on the platforms and use critical thinking skills to control the addiction that recommendation algorithms, for example, create. Furthermore, some respondents indicated that awareness among educators, managers, or those in charge at work is essential. Finally, one respondent (R11) believed that it requires some comprehensive study of potential social effects on the general public, particularly regarding social media algorithms.

Aside from the preceding, some participants suggested that the government should provide universities incentives to raise awareness (R1). Some also had asked the public to assist by leaving or deleting the account if it is not doing well. One respondent advised users to sign a petition and express their concerns (R7). Another participant worried that "AI might take over the world," adding that "you could say it's the sci-fi movies created fantasy, but there is a real possibility that it could happen as they've already become a current and realistic danger" (R10).

5. Discussion

This discussion section will highlight critical results that address the research question, offer interpretations in light of the significant body of literature discovered, and consider how these findings might be interpreted and applied in the broader context.

5.1 Awareness

The initial portion of the interview was intended to gather information about the social media algorithm repercussions that respondents were most concerned about regarding social interaction, communication, and personal development. Nevertheless, every conversation was intriguing because it was with a young adult who uses social media and knows how the platforms function. When the respondents were advised to put themselves in the shoes of professional designers, the responses eventually started to reflect the idea that they were the victims of their creations.

Both the literature reviews and the findings of the interviews indicate that algorithms are crucial for improving the user experience on social media and other digital platforms. However, most respondents were aware of the algorithmic implications during the interview and identified recommendation algorithms as the primary reason for the harm. It is intended to immerse users in a type of political news, for instance, that frequently upsets and embarrasses them, when morally, consumers should be allowed to consider many points of view when it comes to politics or any other opinions. Furthermore, despite their awareness, participants claimed that modern patterns of recommendation algorithms readily lead them to compare themselves to individuals who appear to have it all online, resulting in a wide range of socioeconomic problems.

5.2 Importance of Awareness

The patterns of awareness and concern indicated by the majority of respondents suggest that the social fabric of how society works to socialize young adults can be controlled and

manipulated as a result of unfair algorithmic implications. Even if the users know that harmful content is not actual, it may still influence them and harm their social beliefs and interactions. However, when asked how they believe social media influences their career decisions and overall personal and socioeconomic development, a small number of respondents felt that it has "no Influence at all," which is more concerning because they are not even aware that they are being influenced, as opposed to those who indicated that they are aware of the harmful effects. Livingston (2020) suggests that even "self-disclaimers" are frequently ineffective at protecting young women from the possibly detrimental impacts of unrealistic appearances on digital social media. Many sociologists, including prominent sociologist Cooley (1902), argue that any social interaction impacts personal and socioeconomic development. Even if they believe they are just having fun, interacting with those amusing things may influence their growth in either a positive or negative way.

Furthermore, most respondents worried that they see no real-life aspects of the people actively posting on social media, only limited filtered material that they prefer to share, which is frequently misleading. This practice could lead to a user developing a strong belief that everyone else is different, more robust, bright, and very unlikely to be friends with, leading them to choose social isolation, which disrupts their real-life appropriate socialization process.

Social connection is more crucial than most social beings realize when understanding themselves. The "looking glass self" theory explains that they are wired to seek social acceptance and prestige (Cooley, 1902). This process, mainly when applied in the context of the digital era, raises responsibility questions around the new nature of identity, socialization, and the developing self. Cooley's (1902) concept of the "looking glass self," a popular claim made in the context of "symbolic interactionism," has gained more excellent traction (e.g., Giddens 1991; Habermas 1987 as cited in Yeung et al., 2003) is that the development of the self is a social

process in which we come to understand ourselves through the viewpoint of others (Yeung et al., 2003). Before the emergence of digital social media, people tended to get that "looking glass self" experience from real-life in-person social settings, but now the opposite person on the glass has become sophisticated and sometimes faked. However, they may affect similarly in social growth. Table 06 below explains how algorithms affect and raise responsible design concerns in all three steps in Cooley's approach (1902).

Table 06

Looking Glass Self Theory

According to Thompson et. al. (2016):		
Cooley ([1902] 1922) described three successive steps in the process:	**How algorithms affect that**	**Responsibility Concerns**
1. The imagination of our appearance to others.	Highlight reels are not real and often disappointing and misleading.	Promoting those content to reach the individuals who are already depressed with their existing appearances.
2. The imagination of their judgment of that appearance.	Caring for likes, comments, and sharing: Expectation of Social validation	Addictive: Acts like drugs, which leads to depression if not receiving enough.
3. The development of feelings about and responses to these judgments	Acting according to other feelings: If the audience likes misleading content, the creator will be encouraged to create more of those content.	Humans prematurely tend to respond to the threatful, emotional, and misleading content first, prompted by their survival instinct, and using that weakness to do harm is irresponsible.

Table 06 illustrates and verifies several participants' claim that designing such algorithms to promote those false expectations is not a responsible design. Additionally, many participants mentioned that the moderation mechanism would prevent them from being exposed to content

that contradicted their beliefs and perspectives, such as a video with controversial ideas. Thus, it somewhat shields people from different viewpoints and limits their opportunity for progress. They felt they should be able to explore other people's perspectives to build a broader view of their own. Thompson et al. (2016) interpreted that socialization teaches us the normative expectations associated with each life stage and prepares us for entry into the next stage. Those false expectations reportedly created by social media usage may not take those young minds in the right direction at any stage of their lives.

5.3 Learning to Do It Right

The information provided by respondents about the education and training they received concerning the responsible design of algorithms may be insufficient, or students may have forgotten about the curricula at that point. Although participants reported receiving some lecture, seminar, or assignment on that topic, and since the participants were from the University of Alberta, this research performed some secondary content search on the university website at this point of analysis and found that the institution has programs that emphasize the interdisciplinary aspect of computing and allow students to study computing science alongside other subjects they might be interested.

