Students' experience with using chat systems for social interaction during the COVID-19 pandemic

Muminah Koleoso

4th Year Project Report
Computer Science and Mathematics
School of Informatics
University of Edinburgh

2023

Abstract

Positive social interaction in Higher Education (HE) can improve students' well-being and by extension their academic performance. During the COVID-19 pandemic, the transitioning to hybrid teaching and studying remotely have had a considerable impact on students' social interaction, with snowballing effects on their settling into and benefiting from university life, integrating into the student community, and even mental health.

While not a complete solution, chat systems such as WhatsApp, Facebook Messenger and Slack have been a help to students under these circumstances. Also referred to as messaging apps or (mobile) instant messaging tools, they allow two or more people to communicate via the Internet or a network through sending and receiving messages, primarily via text, but with recent advancements also through graphics and audio.

The aims of this project were to understand student experiences with using freely available chat systems for social interaction during the pandemic, and evaluate existing chat systems against the features that prove beneficial. Its steps were the following:

1. Review the literature on social interaction amongst HE students and during the pandemic;

2. Conduct a systematic review on student experiences with using chat systems for social interaction during the pandemic; extract beneficial, and less beneficial, features of this systems, which become the evaluation criteria for step 3;

3. Conduct an evaluation to a) identify all freely available, functional and recently updated chat systems from the systematic review and user study; b) assess them in terms of including the beneficial features; c) conclude on the best overall chat systems, and the best for different features;

4. Make recommendations for the best chat systems.

Research Ethics Approval

This project obtained approval from the Informatics Research Ethics committee.
Ethics application number: 7078
Date when approval was obtained: 2022-10-26
The participants' information sheet and a consent form are included in the appendix.

Declaration

I declare that this thesis was composed by myself, that the work contained herein is my own except where explicitly stated otherwise in the text, and that this work has not been submitted for any other degree or professional qualification except as specified.

(*Muminah Koleoso*)

Acknowledgements

Firstly, I would like to thank God for granting me the wisdom and perseverance to complete this project. Next, I would like to thank my supervisor Cristina Alexandru for all of her help and support throughout this project. And last but not least, I would like to thank all of my family and friends for their love and support.

Table of Contents

Chapter 1

Introduction

1.1 Context and Motivations

It is well-known that a major part of a student's experience of Higher Education (HE) is not just down to the quality of their studies, but also the quality of their social interactions [63] [78]. Positive social interactions in HE can improve the well-being of students and by extension their academic performance as well [108].

With the onset of the COVID-19 pandemic and subsequent implementation of social-distancing and lockdown measures, most Universities across the world became fully or partially closed, which affected more than 80% of students[94]. This meant many could not return to campus, and those on campus had limited interactions with members outside their shared household. Students thus had to adapt to socialising solely through online means.

Social interaction is particularly important for students and young people because for many students, University is their first time navigating the world independently of family support [48]. Therefore, it is vital that they are able to form new support networks and communities within the student environment.

The shift to online social interactions, resulted in many challenges for students such as the difficulties with settling into University life and integrating into the student community, resulting in feelings of loneliness and isolation [108]. However, the increased online social interaction did result in some positive outcomes for students such as the ability for them to form communities and a sense of belonging that transcended geographical borders, timezones and other physical constraints.[110] Furthermore, socialising via online means allowed students to utilise unique aspects of the communication channel such as asynchronous communication, to enhance their interactions.[41]

Ways that students used to socialise online include[41]: chat systems such as, WhatsApp[30] and Telegram [26], video conferencing tools such as Zoom [31] and Microsoft (MS) Teams [25], discussion forums such as Reddit[19] and social media platforms such as Instagram [12]. However, this report focuses on students' experience of using chat systems.

Therefore, the purpose of this project is to help guide students in deciding which chat system is best for facilitating social interaction between them and their peers, as currently there's a wide variety and the most popular system in the market may not necessarily be the best for the intended purpose. Furthermore, choosing a sub-optimal chat system could limit the quality of a student's social interactions, which in turn could result in negative consequences for students, as mentioned previously. This project also aims to determine how the way students use chat systems for social interaction can be improved by recommending design practices that developers can use when creating these systems.

1.2 Aims and Objectives:

The aim is to analyse the effectiveness of chat systems in facilitating student social interaction in, both academic and extracurricular settings, during the COVID-19 pandemic through answering the following research questions (RQs):

- RQ1 What are the characteristics of a beneficial online social interaction?

- RQ2 In what ways did students make use of chat systems for social interaction during the COVID-19 pandemic ?

- RQ3.1 Which chat systems did students find most effective for facilitating social interaction?

- RQ3.2 Which features of chat systems did students use, and what made them more or less beneficial for social interaction?

- RQ4 What guidelines can be derived for design practices to better facilitate beneficial social interaction between students via chat systems?

RQs 1-3 were answered, based on results from the literature and user study of University of Edinburgh (UofE) students and RQs 3-4 were answered based on results from the software evaluation.

1.3 Project Overview

In chapter 2, I have outlined the background of this project, defining key terms and providing a literature review of recent, relevant work. In chapter 3, I have described the method used to complete this project including a literature review, user study, systematic review and software evaluation. In chapter 4, I discuss the results of the user study, providing quantitative and qualitative analysis of the data. Chapter 5 outlines a detailed plan for the systematic review using an adapted version of the PRISMA[83] statement and the results obtained from this review. Chapter 6 outlines the evaluation of different chat systems' functionality and the results of this evaluation. Chapter 7 provides some guidelines and recommendations for designing chat systems. And finally, chapter 8 provides a summary of the project's results, conclusion and discussion of the implications of this project and potential future work.

Chapter 2

Background

2.1 Social Interaction

2.1.1 Importance of social interaction for HE students

Human social interaction has been an integral part of well-functioning societies and communities for centuries [34] and is facilitated through various forms of verbal and non-verbal means of communication. The main benefit of social interaction is the positive effect it can have on people's physical and mental well-being [44]. It also helps people to form connections and build a community, which is important in combating the risk of loneliness and isolation.

Socialising in the context of Higher Education can refer to both peer-to-peer interactions amongst students as well as student-faculty relations, i.e. interactions with course instructors [70]. Social interaction is particularly important for those in Higher education in helping them build a support network with other students and gain a sense of belonging [44] which is an integral part of easing a student's transition into campus life. Furthermore, students can make connections that could prove useful in the future e.g. in building a professional network, enhancing their social skills [114] and improved academic performance [106] [61]. Social interaction is an integral part of students' well-being, and can increase their motivation and engagement with learning [63] [61] which can result in their improved performance[42] [108]. Conversely, a lack of positive social interactions can result in overall decrease in student well-being through feelings of loneliness and isolation [109] which can negatively impact their experience of HE.

2.1.2 Advantages and disadvantages of Online Social Interaction

Since the development of Internet Communication Technologies (ICTs) such as emailing, texting and online chat systems[89], students have been able to socialise both in-person and through online means. Online interactions can also be referred to as Computer Mediated Communication or CMCs [41]. Some advantages of online social interaction compared to socialising in-person include:

(1) Increased accessibility[110] to interact with people irrespective of geographical lo-

cation, e.g. in different time-zones. This enriches their student experience by increasing the overall number of people they can interact with and exposing students to greater diversity in experiences and backgrounds.

(2) The option of anonymity, which allows students to communicate more openly without fear of being judged (depending on the features of the system being used to communicate). [110]

(3) The opportunity for asynchronous communication e.g. the ability to review a message before submitting it allows students to draft contributions to conversations in a way that cannot be facilitated by face-to-face (F2F) social interactions. [110]

However, online social interaction, especially amongst young people, is often associated with various harms and risks such as cyber-bullying [110], the ability to distract users from sleep or important responsibilities like schoolwork [93] [64]. However, there is a general consensus in research that these risks can be mitigated by young people's techniques for handling and navigating them [110], such as reaching out to trusted family members/carers, utilising report functions on platforms and being mindful of their account privacy settings. [93]. Another disadvantage of online social interactions is that in order to access to utilise CMC, students would require electronic devices such as mobile phones and suitable software, e.g. an instant messaging app on their phone and lacking the necessary equipment and/or internet connection would prevent them from connecting with their peers in this way. This issue is minimised, however, as use of electronic devices, in particular mobile phones, is widespread amongst the student population [105].

2.1.3   Social Interaction and COVID-19

Following the World Health Organisation's (WHO) declaration of the COVID-19 pandemic on March 11th 2020 [46]many countries implemented some form of lockdown and social-distancing restrictions in order to counteract the virus' spread. This led to the full or partial closure of Universities and the shift from in-person to predominantly online and hybrid teaching models. As a result of these measures, facilitating in-person social interaction beyond members of one's household became difficult [71], so students had to rely on ICTs such as chat systems to help bridge this gap. As discussed previously, a lack of social interaction can lead to adverse consequences for students and studies have shown that feelings of loneliness and isolation increased as a result of the pandemic [109] [58] especially amongst young adults [71].