The main computing science programs that the university offers are as follows:

- Bachelor of Science (BSc) Specialization
    - Specialization (Computing and X): Use computers to amplify their talents in different disciplines - from anthropology to film to medicine to zoology
    - Business Minor or Software Practice: Focus is on one of these specially designated areas
- Bachelor of Science (BSc) Honors
    - A challenge for highly motivated students

- Bachelor of Science (BSc) General
    - Allows them to focus on more than one area of study
    - Students can major or minor in computing science.

Source: www.ualberta.ca

However, three undergraduate three-credit courses related to this topic were found to be offered in the 2021-22 academic year, as follows:

CMPUT 298: Ethics of Data and Artificial Intelligence ★3

CMPUT 300: Computers and Society ★3

CMPUT 302: Introduction to Human-Computer Interaction ★3

Note: the complete list is in the Appendix

As reported by the respondents, most of these courses have only recently begun to be offered, and none of them are required for graduation, so students may avoid them if they are unaware of their importance. The participants also believed that raising awareness among the students and instructors is necessary because the authority may not afford to force someone to do or learn something unless students are aware and find it interesting and valuable for their careers. Therefore, they generally advised that the institution is in charge of raising awareness, redesigning the curriculum, and bringing the matter up in every academic discussion area where students are taught and trained to create algorithms.

5.4 Algorithmic Responsibilities

Respondents were first asked to envision themselves in the designer position and evaluate the professional practices of designing algorithms they could assume regarding their social media user experience and awareness. Then, different follow-up questions were asked when they mentioned negative aspects, including what they would want to keep in mind when they are

supposed to design the system responsibly. After generalizing most of their responses, it became clear that they put their thoughts on the irresponsible use of algorithms which already put people at an intersection where they may have to determine what is real and what is not all the time. Thus, they cited transparency, advocacy, and proper experimentation before making decisions as it tends to influence and shape social experiences.

These findings contribute to a better understanding of the interaction between technology and society, which Mauthner and Kazimierczak (2018) addressed by combining four conceptual approaches. Primarily, this technology is not neutral as it becomes an integral part of human interaction; when the users are on a platform using it, they are programming those algorithms to better understand them in the future. Moreover, there is very little human moderation happening on the backend, and therefore, most of the interactions are between the decision of algorithms and humans. For example, what kind of moderation does the automated system perform when accepting content and advertisements on the platform for a display to the general public? According to McChesney et al. (2013), even though the media are facilitating the users with the efficient ways possible to practice democracy, the political economy, on the other hand, is manipulating their engagement strategies on those platforms.

According to the literature review and the interview findings, algorithms, like democracy, influence what people see, do, and engage with in their daily lives. Thus, the designer must bear the responsibility of ensuring that algorithms reflect social norms, values, and principles. Finally, responsible design must not reinforce existing injustice. As a result, the young adult Computing Science students avoid utilizing social media since they are algorithmic aware and aware of its harmful effects. In the process of proper creative socialization for them, however, it is essential to surround themselves with the right people and objects. Following primary socialization as children and adolescents, secondary socialization occurs throughout their lives, whereby social

media may influence them if they are not conscious. Table 00 illustrates that as parents or guardians were used to moderating what they watch and do on digital media when they were children, how algorithms had been given the authority to make that decision for them on social media. It also demonstrates that while nobody is showing them the right paths, algorithms are taking advantage of their emotional weakness and misleading them accordingly.

Table 07

Social Media Communication and Socialization

Social media communication	**Primary Socialization**	**Secondary Socialization**
Time of life	Childhood and Adolescent	Rest or their entire life
Who are in control	Parents or guardians	Algorithms
Moderation tendency	Tend to moderate for their own good.	Moderate to maximize profits.
Example:	Parents may like to find a good friend for them and filter out bad friends even if they enjoy interacting with those bad friends because they are fun and exciting.	Regardless the good or bad, it may try to find like-minded friends: if the individuals gone anytime terrorist minded, technically it may help the users to find more terrorists to be friend with.

Regardless of their preference, they are exposed to the connections, content, and advertisements that may influence their growth. Furthermore, the algorithmic systems' recommendations may be highly biased in determining what users enjoyed or why they interacted with the information. Spending a few seconds on a post does not mean the viewer liked it. It might also suggest that the viewer disliked it but spent some time viewing it because the users felt it was scary or evil content. Regardless of the reasons, spending a few moments on it may give algorithms the authority to suggest the same type of content, which may not be a responsible

design to social responsibility. Although more research is needed on the platforms' operational policy initiatives and limitations, parents or guardians would never subject their children or adolescents to such treatment. At this stage of socialization of young adults, the most common guardian to decide is the state or local government, not algorithms or the company that implements those algorithms.

5.5 Possible Solutions

The following recommendations raised by participants may be due to limitations in their understanding of the issue, misinformed with regards to the role or responsibility or scope of govt policy and regulation. When participants were addressing the issues, they simultaneously started to recommend different solutions they could consider. Most participants started putting their thoughts on curriculum designers first before paying attention to any other group. This perception could be because they are still in that academic environment. When the respondents were asked about the missing part, they could think in terms of preparing the computing science student ready to design algorithms responsibly; they said that education policymakers should look into this issue closely and design curriculum accordingly so that students become prepared for it when they are in the job field. Some even recommended making the ethical design of algorithm courses mandatory to take in order to graduate.

After that, they pointed to the employers, the owner of the social media platforms, for instance, as most respondents felt that this decision is made without taking into account the harmful effect the users might have; instead, they optimize it just for financial gain. If the employers want developers to act responsibly, they can acquire it independently, even if they were not trained in ethics academically. Thus, learners will be interested, and academic institutions will also start offering those courses.

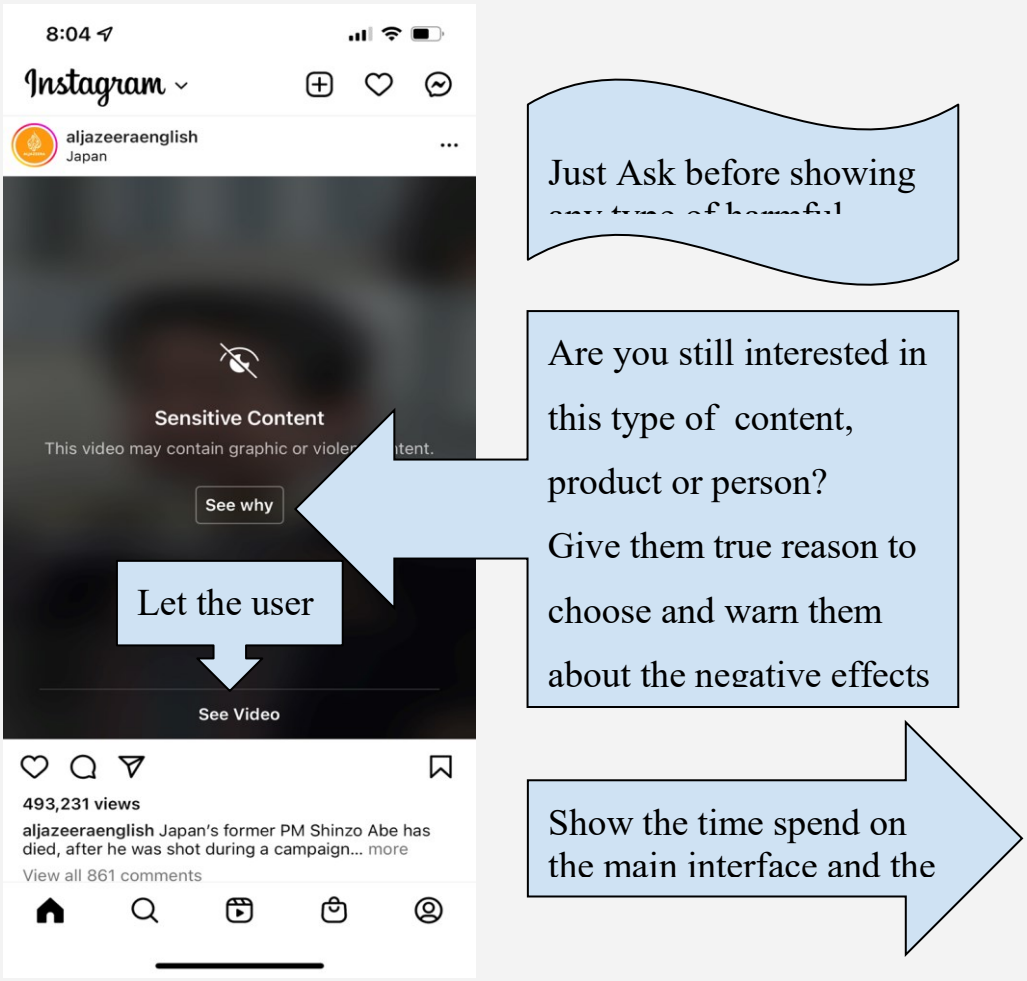
However, at this point, they raised the question: "who is going to make an employer do that as it would be more or less against their existing business policy." Then they found one group, the government, vital to play an essential role in resolving these ever-emerging problems. The respondents requested the government to take action, including researching to standardize ethics, which was suggested quite often, and teaching the designers academically and practically to do it right. These recommendations made by participants may be due to limitations in their understanding of the issue, or to being misinformed about the role, responsibility, or scope of government policy and regulation.

Raising awareness around algorithms and open discussion policy are also the recommendations that stand out. Most respondents mainly emphasized the importance of transparency. In transparency policy, this permissionless innovation on the internet should be "open, secure, and accessible to all" (Huizer, 2016). They also highly suggested keeping the ethical codes they follow open source. Because knowing how they are making decisions on, for example, what the users see and do not see on social media can build trust.

Moreover, many respondents felt that there should be legitimate ways to opt out of sharing users' personal information. Right to choose the information the users see and get to click on and interact with while scrolling social media is another aspect that saw the light during the discussion. Most of the respondents stressed the importance of informing users about what activities can lead them to what content. The main point of those recommendations is simple: "Just ask," as illustrated in Figure 03 below:

Figure 03

Right to Know and Choose



Source: www.instagram.com

The pattern of social media awareness and behavior reported by the majority of participants suggests that whatever content the algorithm suggests, simply giving users the right to know how and why the content is being suggested, as well as the right to choose, can make the platform more positively useful. Most respondents perceive that the goal of algorithms should not replace but enhance human intelligence. It should not make the user lousy by showing curated photoshopped images of how well other people look and how good their lives are. Instead, it should encourage them to do something creative and be confident and happy in life. Therefore, simply tagging a sentence on every curated content saying, "this is not the original photo," can save much emotional intelligence from going into depression.

Moreover, the general idea of recommendation algorithms, most respondents thought, without human moderation is to try to figure out the profile people, then try to match the profile with similar profiles based on their interests. Now, they may find it beneficial in terms of positive things like researching and doing innovative works together, but how about matching terrorized minds with hundreds of terrorized minds around the world so that they can form a group and attack nonsense? A better solution, such as human moderation, may be required here for each piece of content to appear on the platforms. However, to make this change happen, a workable force is needed, which is the most suggested and vital finding of this research; the responsibilities of the government.

In the end, the majority of respondents agreed that the government should first step forward, conduct research to determine the algorithmic implication pattern, implement regulations, and assist businesses in developing appropriate codes of ethics. Additionally, they thought that it would be the continuous work for the employer to keep up with studies, stay informed, and keep staff members updated about what becomes dangerous and what becomes helpful for the users. The fact is that the company cannot be dismissive of responsibility concerns at any point if it is raised by the laws. Governments also need to find out why companies do not care about the responsibility issues in a meaningful way. Respondents who pointed to the government derived from their feelings that employers are primarily responsible, but who will control the employer as they are not acting accordingly? Only the government can do that.

On the other hand, those who did not point it to the employers pointed to the curriculum. Then again, it ultimately means educational policy change where the government may also be involved. Many respondents believed that, even if an organization's entire team cared about responsible design practice, systemic mechanisms that prioritize financial interests over human wellbeing create a pervasive environment of irresponsible technology development.

Consequently, the respondents thought that corporate policy might require close government supervision.