2.2   Overview of Chat Systems

There are lots of different types of ICTs[93] [89] that facilitate online social interactions, with chat systems being one of them[41]. Chat systems can also be referred to as 'messaging apps'[104], 'instant messaging tools'[98], 'mobile instant messaging (MIM)'[98] [105], [103] and are a form of technology that allows for 2 or more people to communicate via the Internet or another form of network through sending and receiving messages[37]. This is done primarily via text [41], but with advancements in chat system technology, messages are often a mixture of media including text, graphics (emo-

jis and stickers) and audio. Some other features of the chat systems include: private and group messaging, and sharing files[102]. Chat systems have multiple features but with messaging as their primary feature (different to SMS texting) and are also not integrated into another platform, e.g. direct messaging functionality as part of Instagram[12]. Due to the text-based nature of chat systems they can be difficult to define as this form of 'online chat' is a common component of other forms of ICT e.g. social networking services (SNS) and video conferencing tools[41]. For the purposes of this project, chat systems have been defined in terms of the following features: (adapted from [102]:

1. Primary function must be messaging

2. Private Messaging

3. Group Messaging

4. File-sharing

5. Sharing images and videos,

6. Chat/message history

Common additional features [102][41], include: calling (audio-only and with video), Online status, Read and Delivery receipt, Contact List and Notifications.

Chat system is the main term that is used in this paper. Other definitions imply that communication is done exclusively via text-based messages, whereas modern chat systems have additional features nowadays such as the ones listed above which allow for various modes of communication. This aspect of chat systems can be referred to as multimodality[41].In this paper the terms: tools, platforms and software will also be used interchangeably to refer to chat systems. Chat systems are one of the most popular forms of ICT [104] [76]. A major advantage of chat systems compared to other ICTs is the unique combination of both asynchronous and synchronous communication, (which can be described as 'quasi-synchronous')[104] [105]). This is because with messaging, one can draft messages before submitting them in a similar fashion to composing an email, but unlike emails users can receive a response both in faster time (sometimes immediately[47]), or after a significant time delay[64].

2.3 Literature and Systematic Review

2.3.1 Introduction

The project involved a review of relevant literature, as well as 2 systematic reviews, one on the student experience of chat systems and another on evaluating the chat systems themselves. A literature review involves examining sources such as research papers and books in order to summarise and critically analyse previous research related to a particular topic.[66] A systematic review involves summarising literature using specific methods to choose and evaluate research on a particular topic. There are different methods that can be used, but they have to be explicit and reproducible. [35] [113] The main difference between the 2 review types is that a literature review tends to look at a smaller sample of literature, whereas systematic reviews are more

comprehensive/rigorous as they look at all the relevant literature on a topic before filtering out resources that do not fit the eligibility criteria.

2.3.2 Description of PRISMA [83] Framework

For the systematic review in this project, the PRISMA[83] statement was used. The PRISMA [83] statement (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) is a well-established, widely-recognised guideline including a 27-point checklist that can be used to efficiently report on a systematic review. The checklist is divided into 7 sections, namely Title, Abstract, Introduction, Method, Results, Discussion and Other Information. Below is a description of each section [83]:

Title: The title should include details regarding the objective of the study. [83]
Abstract: Provides a short overview/summary of the review [83]
Introduction: Includes the rationale and objective of the review[83]
Methods: this section details the eligibility criteria used to filter sources so that only relevant ones are included in the review [83]. Additionally, this section includes the plan used to search for studies and explains how they were selected. The method of extracting, summarising and analysing data from the studies as well as assessing the levels of bias and certainty in them is also mentioned.
Results: The PRISMA[83] framework also includes a flow diagram in this section to track the number of records initially selected before the screening process, where items are included/excluded based on a set of eligibility criteria. The studies that are included are cited and their results stated. Then the results are analysed and reported.
Discussion: Includes a summary of the review results, expansion on any limitations of these results or the review process itself, as well as discussion of future research[83].
Other Information: In this section, registration information and review protocol (if applicable) are stated[83]. Also, any support for the review (e.g. financial) is mentioned along with competing interest between multiple authors of the review (if applicable) and the availability of data from the study.

2.4 Data Collection and Analysis Methods

The project also involved a user study. For the study multiple data collection methods were considered including [84] focus groups, interviews, questionnaires and observation studies. Focus groups involve gathering information of the opinions and attitudes of a group of people through moderated discussion[60]. Unlike focus groups, interviews involve a researcher directing questions to an individual. Interviews can be either structured, with a fixed set of prepared questions, completely unstructured using open-ended questions based on participant responses and semi-structured which combines both methods. Questionnaires resemble interviews as they can include both open-ended and close-ended questions, however unlike interviews, questionnaires can more easily gather information from a large group of individuals therefore generating lots of data. All of these methods can be conducted F2F or online and can produce a mixture of qualitative and quantitative data. The standard analysis methods of descriptive statistics (including mean, median, mode and standard deviation) can be used to summarise

quantitative data and interpret results[52]. To interpret qualitative data, the techniques content coding[95] and thematic analysis[40] can be used. Content coding [95] involves labelling and categorising data into themes, and thematic analysis is a useful method to examine these themes and identify key patterns.

2.5 Software Evaluation

The effectiveness of a piece of software can be evaluated in terms of both its functional and non-functional features[43]. Functional requirements encompass a system's capabilities and tasks it must be able to carry out, e.g. if a chat system includes a feature to share files between users. On the other hand, non-functional requirements refer to general attributes the system should have that affect a user's experience, e.g. how easy or difficult a system is to use. There are various different methods for evaluating software [111] including those that involve the target user either by collecting their usage data directly or by asking users to provide feedback in the form of verbal reports or a questionnaire. Other methods such as design walkthroughs where software developers walk through a software to identify potential areas of improvement and heuristic reviews involving evaluating systems based on a set of usability heuristics. Non-functional requirements such as usability can be difficult to define [43] as they are less tangible than functional features of a system. However, this User Experience Questionnaire[97] which is a standardized questionnaire format often used to measure software usability, details a comprehensive list of various different non-functional requirements for software.

2.6 Related Previous Work

2.6.1 Students' usage of chat systems for social interaction

Previous literature on chat system usage for social interaction concerning HE students tended to focus on socialising within an academic setting, e.g. peer-learning, discussions, group projects etc. rather than in extracurricular capacities [87] [76]. In particular, this systematic review by Sivabalan K, Ali Z [98] synthesised results from 40 articles and focused on how using MIM improved the language learning experience for students. Christoph Pimmer and P Rambe [87] conducted a systematic review that found using MIM in education improved student engagement and enhanced collaborative learning. However, the main limitation of this study's finding is that only 11 studies were included in the review. A more-large study [76] carried out by Florence Martin, Lynn Ahlgrim-Delzell, and Kiran Budhrani analysed 157 articles and identified instant messengers as the most used ICT compared to other video conferencing tools and other ICTs. The greater number of studies included in the review therefore make the findings more generalisable, however, all three of these studies [98][87] [76] are quite outdated which limits the significance of the findings. A more recent systematic review[39] by Melissa Bond, Svenja Bedenlier, Katja Buntins, Michael Kerres, and Olaf Zawacki-Richter explored how a range of ICTs, including social networking tools (some of which could potentially include chat systems) effectively engaged HE students in their

education. However, although more recent, all four of these studies precede the onset of the COVID-19 pandemic and therefore are not applicable in this context. Other research related to use of chat systems in Higher Education were limited to studying the experience of a small subset of students, within one department of the university e.g. Law or Nursing [70], [86] which meant that the relationship between how students from different departments interact with ICTs could not be explored.

Other studies concerning students have mainly studied their experience using multiple forms of ICTs and has not focused on chat systems, again in primarily educational contexts[90][36]. For example, Jessie S Barrot. provided a comprehensive number of chat systems (classified as social media) in this systematic review[38], including not only WhatsApp [30], but WeChat [29], QQ [27], Snapchat [24], and Skype [22] as well. The study found that social media (which included chat systems in this classification) is beneficial for facilitating language learning amongst students. It is important to note the literature included in this review was not limited to HE context - it included Primary and Secondary education, so this may affect how applicable the results are to HE students. Where the studies explore chat system usage only, most tended to focus on only one chat system, especially WhatsApp[30] such as these studies exploring how Whatsapp helped create a sense of belonging and connectedness amongst students[81] [99].

2.6.2 Evaluating effectiveness of chat systems for social interaction

Previous research has tended to focus on only one or comparing a small handful of chat systems, especially the more popular ones such as [102] WhatsApp[30] [87] [98] and Telegram [45]. These studies [87] [98][102] are quite outdated as they were conducted before 2020, in particular the study by Sutikno, Tole, et al. was published in 2016 and since then the messaging app Viber has become less popular with WhatsApp [30] being more-widely used currently [98]. Additionally, the chat systems mentioned in these studies have been updated to include new features such as the ability to delete messages for all users in a chat[45], share stories [36] or send disappearing messages [73]. Studies that provided a comparison of several chat systems tended to only evaluate one or two features of the systems, for example this study [96] by Theodor Schnitzler, Christine Utz, Florian M Farke, Christina Popper, and Markus Durmuth on user's perception of message deletion in MIM which examined the function in 17 different chat systems and this study[56] which focused on emoticon usage.

Overall, what makes this project significant is the context of COVID-19, focus on extracurricular peer-peer interactions and evaluation of multiple features of several chat systems. The results of this study are thus useful in addressing a gap in the research on HE students' online social interactions. This project is also unique due to the triangulation of the following methods: a user study, systematic literature review and evaluation of chat systems with a focus on student's experience of using them for social interaction during the COVID-19 pandemic. Although the scope of the User study in this project was limited to a sample of UofE students, the systematic review was not limited to only this context, therefore the more generalised results have helped to support any findings from the user study. Finally, the evaluation, provided a practical application of these results.

Chapter 3

Methodology
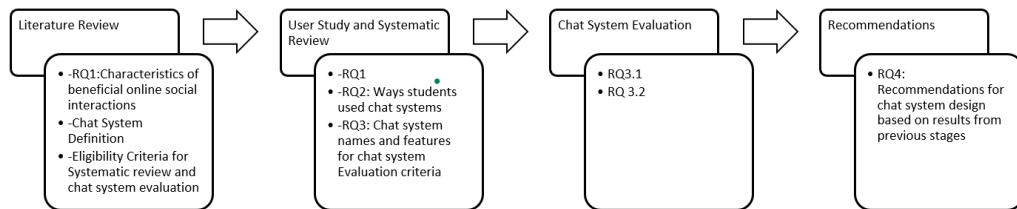
Figure 3.1: Flow chart illustrating the main steps of this project and the outcomes of each step

The following chapter outlines the steps taken to complete this project.

3.1 Literature Review

The initial stage of the project involved conducting a review of literature on topics relating to social interaction amongst students in Higher education, in-person or online via ICTs including chat systems or in the context of the COVID-19 pandemic to gather background information on the topic. Specifically, the outcomes the literature review produced included providing eligibility criteria to be used in conducting the systematic review and chat system evaluation. Additionally, the literature review provided key features for defining chat systems as well as methods for reviewing literature and collecting and analysing data to inform the method of this study.

3.2 User Study

The next step involved conducting a user study of UofE students on their use of chat systems for social interaction during the COVID-19 pandemic to provide answers for RQ2 and RQ3. For this, various different data collection and analysis methods

were considered as detailed in section 2.4 of the background chapter, but ultimately questionnaires were chosen. Focus groups[84] were considered as more data could be collected per focus group session due to the ability to observe multiple participants simultaneously. However, organising focus groups poses the logistic issue of getting multiple people who are all available at the same time to participate. As well as this, they would need to be hosted by an experienced moderator, which was not available for this study. Therefore, there is a greater risk of not receiving balanced input from participants which would result in data biased to a handful of individuals, essentially defeating the initial purpose of the data collection method.An online questionnaire was chosen as it is an easy way to distribute questions to a large number of participants, thus increasing the probability of gaining a sufficient amount of data [60]. Furthermore, an online questionnaire also allows answers to be given anonymously, which is likely to encourage participation. However, the main risk with questionnaires is for participants to not feel incentivised enough to take the time to complete the questionnaire and give quality answers. To help with this, semi-structured interview questions were prepared to complement the questionnaires and gain more in-depth responses from participants. However, running the questionnaire resulted in enough responses with detailed and insightful data, so conducting interviews was no longer necessary. This was also partly due to the consideration of time constraints as the interviews themselves, as well as the process of transcribing and analysing all the resultant data, is incredibly time-consuming.

Once results were obtained from the user study, descriptive statistics and visualisations such as graphs were produced from the quantitative data. The qualitative data obtained was reviewed and thematically analysed.[40] Reviewing the data involves content coding [95]. Different techniques were considered[95] including Descriptive, in Vivo, Emotion and Process. Process coding was not used as it is more applicable to responses involving lengthy descriptions of a process, which is not applicable in this case as a majority of students' responses to the open-ended questions were brief. Combining Descriptive, inVivo, and Emotion coding made it easier to simultaneously summarise, maintain some key recurrent words from student responses as well as keep track of the emotions expressed. Thus, the likelihood of losing out on some data was minimised, which ensured maximum opportunity for rich analysis.

3.3 Systematic Review

The systematic review had two main stages, which were adapted from the PRISMA statement[83]: forming the plan and executing this plan to review literature exploring the student experience of chat systems during the COVID-19 pandemic. The plan involved first setting eligibility criteria for including relevant sources in the review and excluding irrelevant sources, as well as choosing key search terms to extract results from the search engines Google[8] and Google Scholar[10]. Once extracted from the 2 search engines, all results were screened and either included or excluded depending on if they met the eligibility criteria or not. Finally, relevant data in the form of quotations were extracted from the included papers, stored in a spreadsheet table and the major findings overall were summarised in this report. An additional outcome of this systematic

review involved extracting eligible chat systems to be evaluated, and the overall results contributed to answering RQ 2 and RQ3.

3.4 Evaluation of Chat Systems

The chat system evaluation was conducted in order to determine which platforms were the most effective for facilitating social interaction overall and in terms of their individual features, and thus provide answers to RQ3 and RQ4. The methods of evaluating software detailed in the background chapter are usually implemented for one system but as I evaluated multiple, using one of these methods, e.g. collecting usage data for multiple chat systems, would be an incredibly time-consuming process. Therefore, the method used in this project that suited the limited time and resources of this project, was an adapted version of a design walkthrough focused on identifying the existence or absence of specific chat system features. To evaluate some aspects of the system's usability, I also adapted criteria from this User Experience Questionnaire [97].

I downloaded each chat system in order to carry out the evaluation, if downloaded and an account created successfully, then the chat system was included in the evaluation process. I then created a second account on a different device and carried out the evaluation, simulating communication between two parties from these devices. I exclusively tested mobile app versions available on a Samsung Galaxy A80 phone[20] and Samsung Galaxy S10e[20] device, both with Android[2] Operating systems (OS). (I used these 2 devices as they were readily available to me and no funding was provided to explore the option of purchasing alternatives.) Any feature that could not be found were then looked up on the company website for the app, or generally via Google [8] Search. I tested most of the features myself using these 2 accounts but in order to test the group features, I involved another person to simulate group functions as group functions could only be tested effectively with a minimum of 3 different accounts in the same chat otherwise with only 2 people all communications would be equivalent to private/direct messaging. No personal data was collected from this person in this process, as they required no active involvement. A numeric scoring system was used to track the availability of the features, with descriptive statistics calculated for the subtotal and final scores.

3.5 Guidelines for Chat system design and usage

The final stage of the project involved providing guidelines and recommendations in answer to RQ4 on chat system design based on the results produced from the previous stages of the project.

Chapter 4

User Study

This chapter outlines the process of carrying out the user study and also contains a summary and analysis of the results.

4.1 Aim

The aim of this study was to provide answers for RQs 1-3 through gaining a better understanding of students' attitudes and behaviours using chat systems. In particular, their expectations for what beneficial social interactions via chat systems should entail (RQ1), how they used these systems to facilitate social interaction (RQ2) and which chat systems and their specific features they felt aided or hindered this process (RQ3).

4.2 Study Participant Recruitment

In order to recruit participants, my supervisor emailed the questionnaire to all students within the School of Informatics, and I also forwarded the questionnaire through other social media channels and groups with fellow Edinburgh University students. The questionnaire was open for 12 days from 27th October till 7th November 2022 and during this time follow-up messages were sent out to students to encourage them to complete the questionnaire. The total number of participants that completed the questionnaire was 110, and based on the results from A.11 - 108 of these students had experience using chat systems. (The remaining 2 did not have experience and therefore were only able to answer questions 1-9 of the questionnaire, as the remaining questions regarding chat systems were not applicable.) A detailed summary of the participant demographics is in this table A.9 Each participant will hereby be referred to as S1-110.

4.3 Protocol

As detailed in section 3.2 of the methodology, I prepared a set of close-ended and open-ended questions based on RQs1-3 A.1, for participants as well as a Participant Information Sheet (PIS) and consent form D.1 for them to read before answering the

questions. MS Forms[17] was used to create the questionnaire and gather responses. The online format was used as a convenient way to distribute the questionnaire amongst students in order to directly access their perspective of chat system use for social interactions during the COVID-19 pandemic.

4.4 Data Analysis

I initially got some basic and overall insights using automatically generated visualisations provided by MS Forms[17] and MS Excel[16]. I used these and calculated descriptive statistics to analyse the quantitative data. For qualitative data, results from the literature review were used to suggest some themes as starting points for top-down coding (also to list some potential themes and subthemes for the thematic analysis[40]). NVivo[18] was used to carry out this combination of top-down and bottom-up coding and thematic analysis. The coding techniques [95] used were a combination of primarily In Vivo coding as well as Descriptive and Emotion coding. After coding all the data, I introduced some themes based on key themes identified in literature review and added new themes identified from the coding process. Themes were then reviewed again after the 1st systematic review to rename/re-categorise some responses and themes to align better with certain terminology/themes identified in the review. This section of the appendix **??** shows the final themes and subthemes.

4.5 Results

4.5.1 RQ1 Characteristics of beneficial online social interactions

The following are the major themes identified in participant responses to Q9A.11 discussed in order of most to least mentioned.