5.6 Summary of the Findings and Discussion

It was so interesting that the discussion included the responsibility of university or curriculum designers, then the responsibility of the designers and employers. Then also the responsibility of the users. These arguments are also supported by Giddens (2009) that individual action and interaction creates and recreates a social structure. Although everyone needs to contribute to this process to solve this issue efficiently, there is only one agency that the respondents believed may become so useful here. This power issue added the government to the conversations throughout this study. A total of four groups of people are eventually involved during this process who play their part in making such products or platforms a reality for the general public and, at some point, also hold the responsibility to make it harmless. The table 09 below depicts the most effective mechanism that needs to be investigated further to see if it can effectively solve this ever-emerging problem.

The four groups of people evolved during this study.

Table 08

Mechanism to Reduce Negative Effect of Social Media

<table>
<tr><td rowspan="2">Government-></td><td>Group -1

Education policy and Curriculum designer</td><td>Group- 2

Students and Instructors</td><td>Group-3

Employer and Clients</td><td>Group-4

->Government</td></tr>
<tr><td>Push -></td><td>-></td><td>-> Pull</td></tr>
<tr><td colspan="5">Government -> Government -> Government -> Government -></td></tr>
</table>

The government may have to be more actively engaged in playing "Push" and "Pull" forces here to get the system working toward solving those ever-emerging problems. They would have to push the curriculum designer to design courses that raise awareness and teach the responsible design issue and proper code of conduct while teaching them to design algorithms. Then again, they would have to regulate employers so that they require employees to have the skills to pull the responsible design learnings from the curriculum and put them into practice. The majority of respondents indicated that the government may need to act as an engine for the vehicle that can bring about the changes that the world desperately needs. They also emphasized that the general populace, which is suffering, has already granted the government the power by electing them to initiate the mechanism that may bring about changes to ensure that the algorithms are not harmful to anyone, including age groups such as young adults, and help everyone communicate better without causing destruction to develop in life properly.

5.7 Limitations

This thesis has limits, just like every other piece of research, which were also taken into account when interpreting the results. To begin with, this study relies on a small sample size to make claims about entire courses or curriculum. This limitation should be noted, and future research should include a more detailed review of specific course content as well as interviews with instructors in computing science program. Second, due to time and travel constraints, the study had to go with someone with specific social media experience or at the very least knowledge of how systems are currently designed to work, even though it was crucial to obtain the most recent algorithms operating social media experience data from young adult computing science students as they were the focus of this study.

Finally, the research also has the limitation of considering the demographic focus of this study: the young adult computing science student's experiences are used to analyze and find the

result to apply to all the users. However, during the interview, many of them also found in the practice of their controllability recognizing harmful effects, which might be because they do have specific knowledge that the average user might not have even after raising a certain level of awareness among them. Moreover, the result might not apply to most young adult users with no post-secondary education, as this research aims to see whether including awareness education in every post-secondary curriculum might solve the problem. Gran's (2021) exploratory study in Norway also found significant demographic differences in people's awareness of algorithms based on their attitudes toward algorithm-driven newsfeeds and recommendations, which may also vary from culture to culture. The most crucial factor is if the system's design can prevent users from being in a situation where they constantly may have to exert self-control over potentially harmful content on social media, posing the challenge of what to trust and what to follow instead of concentrating on their development and something that matters to them, then why not do that?

6. Conclusion

Social media users encounter both positive and negative effects. Because young adults are the most frequent users and the right social environment is necessary to ensure their proper individual socialization, this study aimed to determine whether a certain level of awareness can help them use the platforms effectively while minimizing negative effects. The study achieved this by examining patterns of awareness among computing science students, a unique group of individuals who are algorithmically aware, as well as young adult consumers and future creators of the system since average young adult users are not expected to be algorithmically aware. The analysis found how their awareness prompts them to use it in a way that brings more positive outcomes reducing harmful effects. Additionally, it examined how they viewed current trends in instruction and training they had received about the responsible design of algorithms while

learning to create such platforms at a Canadian post-secondary institution. Finally, the research explored their opinions and suggestions regarding who is responsible for addressing this issue. Consequently, the following research questions were utilized:

RQ1: How do young adults with training in computing science perceive and understand the role of Algorithms in their social media consumption, and to what extent that awareness changes their users' behavior?

RQ2: How do they evaluate the responsible design aspects and the training and education offered to prepare them to design algorithms responsibly?

RQ3: What are their views and recommendations regarding responsibilities to solve any emerging problem and make algorithmic systems better aligned with human development?

The following section provides an overview of this study's results, significance, and limitations with future direction. First, it highlights the most important findings and suggestions, clearly explaining their significance regarding the research questions. Next, it describes how the results add to the body of knowledge on the subject and identifies the professional practices. Then it identifies opportunities for future research that arise from the study and provides specific recommendations based on the findings and limitations of the investigation. Finally, it summarizes the essential findings and contributions to the field and professional practices.

6.1 Summary of the Findings

Through a relevant literature review, the study obtained essential data on how algorithms are implicated in both the meaningful and harmful effects of young adults' social media consumption, which was also reflected in the interview. However, the careful analysis of interview data uncovered that, being aware of the irresponsible use of algorithms on social media, most young adult computing science students do not actively use the platform to avoid its harmful effects. Some reported having control over their consumption behavior, and most believe

it is created for the general public to maximize their time on the platforms instead of presenting them with the most valuable content.

The most disturbing finding in this study in terms of algorithmic implication on social media design is regarding recommendation algorithms that they believe the more people participate, the more the system learns how to make them more addicted, which may be difficult for ordinary young adult users to understand unless they have been institutionally educated and trained about it. However, due to being aware of the irresponsible design pattern, respondents are less likely to click on any content they do not want to be recommended further. On the other hand, the training and education provided to computing science students on responsible algorithm design were insufficient for them to confidently state that they could do it responsibly. Instead, the majority declared, they avoided it because it was not necessary or incentivized.