Emotions and Feelings (148)
The most common theme in students' answers (136/148 references) related to a positive feeling or emotion they felt that online social interactions should elicit or should be experienced. The 2 most recurrent themes that were mentioned being related to 'Happiness/increased well-being' and 'Community/connection/togetherness and sense of belonging'. The following response exemplifies both themes: S36 'Comfort, happiness and having a connection with a person online makes you feel less lonely'. This is in-line with results from the literature, as it highlights the importance of community and sense of belonging that students have[75] [62]. Some answers (12/148) students gave referred to negative emotions they wanted to avoid in order to have a beneficial online social interaction. This included students who explained how it was important to them to feel less lonely or isolated: One student detailed how they did not want 'toxicity' in an interaction and two stated they wanted interactions to not be 'anxiety-inducing' which can be expected as online communications have often been associated with evoking stress and/or anxiety for users [33]. One participant, S82 also explained how it was important that online social interactions are: 'situations where it does not feel like I'm being talked down to, and that what I'm saying is being properly understood'.

Relationships

Many answers (44) students gave also referenced how beneficial online social interactions involve certain relationships, such as those with family and friends, maintaining pre-existing relationships as well as forming new ones. S44: 'Meeting new people, keeping contact with friends and family who you may be away from' In particular, many student responses mentioned how chat systems helped them to maintain contact with other students when physical distance was a barrier, e.g. being outside the UK due to COVID-19 restrictions.

Purpose of interaction

Students also (41) detailed purposes of online social interactions they perceived as beneficial. This included: general communications with one another talking and chatting or asking/answering questions as well as providing social support and helping each other, particularly providing information e.g. notifying each other of University events.

Connection with in-person interactions

Some students (7) mentioned how they felt a beneficial online social interaction should prove an adequate substitution for F2F interactions, provide a means for preparing to meet another person online or that the interaction should motivate them to want to continue interacting with the person beyond their online relations but in-person.

4.5.2 RQ2 Ways students used chat systems for social interaction

Frequency of Chat System Use

Based on results from Q11 A.13 (91/108, 84.26%) of students used chat systems at least a few times a week to interact with other students and (75/108, 69.44%) used them at least once a day, which conforms with findings in literature that most students use chat systems at least a few times a week [70].

Academic and non-academic social interaction

Based on results from Q12A.14 of the questionnaire, it can be hypothesised that most of this usage of chat systems was spent interacting with other students for mostly non-academic purposes: (46/108, 43 %) used chat systems for 'Mostly non-academic related, occasionally academic-related purposes'. And few used for solely academic or non-academic purposes (8/108, 7.4%).

Approximately 40% of students (43/108) did not explain any ways chat systems aided their social interaction and responded to Q16A.20 with 'none' which could have been for numerous reasons: (1) The student felt chat systems had not helped them with social interaction at all (which is unlikely as this would contradict the results from Q15A.19 where most students (58.3%,63/108 felt chat systems improved the quality of their social interactions); (2) they were not sure/ could not remember any particular reasons; (3) it was quicker to write none in order to move onto the next question. Therefore, the following results will be referring to the remaining 60% of students (65/108). The results from the previous paragraph are reflected in Q16A.21A.22. Few responses (4) related to an academic purpose of communication, such as questions about homework or exchanging 'academic advice'. The 3 main activities students mentioned they used chat

systems for were chatting, calling and arranging meet-ups (both online and in-person). Many students (12) explained how chat systems helped them to maintain relationships and 'keep in contact' or 'stay in touch' with other students, especially those a distance away. A lot of students (7) also expressed how they used chat systems to 'connect with friends' and other students (9), particularly members of the same course or year group. In particular, one student mentioned how interacting in a group setting helped them, S77: 'The chat system I preferred to use did not necessarily need direct conversation between users, being able to interact in groups took the pressure off when initiating conversation or asking questions.' This student answered Discord [5] as their most preferred chat system question, therefore they were most likely referring to Discord's large group chat feature-the server[68].

4.5.3 RQ3.1 Most effective Chat Systems

Based on the results to Q10A.12, WhatsApp[30], FB Messenger[7], Snapchat[24] and Discord[5] were the 4 chat systems students had the most experience with. Based on the results from Q13 A.17A.16, WhatsApp [30], Discord[5], Messenger[7] and Snapchat [24] were the four most preferred chat systems of the students, with WhatsApp almost twice as popular as Discord (46/108, 42.6%) vs (25/108, 23.1%). This shows that generally, the chat systems that students have most experience using were also the most preferred, compared to the other chat systems. Based on the difference in standard deviation of the student responses A.16 there was a greater difference in the chat systems students had experience using, but less so in their preferred systems, which suggests students have a broad range of experience of different chat systems but mostly prefer to use the same few systems.

WhatsApp[30]: (83 responses) The main reason students gave (14/83) for why they preferred WhatsApp was its popularity with other users, i.e. the fact that most of their peers also used the app, which is exemplified in this quote from S45: 'Everyone I know uses it'. Many respondents (11/83) also mentioned how easy they found the app was to use and that they felt familiar with or used to using the platform (7/83.)
S22 - 'It is what I've used since I got a phone, so I'm most familiar with it.'

Discord[5]: (62) Most answers students gave explaining why Discord was their preferred chat system for interacting with other students referenced the wide range of features the system has compared to others (7/62) or mentioned how it helped them keep in touch with friends and other students, especially via student groups (6/62). Many students also mentioned that they found the app was 'easy to use'.
Messenger[7]: (24) Many students preferred FB Messenger as they found it easy to make student groups via the app, as it was easy to find people without using their phone numbers as a lot of other students had Facebook[6] accounts (9/24).

Snapchat[24]: (14) Similar to WhatsApp [30], and Messenger [7], the primary reason student gave for preferring Snapchet over other chat systems mentioned was that 'a lot of other people used' the app. Additionally, a couple of students mentioned that interactions via Snapchat compared to other systems
S40: 'feels more spontaneous and "human"'

Conversely, based on Q10 A.12, KakaoTalk[13] and Tencent QQ[**?**] only had 3/108 students respectively that had experience using them, which is most likely due to the fact that KakaoTalk is most popular in Korea[62] and Tencent QQ in China [27] with less usage outside the countries.

4.5.4 RQ3.2 Chat System Features

Based on the results from Q20 A.37, the top 5 features out of 18 that students selected as 'extremely beneficial' or 'very beneficial' are File-sharing, Sending images and Group messaging, Private messaging and Sending videos. This is reflected in the students' answers to Q18 A.26 and Q19 A.27 as the most mentioned features that students felt were important for a chat system to have were related to private or group messaging and exchanging media files (such as images and videos).

Chat, Messaging Features (74)
The two main sub-features of messaging mentioned by students were graphics (23/74) and voice notes/messages (13/74). The main reason students gave for the importance of graphics in a chat system was how they felt it would improve communication by allowing for more expression and also reduction in ambiguity of messages. Voice messages were also mentioned as improving communication for similar reasons, additionally two students mentioned their preference for speaking rather than communicating by traditional text-based messages.

The following are other sub-features of chat/messaging that were identified in at least 2 responses as being important for a chat system to have. Message reactions - the option to react to a message with an emoji makes the chat 'less cluttered', more realistic and makes communication easier. Read receipts - informs students if their message is being 'ignored' and puts pressure on recipient to reply. Chat muting - allows students to control and decrease overload of chat notifications. Specific message replies,- allows more clear communication. Visible Chat history - allows students to remember previous conversation. Text-formatting - in particular latex and code formatting was referenced due to the STEM-related degrees the students were studying.

Group chats (30)
Students felt group chats were important, mainly for facilitating Uni-related collaboration (8/30) e.g. for group assignments. In particular, one student, S86, expressed their desire for chat systems to be able to host especially large groups: "to involve larger groups of students and keep them connected". Some students (7/30) mentioned server/channel features, and the reasons given for their importance included how they helped students organise their conversations and made it 'easier to talk about common things'. This may have been in order to combat the potential for online conversations to overwhelm users with the frequency and volume of messages[33].

Media Features (39)
Out of 39 student responses related to media features, apart from 6 responses which referenced media in general: 15/39 mentioned sending images mainly because it helps them 'share stuff' with other students e.g. Uni-work; 10/39 sending files or documents because it facilitates sharing information and resources and 4/39 mentioned sending

videos mainly because it increases interactivity.

Calls (28 responses)
Video calls (19/28) were mentioned the most in student responses, the main reason given for why students felt this was important was that the feature enhanced their interactions either through making it more realistic or personal. The sub-feature share-screen (5/28) was mentioned the most, because it makes it easier for students to work together (assumed on University work).

Non-functional Features (34)
The most mentioned non-functional requirements that students felt were important for a chat system to have (based on answers to Q9, Q18 A.36, Q16, Q18 and Q19) were: Ease-of-use, Accessibility and Security. Many student responses mentioned how they felt it was important for chat systems to be 'easy to use' with the main reasons given for this being (out of 13 responses relating to this theme given to q16) (5/13) that the system's ease-of-use makes it worth using and the reverse, lack of ease-of-use would discourage them from usage. A few students (3/13) explained that the system being easy to use makes it easier for them to understand how to use the system, and (2/13) students mentioned that it affects the system's accessibility. Overall, ease-of-use being mentioned much more than the remaining non-functional features suggests students feel this feature has the greatest impact on their experience of using chat systems for social interaction compared to the other non-functional features. A few students' responses (7) explained how they felt the accessibility of chat systems was important because it would allow them to use the systems in different settings, e.g. 'on the go' or without having to leave their bed. (3/4) student responses related to security and privacy explained how they felt encryption was an important feature as it preserves privacy, with one student even saying that it 'affects experience the most'.

Less beneficial features
The top 3 features that students selected as 'not beneficial at all' in answer to Q20A.37 are: Location sharing (17.6%), Read Receipts (10.2%) and Online Status (7.4%).
The opinion of location sharing may have been influenced by privacy/security concerns that students had, as a couple of the students that felt location sharing was not very beneficial also mentioned security features such as end-to-end encryption were important for socialising with other students via chat systems in answer to Q19 A.27. Read receipts maybe have been viewed as less beneficial, as some students (4) explained in answer to Q19 A.27 that they 'forced' others to 'reply in real-time' and could also indicate if their message was being ignored. Additionally, one student, S24, highlighted how they felt both read and delivery receipts could be beneficial but also detrimental to their social interactions via chat systems: 'Having it all in the same space is quite nice often. Knowing when someone has read a message is nice ...though to be fair it can be annoying as well...' Similar conclusions can be drawn regarding the visibility of a student's online status to other students as indicated in S27's response to Q19 A.27: S27 'It's useful to see if other students working on a project are free to talk' - implying that a student's online status may be taken as invitation to strike up conversation, which may add unwanted pressure to a student to read and respond to messages.

Features that proved as barriers to beneficial social interaction

Based on the answers to Q17 A.23 A.25 (and some negative responses to Q16 A.20), most students (27) explained how socially interacting via chat systems was an inadequate substitution for in-person interactions, with some (4) expressing a general preference for in-person interactions and a common reason mentioned was a major limitation of primarily text-based chat system communication - message ambiguity [33]. (11) students discussed how they found it challenging to deal with message ambiguity when socialising with their peers during the pandemic.

A lot of students (11) also expressed how interacting via chat systems affected their relationships, especially how it made it difficult for them to form new relationships as well as how easy it was to lose contact with people and their discomfort with socialising with 'strangers' (i.e. students they did not know as well). Some students (13) mentioned the following negative emotions when recounting aspects of their experience socialising via chat systems: anxiety, depression, fear, awkwardness, exhaustion and overwhelm. For example, S16: 'It felt awkward starting a conversation without a reason, sometimes it was distracting from studies or work'. A few students (4) also explained how they found their messages being missed or not responded to, challenging. S22 'Lack of stimulation and authentic interactions/ bad feelings from not responding to others and not being responded to'. A few students (3) also mentioned how technology-related issues such as internet connectivity and audio issues negatively impacted their experience with social interactions.

4.6 Discussion

4.6.1 Limitations of evidence and study process

Generally, there were some conflicting responses, as some features and aspects of their experience of social interaction via chat systems were both liked and disliked. In most cases, the focus is on the majority opinions, but some minority opinions and anomalies were also discussed as they provide valuable insight into the students' experience overall. Participant recruitment and engagement with the survey was surprisingly not really an issue, so sufficiently rich data was obtained. However, the sample of students was quite biased and were not proportionate to the population of different student groups in the University of Edinburgh, e.g. there were few postgraduates and more than half of the students that completed the questionnaire were from the College of Science and Engineering. This limits the generalisability of any conclusions drawn regarding students' responses and their demographic data. There was some issue with forming the questions to be interpreted in the intended way and then also making assumptions and trying to understand student answers to questions requiring a written response, perhaps interviews could be done next time to help with this. Main limitations were assumptions made as to the meanings of student responses in the qualitative analysis, e.g. assumption that references to work were in relation to University/academic endeavours as opposed to employment. Some assumptions were made: e.g. spelling errors in student responses, interpreting the meaning of their answers and relating them to a theme. Students interpreting the questions differently. As well as this, asking students to self-report their experience of using chat systems leaves room for error, e.g. if students had trouble

recalling certain details or if their more recent usage of the systems influenced their perception of less recent usage (e.g. in the earlier period of the pandemic). An extension, limitation to improve the validity/reliability of the user study, perhaps a pretest could have been carried out to ensure the questionnaire questions are worded in the best way to ensure participants understand them better.

4.6.2 Summary

To summarise, students identified the following as important characteristics for beneficial online interactions; evoking positive feelings, maintaining pre-existing relationships with family and friends as well as establishing new ones and substituting in-person relations. Students used chat systems often and for mostly non-academic purposes, with the most popular and preferred chat systems being WhatsApp [30], Discord [5], Messenger [7] and Snapchat [24]. And finally, based on the overall results it can be seen that many students felt that features of chat systems, especially messaging, group chats and graphics enhanced the quality of their social interactions during the pandemic and contributed to a mostly positive experience of beneficial social interactions via these platforms.

Chapter 5

Systematic review

This chapter is split into two main sections. The first lays out the plan for the systematic review of literature, and the second part details the process of conducting the review and discusses the results obtained to provide answers to RQ2 and RQ3.

5.1 Systematic Review Plan

5.1.1 Introduction: Rationale and Objective

Currently, there is a consensus that the students' experience of using chat systems during the pandemic was a mixture of positive and negative however, by reviewing all the relevant literature on the topic, we can gain a better insight into this experience and will be able to conclude if it was a majority positive or negative experience. The main objective of this systematic review is to answer RQs 2 and 3. Through analysing the results of the systematic review, conclusions were drawn that can also provide answers to RQ1.

5.1.2 Methods

General Eligibility Criteria (EC1.1-1.5):

Results included in the systematic review must have the following characteristics:

- EC1.1 - Date of publication: 2020 onwards, this is because the start of the COVID-19 pandemic was declared in March 2020[46] so prior to this, all studies would have been completed outwith the context of the pandemic and therefore would not be relevant to RQs 2 and 3.

- EC1.2 - In English (either originally or an official translation)

- EC1.3 - From reliable source i.e. Research papers, Articles, Journals/magazines, books, e-books and not opinion-pieces or blogs

- EC1.4 - Fully-Published (so for books and e-books the publisher's name must be mentioned and for articles and papers they cannot be drafts and must mention the

conference or journal they are from)

- EC1.5-Free or accessible via the University Licence. (as this project is non-funded)

Content-Specific Eligibility Criteria (EC1.6-1.10): To ensure the studies are relevant to RQs 2 and 3, the content of the studies respect the following criteria:

- EC1.6 - Study must focus on students' experience of using chat systems

- EC 1.7 - The students mentioned must be in the context of Higher education

- EC1.8 - the chat systems can be referred to by synonyms identified in the literature e.g. chat app, mobile instant messaging however they must fit the definition from the background chapter

- EC1.9 - chat systems mentioned must have been active during the pandemic i.e. not be a future product that has not been released yet/is still being developed

- EC 1.10 - All of the above must be in the context of the COVID-19 pandemic

Information Sources

Searches for eligible studies were done via Google[8] and Google Scholar[10]. The former search engine can produce many reliable and relevant results such as articles and e-books published on websites unrelated to publishers e.g. on an authors' personal page and the latter can also provide access to many different types of scholarly resources.

Search Strategy

The focus of this research study is "Higher Education Students' experience using chat systems for social interaction during the COVID-19 pandemic" which effectively encompasses RQs 2 and 3 therefore, extracting the relevant keywords 'social', 'student', 'Higher education', 'COVID-19' 'pandemic' and 'chat system' from this is likely to produce results relevant to the study. Additionally, relevant morphs of the words, synonyms and alternative spellings obtained from the literature review and searching online thesauruses [77] [50] were also included.

1. social interaction, interaction, social, socialise, socialising, socialisation, socialize, socializing, socialization

2. student, undergraduate, postgraduate, scholar, tutee

3. higher education, higher learning, tertiary education, University, College, graduate school, institute, varsity, school, polytechnic, campus

4. COVID-19, COVID, coronavirus

5. pandemic, epidemic, outbreak

6. chat system, online chat, (social) chat/chatting app, (mobile) instant messaging/messenger (app/service/platform/software), MIM, IM, social messaging/messenger (app)

Keywords were tested out in Scholar[10] first as generally Scholar[10] produced more results than Google and were then refined to produce the following keywords which

were used in both Search Engines:

(“social interaction”) “student” (“higher education” OR “university”) “COVID” (“instant messenger” OR “chat system” OR “online chat”)

Explanation of operators used [32]:
the logical ‘AND’ between search terms is assumed by Google[8] so does not have to be specified
‘OR’ is equivalent to logical OR
‘()’ partitions the search query and determines which ones are checked first
“” ensures search results match the exact wording
‘-’ excludes a word from the search

The keywords were refined due to the following constraints [69]:
- Google’s[8] limit of 32 words in the search
- Google Scholar’s [10] 256-character max limit
- An Upper bound limit for of a total of 1000 results overall from Google and Scholar[10] combined was set. This was intended to help make the workload of the review manageable within the time-frame. The keywords were chosen in order to get as close to this upper bound as possible to minimise the effect this limitation will have on the quality of results obtained.