In terms of recommendations, the study's result yielded a collective approach to solve the problem that the institutions and agencies responsible for the platforms' existence must do their bit responsibly to address the issue. The process starts with educational institutions redesigning curricula for general students to raise awareness and for computing science students to ensure they learn to design algorithms responsibly. Employers then follow suit by acting under their social obligations. Finally, and most importantly, the government enacts rules and regulations to make the changes happen. The primary rationale behind this argument is that, like any other industry, when something poses a risk to the public, government regulation is required to ensure that it is operated responsibly.

6.2 Findings in Context

This study contributed to the algorithmic awareness literature focusing on young adults. Social media is a powerful and rapidly evolving communication vehicle; they must learn to use it better. The research result has become significant in the academic and professional world as it

discovered that a specific pattern of awareness could prompt everyone, including young adults, to look beyond the technical possibilities and ask what aims such convenient social communication platforms serve. This query is consistent with Gillespie's (2014) research on the importance of algorithms and the public value of analyzing the systems to understand them.

Moreover, how algorithmic awareness changes user behavior on social media is a promising discovery that could apply to all social media users. Thus, the study results also add to the "social shaping of technology" (SST) literature by illustrating how social experience influences reshaping technology usage (MacKenzie & Wajcman, 1985). Furthermore, the study result contributes to the literature on corporate social responsibilities, where the respondent recommended that employers act under their social commitments. Finally, it adds to the debate over why and how employers require a set of standards for responsibly creating and administering algorithms on the platforms to be financially successful and gain user trust while being responsible to society and its progress.

However, the most significant contribution of this research is the recommendation regarding government responsibilities to address the matter, including holding employers accountable. This accountability also allows other recommendations, such as changes in curricula, employer expectations, or company policy, to become a reality to solve the problem. Furthermore, the authority needs to act as soon as possible because industries using algorithms are growing so fast that they already exist everywhere. For example, when the plastic industry was discovered, the world could not be happier to have different tools at the lowest price possible. Similarly, people did not consider electric cars because gasoline engines were initially found to be more convenient. However, when the global environmental issue came up, the discussion started, but it became too late, so the globe is suffering. Is it still too hard to picture the same scenarios with algorithms? Social media with algorithms is becoming as beneficial as those

industries, with easy access and convenience, but is it adversely affecting our social environment?

6.3 Future Direction

Although this research tried to find groups of professional designers on the Discord platform, no such discussion was found regarding the responsible design of algorithms. However, based on this research findings and limitations, further study could be done in the following area:

1. Researchers should study the professional group of algorithm designers to find out what they perceive when designing algorithms responsibly.
2. Researchers must assess the level of awareness among other program students to bring the necessary curriculum that may considerably raise awareness while not using too much of their academic period.
3. The study result contributes a little to the literature on corporate social responsibilities and code of conduct which could be recommended as an avenue for future research.
4. Researchers should also explore how the government can plan to implement appropriate regulations to address the issue.

The researcher also tried to validate the information provided by the respondents regarding awareness and discussion of the issue among the students and professors, talking to some instructors, and they provided the same information as the respondents did, which is that they follow the curriculum. Furthermore, despite the secondary search on the University of Alberta website to validate the information the computing science students provided regarding their training and education to design algorithms responsibly, this research still asserts that more in-depth exploration is required around curriculum design for computing science students.

6.4 Summary of Conclusion

This study begins with the researcher's interest in the harmful effect of social media use on young adults and the pattern of their awareness regarding algorithmic implications of their social media consumption. Then it evolved into a study examining how algorithmic awareness may help young adults use social media in a way that could lead to more beneficial results reducing harmful effects. Thus, the final goal of this research was to explore the experience and perceptions of young adult computing science students, who are considered algorithmic aware, to see if raising awareness among all young adults could be recommended as part of the solution to the ever-emerging problems of algorithmic implication. As a result, the study came with several significant findings that expanded and deepened the conversation on the responsible design of algorithms.

The findings contribute that if education and training regarding responsible design practice for students envision themselves designing algorithms and awareness to all other students could be ensured through academic curricula, it may bring practical solutions to the problem. However, it also answers how and what could make this change happen. Primarily the changes in academic curricula seem possible if the employer demands employees who know how to design algorithms responsibly, which may directly conflict with employer interest and the company's policy to maximize profits. In that moment of discussion, the most important result of this study was discovered; government responsibilities. Although many respondents said that whether it is a government or educational institution, the initiative has to come from an institutional level as no individual can do much about it. Almost all of them recommended that the government be responsible for protecting its people just like they do to secure the public from other issues.

In summary, the most significant contribution of this study to the field and professional practice regarding the design and use of such platforms is providing the necessary education and

raising awareness through the academic curriculum. In addition, to make these changes happen, the government could play a dual role by incentivizing education and awareness-raising practices by redesigning the curricula and enforcing the corporation to change their operational policy, creating demand for the outcomes of those redesigned curricula learnings. Finally, governments need to control the employer's irresponsible motives towards developing those platforms with rules and regulations just like they do to protect people from other socioeconomic insecurity.

References

Arnett, J. J. (1995). Adolescents' uses of media for self-socialization. *Journal of Youth and Adolescence: A Multidisciplinary Research Publication, 24*(5), 519-533. https://doi-org/10.1007/bf01537054

Alvarado, O., & Waern, A. (2018). Towards algorithmic experience: Initial efforts for social media contexts. *In Proceedings of the 2018 chi conference on human factors in computing systems.* 1-9. ACM Press, Montreal. https://doi-org.login.ezproxy.library.ualberta.ca/10.1145/3173574.3173860

Barron, A. M., Krumrei-Mancuso, E. J., & Harriger, J. A. (2021). The effects of fitspiration and self-compassion Instagram posts on body image and self-compassion in men and women. *Body Image*, *37*, 14–27. https://doi.org/10.1016/j.bodyim.2021.01.003

Bijker, W. E. (2015). Technology, social construction of. *International Encyclopedia of the Social & Behavioral Sciences*, 24(2), 135-140. https://doi.org/10.1002/9781405186407.wbiect025

Boddington, P. (2017). *Towards a Code of Ethics for Artificial Intelligence*. Springer. UK

Bradshaw, C., Atkinson, S., & Doody, O. (2017). Employing a Qualitative Description Approach in Health Care Research. *Global Qualitative Nursing Research, 4, 1-8.* https://doi.org/10.1177/2333393617742282

Brisson-Boivin, K., & McAleese, S. (2021). Algorithmic awareness: Conversations with young Canadians about artificial intelligence and privacy. *MediaSmarts*. Ottawa.

Brough, M., Literat, I., & Ikin, A. (2020). "Good social media?": Underrepresented youth perspectives on the ethical and equitable design of social media platforms. *Social Media and Society*, *6*(2), 1-11. https://doi.org/10.1177/2056305120928488

Bucher, T. (2013). The friendship assemblage: Investigating programmed sociality on Facebook. *Television & new media*, *14*(6), 479–493. https://doi.org/10.1177/1527476412452800

Bucher, T. (2017). The algorithmic imaginary: Exploring the ordinary effects of Facebook algorithms. *Information, Communication & Society*, *20*(1), 30–44. https://doi.org/10.1080/1369118X.2016.1154086

Bucher, T. (2020a). Nothing to disconnect from? Being singular plural in an age of machine learning. *Media, Culture & Society*, *42*(4), 610–617. https://doi.org/10.1177/0163443720914028

Bucher, T. (2020b). The right-time web: Theorizing the kairologic of algorithmic media. *New Media & Society*, *22*(9), 1699–1714. https://doi.org/10.1177/1461444820913560

Christian, B. (2020). *The alignment problem: Machine learning and human values.* (1st ed.). W.W. Norton & Company.

Cooley, C. H. (1983). *Human nature and the social order*. Transaction

Crouse, L. (2021, October 08) *For teen girls, Instagram is a Cesspool.* The New York Times. https://www.nytimes.com/2021/10/08/opinion/instagram-teen-girls-mental-health.html

Deibert, R. (2020). *Reset: Reclaiming the internet for civil society.* House of Anansi Press.

Festl, R., Reer, F., & Quandt, T. (2019). Online sexual engagement and psychosocial well-being: The mediating role of sexual victimization experiences. *Computers in Human Behavior*, *98*, 102–110. https://doi-org/10.1016/j.chb.2019.04.010

Gangneux, J. (2019). Logged in or locked in? Young adults' negotiations of social media platforms and their features. *Journal of Youth Studies*, *22*(8), 1053–1067. https://doi.org/10.1080/13676261.2018.1562539

Geib, S., Magin, M., Jürgens, P., & Stark, B. (2021). Loopholes in the echo chambers: How the echo chamber metaphor oversimplifies the effects of information gateways on opinion expression. *Digital Journalism*, *9*(5), 660–686. https://doi.org/10.1080/21670811.2021.1873811

Giddens, A. (2009). *Sociology* (6th ed.) Polity Press.

Gillespie, T. (2014). The relevance of algorithms. In T. Gillespie, P. J. Boczkowski, & K. A. Foot (Eds.), *Media technologies: Essays on communication, materiality, and society.* (pp. 167–194). https://doi.org/10.7551/mitpress/9780262525374.003.0009

Gillespie, T. (2018). *Custodians of the Internet: Platforms, content moderation, and the hidden decisions that shape social media*. Yale University Press.

Gran, A. B., Booth, P., & Bucher, T. (2021). To be or not to be algorithm aware: A question of a new digital divide? *Information, Communication & Society*, *24*(12), 1779–1796. https://doi.org/10.1080/1369118X.2020.1736124

Hemphill, T. A. (2019). 'Techlash', responsible innovation, and the self-regulatory organization. *Journal of Responsible Innovation*, *6*(2), 240–247. https://doi.org/10.1080/23299460.2019.1602817

Huizer, M. (2016, October 17). Freedom, permissionless innovation, and a successful internet. Retrieved from Educause Review: https://er.educause.edu/articles/2016/10/f-p-i-and-a-s-i

Kemp, S. (2022, January 26). *Digital 2022: Global overview report*. Datareportal. https://datareportal.com/reports/digital-2022-global-overview-report

Khatoon, B., Hill, K. B., & Walmsley, A. D. (2015). Instant messaging in dental education. *Journal of Dental Education*, *79*(12), 1471–1478. https://doi.org/10.1002/j.0022-0337.2015.79.12.tb06048.x

Kidd, P. T. (2012). Social networking technologies as a strategic tool for the development of sustainable production and consumption: Applications to foster the agility needed to adapt business models in response to the challenges posed by climate change. In M. Cruz-Cunha, P. Gonçalves, N. Lopes, E. Miranda, & G. Putnik (Eds.), *Handbook of Research on Business Social Networking: Organizational, Managerial, and Technological Dimensions* (pp. 509-522). IGI Global. https://doi.org/10.4018/978-1-61350-168-9.ch027

Kim, Y., Wang, Y., & Oh, J. (2016). Digital media use and social engagement: How social media and smartphone use influence social activities of college students. *Cyberpsychology, Behavior, and Social Networking*, *19*(4), 264–269. https://doi.org/10.1089/cyber.2015.0408

Kitchin, R. (2017). *The data revolution: Big data, open data, data infrastructures & their consequences*. Sage, UK.

Koenig, A. (2020). The algorithms know me and I know them: Using student journals to uncover algorithmic literacy awareness. *Computers & Composition*, *58*, N.PAG. https://doi-org.login.ezproxy.library.ualberta.ca/10.1016/j.compcom.2020.102611

Kunst A. (2022, May 18). *Social media usage by platform type in Canada 2022.* Statista. https://www.statista.com/forecasts/998535/social-media-usage-by-platform-type-in-canada

Li, J., Li, F., Wang, W., & Zhai, J. (2021). An information dissemination influence model for mobile social network under multi-role view. *International Journal of Uncertainty, Fuzziness & Knowledge-Based Systems*, *29*(1), 1–15.