1. Searching “social interaction” without forcing the exact match returned more than double the results of searching for the exact match of the phrase. Therefore, the “” were kept to limit the results.
2. All synonyms for ‘student’ were dropped as, in Higher education, student is the most likely term that would be used, as for example pupil tends to refer to students in earlier education, tutee in private tuition and scholar in more advanced academic settings e.g. when referring to a researcher in a field
3. The extra synonyms for university were dropped in favour of retaining more synonyms for chat systems and socialising.
4+5. Including ‘COVID-19’ ‘coronavirus’ and the synonyms for pandemic limited results too much to about 100 in Google Scholar[10]. Also, the words referring to COVID and the pandemic could be omitted to keep within the search term limit because filtering the searches from 2020 onwards already increases the likelihood for results to fulfil EC 1.11.
6 Including ‘IM’ returned over 14, 000 results in Google Scholar[10] and ‘MIM’ took results over 1000 in Scholar[10], including ’online chat’ also produced approx. 1700 Scholar[10] results and not putting “” around the remaining synonyms returned almost 16,000 results in Scholar[10]. As including these terms greatly exceeded the upper bound limit, they were removed. The final set of keywords chosen produced 1141 total results, which is slightly exceeding the upper bound but by a reasonable amount Removing any one of the current terms drops the number of results by between 100-200. Therefore, it was decided to maintain the current selection in favour of maximising the number and quality of results obtained.

The steps below detail the Search Strategy For Google Scholar[10]:
1. Filter results to a custom range showing only those released from 2020 onwards
2. Untick option to include citations in order to exclude them from the search

3. Navigate to settings to filter results to English-only

4.The keywords were entered into the Search bar

5. Navigating again to the final page of search results to record the total number of results obtained

The steps below detail the Search Strategy For Google[8]

1. Filter results to a custom range showing only those released from 2020 onwards

2. Advanced search settings were used to filter results to English-only

3. The keywords were entered into the Search bar

4. Navigating to the last page of search results to select the option to undo omission of similar results

5. Navigating again to the final page of search results to record the total number of results obtained

-Selection Process EC 1.1-is already met due to the filter options applied for the search results to be restricted to publications from 2020 onwards, therefore does not have to be manually checked for every result.

for Google Scholar[10]

1. View each item in the search results

2. Check to see if the source is fully in English and therefore meets EC 1.2 as despite the filter implemented, some non-English results may still appear.

3. Check to see if the source is reliable and therefore meets EC 1.3 because the content may be based on authors' opinions and any factual information might not be verified and so cannot be included

4. Check to see if the source is fully-published and therefore meets EC 1.4

5. Check EC 1.5, and if free or institution-based access to the source is not possible then it will be dismissed

6. Reviewing the Title, Abstract (if there is one), Intro and conclusion/discussion of each study to see if the content is relevant to EC 1.6-11: and can therefore be included in the systematic review

7. Search for keywords (from the original list) to see if they are on the page using Ctrl+F in the order they are listed below:
a. social interaction, interaction, social, socialise, socialising, socialisation, socialize, socializing, socialization
b. student, students, scholar, tutee
c. higher education, tertiary education, University, College, institute, varsity, school, polytechnic
d. (COVID-19, COVID, coronavirus) OR (pandemic, epidemic, outbreak)*
e. chat system, online chat, chat/chatting app, (mobile) instant messaging/messenger, MIM, IM, social messaging/messenger

If at least one keyword from each list a-e does not appear, then this article will also be dismissed
*For d. some articles may refer to the COVID-19 pandemic, by synonyms of

either COVID or pandemic interchangeably, so mention of either makes the article relevant.

for Google [8]

1. Step 1 is adapted to exclude any results that are identical to those produced by Google Scholar[10] already so that they are not reviewed twice

2. Steps 2-7 is the same as for Google Scholar[10].

Data Collection Process, Data Items and Synthesis Method
Once a study has met all the eligibility criteria, the name, source of the study and details of its data items were recorded in an MS Excel[16] spreadsheet.

The major eligible outcomes (data items) for the systematic review results are:

1. Student Experience of using chat systems for online social interaction during the COVID-19 pandemic
   -How students used chat systems
   -Purpose of interactions
   -Positive outcomes of the experience
   -Challenging aspects of the experience

2. Chat systems
   -Chat system names mentioned
   -Their benefits and limitations

3. Chat system features
   -Chat system features mentioned
   -Their benefits and limitations

Selection of outcomes where multiple were reported: If there are multiple results/outcomes, for example many articles are likely to discuss the experience of students with other ICTs and not just chat systems or online/internet-based social interaction only the information relevant to chat systems were extracted or information referring to a feature that is shared by chat systems and other ICTs were recorded.

Study Risk of bias assessment and Effect Measures were not included as that aspect of the PRISMA is more relevant when conducting a meta-analyses for the studies and not applicable here As this is a systematic review of different types of literature. **Eligibility for synthesis**
Initial screening stage: To determine if an article was eligible to be included for synthesis, it was screened against the EC criteria (insert link).
2nd stage: Then after the initial screening of all the search results, the remaining selected papers were read thoroughly, to extract data but if upon reading the paper it was not relevant enough to the study it was then excluded from synthesis at this stage.

(Synthesis method): Statistical synthesis methods and therefore methods exploring heterogeneity and sensitivity analysis were not explored, which also means corresponding results section for these items were omitted as these would have been relevant for a meta-analysis. Instead, a summary approach where the relevant data points were

highlighted in the papers and extracted to a summary of findings tables has been used. Additionally, thematic analysis[40] was conducted to analyse the results.

5.2 Conducting the Systematic Review

5.2.1 Study Selection
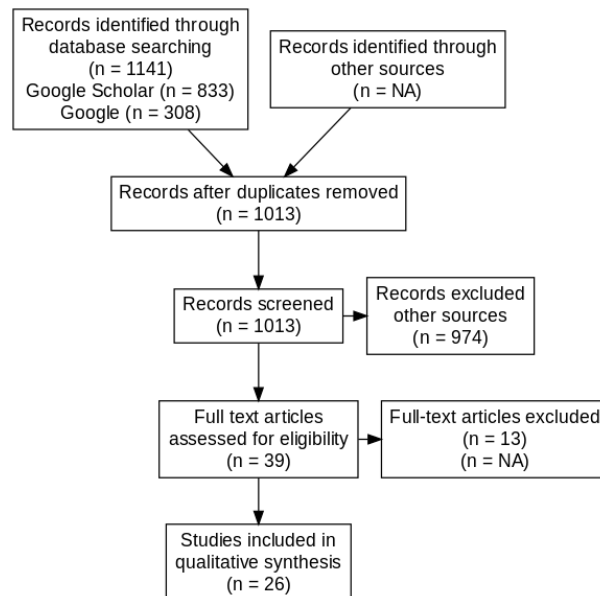
Figure 5.1: PRISMA Flow of studies for systematic review adapted from [54]

Once search results were obtained from Google [8] and Google Scholar[10] they were initially checked via steps 1 - 6 of the selection process. A few articles at this stage were excluded due to failing EC criteria 1.2, 1.4 and 1.5 i.e. were not fully in English, were preprints or had no free full access. However, most articles excluded at this stage of screening failed at stage 6 of the selection process when scanning the titles, abstracts, intros and conclusions due to the following reasons:

EC1.6 - student voice/ experience: Many articles failed these criteria as they were exclusively covering teacher's perspectives of online student social interaction during COVID-19 and did not cover the experience from a student's perspective
EC 1.7 - HE context: Many articles referenced students from different stages of education e.f. e.g. Primary, Secondary or simply referred to a general population (that may or may not have included Higher ed students)
EC1.8 - Many articles referred to chat system use for formal teaching practice, e.g. lessons taught via WhatsApp [30]
EC1.9 - Many articles failed to make mention of any chat systems and either referred to other forms of social software such as social media or video conferencing tools. Others referred exclusively to other ICTs and digital tools/media in general such as Virtual reality tools, chatbots and gaming.
EC1.11 - Covid-19 context : And finally a few articles also failed as they were not in the context of COVID-19, e.g. the study the paper was reporting on was carried out

before the pandemic began. The list of studies included in the synthesis are shown here **??** and the results analysed in the following section

5.2.2 Discussion

5.2.2.1 Interpretation of results

RQ2 Ways students used chat systems for online social interactions

Three main types of interactions were identified in the literature: peer-to-peer which was mentioned in a majority of the literature [62] [33], with mentioning both peer-peer relations as well as student-instructor relations [1] [80]. And finally, a few papers also mentioned the importance of students' interactions with external individuals (non-members of campus life e.g. family) [51].

Chat system mediums A few articles mentioned that a majority of students communicated via chat systems using their mobile phones[33], [55], [80] and in particular this study[67] mentioned that after mobile phones, accessing chat systems via laptops was the second most common method with tablets and PCs being the least popular mediums.