Literat, I., & Brough, M. (2019). From ethical to equitable social media technologies: Amplifying underrepresented youth voices in digital technology design. *Journal of Media Ethics*, *34*(3), 132–145. https://doi.org/10.1080/23736992.2019.1638259

Liu, X., Luo, Y., Liu, Z.-Z., Yang, Y., Liu, J., & Jia, C.-X. (2020). Prolonged mobile phone use is associated with poor academic performance in adolescents. *CyberPsychology, Behavior & Social Networking*, *23*(5), 303–311.

Livingston, J., Holland, E., & Fardouly, J. (2020). Exposing digital posing: The effect of social media self-disclaimer captions on women's body dissatisfaction, mood, and impressions of the user. *Body Image*, *32*, 150–154. https://doi.org/10.1016/j.bodyim.2019.12.006

MacKenzie, D., & Wajcman, J. (1985). *The social shaping of technology: How the refrigerator got its hum.* Open University Press.

Mauthner, N. S. & Kazimierczak, K. A. (2018). Theoretical perspectives on technology and society: Implications for understanding the relationship between ICTs and family life. In *Connecting Families.* (pp. 21-39). Bristol University Press.

McChesney, & R. Waterman. (2013). *Digital disconnect: How capitalism is turning the Internet against democracy.* New York: The New Press.

Meier, A., & Schäfer, S. (2018). Positive side of social comparison on social network sites: How envy can drive inspiration on Instagram. *Cyberpsychology, Behavior, and Social Networking*, *21*(7), 411–417. https://doi.org/10.1089/cyber.2017.0708

Mills, J. S., Musto, S., Williams, L., & Tiggemann, M. (2018). "Selfie" harm: Effects on mood and body image in young women. *Body Image*, *27*, 86–92. https://doi.org/10.1016/j.bodyim.2018.08.007

Montgomery, K. C. (2015). Youth and surveillance in the Facebook era: Policy interventions and social implications. *Telecommunications Policy*, *39*(9), 771–786. https://doi.org/10.1016/j.telpol.2014.12.006

Mortimer, J. T., & Simmons, R. G. (1978). Adult Socialization. *Annual Review of Sociology*, *4*, 421–454.

Mujcic, R., & Oswald, A. J. (2018). Is envy harmful to a society's psychological health and wellbeing? A longitudinal study of 18,000 adults. *Social Science & Medicine*, *198*, 103–111.

Nowell, L. S., Norris, J. M., White, D. E., & Moules, N. J. (2017). Thematic analysis: Striving to meet the trustworthiness criteria. *International Journal of Qualitative* Methods, 16(1). 1–11. https://doi-org.login.ezproxy.library.ualberta.ca/10.1177/1609406917733847

Ozcinar, H., & Tanyeri, T. (2016). The relationship between undergraduates' view on internet censorship, and their media literacy level. *Öğretmen Adaylarının Sansüre İlişkin Görüşleri İle Medya Okuryazarlığı Düzeyleri Arasındaki İlişki.*, *9*(2), 165–188.

Palinkas, L. A., Horwitz, S. M., Green, C. A., Wisdom, J. P., Duan, N., & Hoagwood, K. (2015). Purposeful sampling for qualitative data collection and analysis in mixed method implementation research. *Administration and policy in mental health and mental health services research,* 42(5), 533-544.

Paulich, K. N., Ross, J. M., Lessem, J. M., & Hewitt, J. K. (2021). Screen time and early adolescent mental health, academic, and social outcomes in 9- and 10-year-old children: Utilizing the adolescent brain cognitive development [SM] (ABCD) Study. *PLoS ONE*, *16*(9), 1–23.

Robinson, K., & Aronica, L. (2009). *The element: How finding your passion changes everything*. Penguin.

Rollero, C. (2016). Bringing objectification into social relationships research: Is self-objectification harmful for authenticity? *Spanish Journal of Psychology*, *19*, 1–7. https://doi-org.login.ezproxy.library.ualberta.ca/10.1017/sjp.2016.34

Sandelowski, M. (2004). Using qualitative research. Qualitative Health Research, 14, 1366–1386. doi:10.1177/1049732304269672

Srnicek, N. (2017). *Platform capitalism*. John Wiley & Sons.

Starks, H., Trinidad, S. B. (2007). Choose your method: A comparison of phenomenology, discourse analysis, and grounded theory. *Qualitative Health Research, 17*, 1372–1380. doi:10.1177/1049732307307031

Steinmueller, R. M. (2020). Digital platform origins and novelty. In R. M. Steinmueller, *Advanced introduction to platform economic*s (pp. 15-34). Edward Elgar Publishing Limited.

Sullivan-Bolyai, S., Bova, C., & Harper, D. (2005). Developing and refining interventions in persons with health disparities: The use of qualitative description. *Nursing outlook, 53*(3), 127-133. https://doi.org/10.1016/j.outlook.2005.03.005

Talpur, B. A., & O'Sullivan, D. (2020). Cyberbullying severity detection: A machine learning approach. *PLoS ONE*, *15*(10), 1–19. https://doi-org.login.ezproxy.library.ualberta.ca/10.1371/journal.pone.0240924

Thompson, W. E., Hickey, J. V., & Thompson, M. L. (2016). *Society in focus: An introduction to sociology*. Rowman & Littlefield.

Vaismoradi, M., Jones, J., Turunen, H., & Snelgrove, S. (2016). Theme development in qualitative content analysis and thematic analysis. 100-110. DOI: 10.5430/jnep.v6n5p100

Van Deursen, A., & van Dijk, J. (2014). The digital divide shifts to differences in usage. *New Media & Society, 16*(3), 507–526.

Van Dijck, J. (2013). The culture of connectivity: *A critical history of social media*. Oxford: Oxford University Press.

Willson, M. (2017). Algorithms (and the) everyday. *Information, Communication & Society*, *20*(1), 137–150. https://doi.org/10.1080/1369118X.2016.1200645

Wolfowicz, M., Perry, S., Hasisi, B., & Weisburd, D. (2021). Faces of radicalism: Differentiating between violent and non-violent radicals by their social media profiles. *Computers in Human Behavior*, *116*. https://doi.org/10.1016/j.chb.2020.106646

Yeung, K. T., & Martin, J. L. (2003). The looking glass self: An empirical test and elaboration. *Social Forces*, *81*(3), 843–879.