- Positives: Some studies discussed how student social interaction via chat systems helped to make students feel connected and created a Sense of belonging [75] [62] [80].There was also mention of how students were able to provide each other with Social Support via chat systems and show solidarity through their shared experiences, especially their experience of social-distancing and self-isolation as part of Covid-19 lockdown measures [80]. Another positive aspect of their experience that was highlighted was being able to engage in social interactions that provided stress-relief. [62] [51] -Another key theme was how chat systems aided students with transcending physical/geographical barriers [62] [80] to form connections, which was especially important in the pandemic context that prevented students from being based in one central location (i.e. university campus). In particular this study [82] discussed how, via chat systems, students were able to form a "translocal identity" i.e. achieve global citizenship through the opportunity to form virtual student communities internationally, across geographical borders without needing to physically visit these spaces.

- Another major theme highlighted in the literature was the relationship between students' interactions via chat systems and their persistence and retention in Higher education[49] [107] [79] (i.e. if a student remained enrolled in HE until graduation). In this study, it was identified that student interaction via chat systems was a factor that contributed to student's carrying through and finishing their degree. The findings from [49] also support this outcome. However, this study [107] found that through the use of a class WhatsApp[30] group students were able to form a classroom community which was intended to aid their persistence in HE, however, the study concluded that there was no significant correlation between participation in the group and the student's persistence.

- Activities students engaged in: A majority of the literature discussed the student experience of using chat systems for academic purposes, with the main recurring themes being collaborative learning or group work [33] [85], and using chat systems to facilitate informal language-learning practice [57][107][80]. - The main themes and

topics of student chat/conversations, (aside from academic/course-related conversations) included discussion of Negative news/messaging (especially fear, anxiety or uncertainty concerning Covid-19) [80] [57], Hobbies/Interests and daily life [80].

Negative aspects of the student experience: Negative emotions and mental health issues including depression, fear, anxiety, stress [67] [51] [49] attributed to specific aspects of the nature of online communications[33] such as experiences of cyber-bullying [65] or the general context of COVID-19 related issues effecting students [57]. Loneliness and social Isolation was a prevalent theme in the literature [51][62] [74] [80] [55] [57] due to the feeling students had of chat systems being insufficient in fully-replicating the feelings of in-person interactions Tech-related issues were mentioned either in terms of barriers e.g. lack of internet connection/access to necessary devices e.g. smartphone, laptop [67] or in terms of lack of digital literacy amongst students and the difficulty or reluctance they had to learning how to use new technology in particular new chat systems they were not previously familiar with. [1] [112]

RQ3: Chat systems mentioned (and associated features):
-1. WhatsApp[30]: WhatsApp[30] was the most mentioned chat system amongst the articles(n=16). In numerous studies it was the most popular chat system used amongst students [59] and also the chat system they were most familiar with [67] which aligns with the user study results. A few studies mentioned how WhatsApp[30] aided communication between students despite being physically apart due to COVID-19 restrictions [75] And also made reference to WhatsApp's [30] [75] convenience and 'speed'. In regard to the specific WhatsApp[30] features that were referenced it includes: text messaging, sharing media (e.g. images, videos), file-sharing, status updates, group chats, sending graphics (emojis, stickers etc.) The main benefits of its use that were highlighted were that it was convenient [49] easy-to-use [107] and low-cost [67] [100]. No significant limitations to use of WhatsApp were identified in the literature.

- **Skype [22]**: Skype was mentioned in (n=7) studies.One beneficial features of Skype highlighted in [92] was the ability to use audio and video interchangeably quickly to communicate. In another study, [49] Skype was mentioned as one of the top platforms, students and teachers used to communicate.

- **Facebook Messenger [7] (FB Messenger)** Messenger was the 3rf most mentioned chat system (n=5). The 2 beneficial features of Messenger that were mentioned included its group chats [112] and polling features. Messenger group chats were utilised by students in this study to effectively facilitate collaboration on assignments and the polling feature to vote on decisions relating to this group work. A unique feature of Messenger that was mentioned was the ability that students had to connect with other students they were already 'friends' with on Facebook [6] with due to Messenger's integration with the social media app. This made it easier for the students to form group chats with each other.

- **Telegram[26]** Telegram was mentioned the same number of times as FB Messenger (n=5). The main benefit of using Telegram that was highlighted in the literature [1] was the ability to use the app with pseudonyms i.e. with username which some students and instructors preferred not having to share their names/numbers with others in order to interact. Additionally, the chatbot, group chat feature and ability to directly reply to a

specific message in a chat were also mentioned as useful.

- **WeChat** was mentioned in four studies [67] [72] [41] [55]. One beneficial of WeChat was identified in this study [55] that mentioned a WeChat group chat that had less than 800 members, which implies that WeChat group chats are able to accommodate large numbers of participants. Another beneficial feature that was identified was sharing stories and making status updates, known in WeChat as 'moments' [101]. The study found that students posting these 'moments' and receiving feedback on them, especially in the form of comments, increased social connectedness between users and reducing feelings of loneliness and social isolation. Commenting on posts in particular created a greater sense of connectedness due to the greater, more personalised level of social support users could express compared to 'liking' posts which requires less effort.

- **Snapchat[24]:** Snapchat was mentioned briefly in a few studies (n=4) and in this study [53] was included in a short list of other ICTs that were mentioned as being used to maintain relationships with friends students already had rather than to make connections with new friends.

- **Discord[5]:** Discord was mentioned in 4 studies. The main benefits highlighted were the option to use the app anonymously, and also it's unique server and channel features, allowing students to organise their conversations.

- **Slack** Slack [23][53] was mentioned briefly in three studies [74] with [53] mentioning that the app had "richer functionality" and [112] mentioning one's student's experience of trialling Slack but changing to using FB Messenger [7] instead since Slack was "too messy". This suggests that Slack's range of features is perceived useful by some students, but not by others.

- **Kik Messenger[14]** Kik Messenger (Kik)[14] was only mentioned in one study [80]. In this study, the beneficial features of Kik[14] that were identified include the fact that the app is free, there is no requirement to use a phone number or email address to make an account, and its availability on different devices including phones and laptops.

- **KakaoTalk** KakaoTalk[13] was only mentioned in one study [62] the main benefits of using the system identified by it being the most popular/widely-used MIM in Korea. And the only/main feature that was mentioned was the ability to purchase a wide-range of graphics in the form of emojis and stickers.

- **Differ** Differ [4] was also only mentioned in one study [1] but was unique as a chat system designed specifically for the purpose of facilitating social interaction amongst HE students. The main beneficial feature of Differ that was discussed was the chatbot feature used to introduce students to the app and facilitate conversation between them. The main disadvantage of Differ was that the system was unfamiliar to most students, so they were reluctant to learn how to use it.

The following chat system names were extracted as they were mentioned briefly in some studies but without detail regarding their features: GroupMe [11] (n=2) [85] [79]; Viber[28] (n=2)[65] [55]. Line[15] (n=2) [33] [59]. Google Hangouts [79] [49] (n=2), Blackberry Messenger[3] (n=1)[33]. QQ [27] (n=1)[55].

5.2.2.2 Chat system features

Text messaging/private messaging Generally, the option to text message/private message other students was mentioned [41] mainly in the context of facilitating discussions amongst students but also giving students the option to direct questions directly to an instructor [1]. A beneficial sub-feature of messaging that was identified in [57] and [1] was the ability to reference a specific message when replying, and not just the most recent message.A feature of messaging that was identified as less beneficial in the literature were online status and read-receipts [33] as a relationship was found between actively engaging with these features and the user's stress levels being higher than those users who did not make use of these features.

Emojis/Emoticons Graphics - (emojis, stickers) - these were identified as a beneficial sub-feature in a majority of the studies [62], [72] due to the ability to mitigate ambiguity (the challenge/difficult of interpreting text-based messages [33]) in the online communication sent via chat systems. This is mainly due to the way that students could use emojis to convey emotions and meanings by replicating non-verbal and social cues such as facial expressions and body language through relevant emojis. No limitations or challenges regarding emoji use were identified in the literature, only positive uses and applications, therefore emojis can be classified as an entirely beneficial feature.

Media - file sharing - Pictures and videos by representing emotions, facial expressions and other non-verbal communications important to F2F interactions [72] thus aiding students in self-expression. Sending media in multiple forms to share experiences with their friends/other students was a theme mentioned in [80] as well as [101] which explored how students shared media in the form of 'status updates'. As well as this in [67], [92] and [112]file-sharing was a feature that students benefited from mainly for academic purposes e.g. to share learning materials such as lecture notes and also to exchange files within a group collaborating on assignments.

Group chats Group chats were mentioned in half of the studies (n=13) mainly in the context of facilitating interaction solely amongst students[112] or between students and their instructor[57] modelling real classroom interactions in a virtual format [100]. In terms of peer-peer interactions, the main benefit of group chats discussed was being an avenue students could use to overcome being separated by their peers due to COVID-19 restrictions[88] and facilitating decision-making, discussions and collaboration amongst students as part of group work[92][112] and a means of academic social support [107] e.g. reminders for fellow students [85]. Another theme was the concept of close-tie vs weak-tie relations[33]. Close-tie referring to relations with those students know well e.g. friends compared to weak-tie relations with acquaintances and/or strangers. Students would readily form group chats with close-tie relations for more informal purposes, but more frequently they are also forming groups with weak tie relations [33] where the focus was more on formal academic-related interactions [48]. The main limitation of group chats identified in this study [57] was the difficulty some students had in keeping up with multiple messages in the chat.