Zuboff, S. (2019). *The age of surveillance capitalism: the fight for a human future at the new frontier of power*. New York: Public Affairs.

Appendix A: Interview Guide

Research Questions

RQ1: How do young adults with training in computing science perceive and understand the role of Algorithms in their social media consumption, and to what extent that awareness changes their users' behavior?
RQ2: How do How do young adults with training in computing science evaluate the responsible design aspects and the training and education offered to prepare them to design algorithms responsibly?
RQ3: What are the views and recommendations of computing science students regarding responsibilities to solve any emerging problem and make algorithmic systems better aligned with human development?

To illustrate a clear vision of what the researcher and the participants are going to discuss, a short paragraph by Crouse (2021) is as follows:

> What exactly are we talking about here? Say you're a 23-year-old girl who is beginning to feel anxious about her appearance and has followed some diet influencers online. Instagram's algorithm might suggest more extreme dieting accounts with names such as "Eternally starved," "I have to be thin," and "I want to be perfect."
>
> In an interview with "60 Minutes," Ms. Haugen called this "tragic" that "as these young women begin to consume this eating disorder content, they get more and more depressed," she said. "It actually makes them use the app more. And so they end up in this feedback cycle where they hate their bodies more and more."

Questions

Section A: Awareness and Pattern of social media usage

1. What are the effects of social media algorithms that concern you most?
    a. What's your view on algorithms: How do you evaluate the way that you see and do not see certain content?
2. According to your experience on social media, how do you find yourself using social media knowing how algorithms are implicated on social media to work?
3. How do you think social media influences your career decision, overall your personal as well as socioeconomic development?
4. How often did you discuss the responsible design of algorithms issues with your classmates and how concerned do your instructor and classmates seem to be regarding those issues?

Section B: Perception of responsible design

5. Imagine if you are designing or coding an interface according to the work order of your employer or client, how do you think it's important to think about the possible harm it could make?
6. How would you evaluate those practices of designing algorithms which are creating these effects?
7. How would you address the responsible design and implications of algorithms?

8. Have you enrolled in any course that taught and trained you about the responsible design of algorithms? Have you been taught or trained anything about it?
    a. What was missing or could be done better in terms of preparing you for designing algorithms responsibly?

Section D: Recommendation

9. Who do you think should take the responsibility to assess the responsible algorithmic design issues so that it does not harm any user?
    a. According to your experience on social media, what responsibilities do you think developers should consider while designing algorithms?
10. How do you think the negative effects of algorithms could be eliminated?
    b. Any further recommendations or options to solve this problem?

Appendix B: Undergraduate 3 Credit Courses 2021-22

*Note: INTD courses cannot be used to satisfy a CMPUT option or a Science option in any program.

Course Number	Title	Course Number	Title
CMPUT 101	Introduction to Computing ★3	CMPUT 401	Software Process and Product Management ★3
CMPUT 174	Introduction to the Foundations of Computation I ★3	CMPUT 402	Software Quality ★3
CMPUT 175	Introduction to the Foundations of Computation II ★3	CMPUT 403	Practical Algorithmics ★3
CMPUT 191	Intro to Data Science ★3	CMPUT 404	Web Applications and Architecture★3
CMPUT 201	Practical Programming Methodology★3	CMPUT 411	Computer Graphics ★3
CMPUT 204	Algorithms I ★3	CMPUT 412	Experimental Mobile Robotics ★3

CMPUT 229	Computer Organization and Architecture I ★3	CMPUT 414	Introduction to Multimedia Technology ★3
CMPUT 250	Computers and Games ★3	CMPUT 416	Foundations of Program Analysis ★3
CMPUT 267	Basics of Machine Learning ★3	CMPUT 428	Computer Vision ★3
CMPUT 272	Formal Systems and Logic in Computing Science ★3	CMPUT 429	Computer Systems and Architecture★3
CMPUT 274	Introduction to Tangible Computing I★3	INTD 450	Computers and Games (Capstone)★3
CMPUT 275	Introduction to Tangible Computing II★3	CMPUT 455	Search, Knowledge and Simulation ★3
CMPUT 291	Introduction to File and Database Management ★3	CMPUT 463	Probabilistic Graphical Models ★3
CMPUT 296	Games Artificial Intelligence ★3	CMPUT 466	Machine Learning ★3
CMPUT 297	AI for Non-Scientists ★3	CMPUT 474	Formal Languages, Automata and Computability ★3
CMPUT 298	Ethics of Data and Artificial Intelligence ★3	CMPUT 495	Honors Seminar ★0
CMPUT 300	Computers and Society ★3	CMPUT 496	Distributed Software Development ★3
CMPUT 301	Introduction to Software Engineering★3	CMPUT 497	Intro to NLP ★3
CMPUT 302	Introduction to Human Computer Interaction ★3	CMPUT 497	Introduction to Combinatorial Game Theory ★3
CMPUT 304	Algorithms II ★3	CMPUT 497	Artificial Intelligence Capstone ★3
CMPUT 307	3D Modeling and Animation ★3	CMPUT 498	Performance Modeling and Design of Computer

			Systems ★3
CMPUT 312	Introduction to Robotics and Mechatronics ★3	CMPUT 365	Introduction to Reinforcement Learning ★3
CMPUT 313	Computer Networks ★3	CMPUT 366	Intelligent Systems ★3
CMPUT 325	Non-Procedural Programming Languages ★3	CMPUT 379	Operating System Concepts ★3
CMPUT 333	Security in a Networked World ★3	CMPUT 382	Introduction to GPU Programming★3
CMPUT 340	Introduction to Numerical Methods★3	CMPUT 391	Database Management Systems ★3
CMPUT 350	Advanced Game Programming ★3	CMPUT 396	Intermediate Machine Learning ★3
INTD 350	Game Design Principles and Practice★3	CMPUT 355	Games, Puzzles, Algorithms ★3

Source: www.ualberta.ca