Synchronicity, The synchronous capabilities of chat system communications, are both a major benefit and limitation of the medium. Synchronous communication via chat systems lends itself to speedy, immediate communications which were able to facilitate

social presence for students [48] as students could co-exist in the same virtual space and were able to communicate with each other and receive feedback in real-time. This was also shown as useful for students to collaborate successfully and relay information [92] solutions in a speedy fashion. [75] Synchronicity has been highlighted as an issue, in particular in group settings [1] this is most likely due to the fact that unlike in-person interactions in a group setting, participants cannot easily "take turns" when communicating, so messages can be sent simultaneously.[41]

Variables of techno-stress: The following variables of techno-stress identified in [33] were a key limitation of chat systems identified in the literature and can be viewed as disadvantages of their synchronous nature. **Urgency** The sense of urgency [33] caused students to feel stressed when waiting for replies to their messages, which is heightened if there is a delay and also feeling pressured to reply to other's messages quickly as well. **Overload:** This variable[33] was mainly attributed to the combination of high frequency and volume of notifications students would receive in terms of messages and updates to notify them of user activity in leading them to feel 'overloaded' or overwhelmed with this influx of information. This effect was highlighted as an issue particularly if the interactions were related to their studies[49] and if it occurred in the context of group chats [107] since in a group especially the nature of chat systems give users the opportunity to simultaneously occupy the same turn in a conversational floor[57].

Ambiguity: Ambiguity was mentioned directly or indirectly in a lot of studies and is a major barrier to effective communication using the chat system feature of text-based messaging in particular and is the term used to refer to how the true meaning of a message is difficult to convey without non-verbal cues usually present in the medium of face-to-face communications[33] [100] [82]. Additionally, the research shows [82] that students making use of multiple features of chat systems e.g. a combination of text, audio and graphics (especially emojis [72]) helps to mitigate the effect of ambiguity and allow more opportunity to facilitate or replicate non-verbal cues from face-to-face interactions to enhance their online communications.

Invasion : The concept of 'invasion' was mentioned in [49] and [80] that chat systems allowed online communications to "invade" their interactions outside the virtual space prevented them from being active in their online learning [49]due to chat system messages and notifications proving distracting and disruptive to their F2F interactions.

5.2.2.3   Limitations

As this topic is generally under-researched, the number of relevant studies included in the synthesis was relatively small (n=26) therefore this limits the generalisability of the results. Furthermore, in the studies that were included, the explicit mention of chat system names was limited/brief which reduced the amount of useful data that could be extracted, further limiting the results. Many articles also referred to more general features of chat systems and did not provide more nuanced mention/analysis of individual sub-features, which limited the review results' contribution to answering RQ2 and RQ3.Additionally, due to the lack of uniformity of definitions of chat systems, social media, and various other ICTs, some results included do not refer exclusively

to chat systems and may also be related to other ICTs which limits how much of the result can be attributed exclusively to chat systems. Due to the limited time constraint of the project, the keywords selected for the search strategy were amended to limit the number of articles to be approximately 1000. This meant the scope of search results was restricted, which affects the credibility of the review results and makes them less scalable. Also, the review's results are limited by the fact that only Google and Google Scholar were searched, whereas ideally more databases such as WebOfKnowledge should have also been searched in order to obtain more relevant sources.

5.2.2.4 Implications

To summarise, the results of this systematic review highlight some consistent experiences across a range of contexts regarding HE students' experience of using chat systems for social interaction during the pandemic. The results highlight the numerous benefits and positive experiences students were able to have due to the opportunity to interact via chat systems during the pandemic period, and how particular features, especially group chats and emojis, were able to mitigate the common challenges of online communication via ICTs such as elements of techno-stress ambiguity and distraction as well as the general climate of fear/anxiety relating to the pandemic period. The results indicate that there is a consensus that the app is the most popular and perhaps the best chat system currently available in the market. However, the small number of studies included does indicate that more research is still needed within this area especially to evaluate other lesser known/used chat systems and to explore certain demographics of students in particular e.g. postgrads, international students and explore the effects (if any) these have on HE students' experience socialising via chat systems

Chapter 6

Chat System Evaluation

The following chapter details the process and discusses the results of the chat system evaluation.

6.1 Aim

The main aim of this evaluation is to answer RQs 3 and 4 through evaluating and comparing the chat systems identified in the User Study and Systematic review and their respective features. This is in order to draw conclusions on which chat systems are the best for student social interaction.

6.2 Evaluation Process

The criteria for eligible chat systems is listed here C and the evaluation criteria for the systems are listed here **??** . These were based on results from the literature review, responses to questions 18A.26 and 19A.27 of the User Study questionnaire, as well as the Systematic Review results **??**. The rationale for why each feature was included are also included in the list.

I downloaded each chat system in order to carry out evaluation, if downloaded and account created successfully, then the chat system was included in the evaluation process. I then created a second account on a different device and tested out each feature in the order listed here **??**. I exclusively tested mobile app versions available on Samsung Galaxy A80 phone and Samsung Galaxy S6 devices with Android OS [2], any feature that could not be found was then was looked up online on the company website of the app or generally via Google [8] search.

The mobile app versions were prioritised, as the systematic review results showed that the main mode students use to access chat systems is via mobile applications on smartphones**??**. (In regard to the desktop and web versions their availability was checked but the features themselves were not tested due to time constraints). Additionally, all functionality was tested within the context of the fully free, standard applications with no additional add-ons. I.e. some of the apps had additional features

that could only be accessed through a fee or by downloading a separate app. Not testing paid features was mainly due to the lack of funding for this project. However, testing the functionality of the free features of the apps is in-line with students' preference for using freely available chat systems as mentioned in the user study**??**. For each feature that was available for the system, a score of "1" was given, "0" if the feature was unavailable. Additionally, for the nonfunctional requirement of usability, "0.5" points were awarded where the chat system partially met the criteria. Means, modes, medians and standard deviations were calculated for all the scores.

6.3 Results

Twenty systems from the systematic review and user study were checked against the eligibility criteria C. Five chat systems were eliminated from this list and the remaining fifteen were evaluated. The final results are shown in this table C.8.

Overall, the top three chat systems and their scores were WhatsApp [30] (75), Skype [22] (74). and Telegram[26] (73.5). With Kik [14] (44) ranking the lowest out of all the systems (this is mainly attributed to the fact that the app lacked multiple features). FB Messenger[7], Signal[21] had the average score (63) in terms of the median, mean and mode. This implies that Signal[21] and Messenger [7] each have moderately good functionality overall.

Account and User Profile WhatsApp[30] scored the most in this section with a score of (7) overall and for the "Profile" feature WhatsApp[30] was the only chat system to score (6) which indicates WhatsApp has the most comprehensive set of user profile features. For the "Account" feature, Snapchat[24] and GroupMe had the unique scores of 2 and 0 respectively. This highlights that Snapchat[24] provided the unique flexibility for a user to register an account with either their username or phone number, whereas GroupMe[11] was restrictive and required users to register accounts using both. Amongst the chat systems that required email but no phone number, Skype [22] and Google Chat [9] had restrictions on users as a Microsoft[**?**] account was required to register for Skype and a Google[8] account for Google Chat.

Chat Features: In terms of private/direct messaging no single chat system had all the associated sub-features but [30], Telegram[26], Skype [22] and Viber [28] ranked the highest with a score of 14 each. Telegram[26] and Viber[28] were the only chat systems to score 3 points in on "message editability".

- In terms of replying functions the chat systems scored 2 on average which meant that most of them could support both the referencing of specific messages and emoji reactions however Skype [22], Discord [5] and Slack [23] were the only systems to score 2 on 'text formatting' which implies that these would be the most suitable chat systems to use for sharing rich text and code. Additionally, most of the chat systems (12/15) scored the maximum score of 3 on Graphics, with Slack being the only one to score 1.

On average, the chat systems scored 2 in terms of "message history" features. WhatsApp[30], Skype[22] and Viber all scored 4 for this feature and conversely GroupMe [11],

WeChat[29] and Slack [23] were the only systems to score 0 in this feature. Both sets of systems could still prove effective for social interaction. This is because the former set of systems allow users to control the length of time a message is visible and also the visibility of read receipts providing them with more opportunity to customise their experience. The latter set of systems lacking these features mean that all messages sent remain within the history and don't have an option to disappear after a certain amount of time helping users to keep track/a record of their conversations and also the lack of delivery and read receipts may reduce pressure on users to read and respond to messages.

Group Messaging WhatsApp [30], Telegram [26] and Discord [5] ranked the highest overall for this feature each with a score of 14 and the lowest score shared by Snapchat [24], WeChat [29], Line [15], Google Chat [9] and Kik [14] was 10, indicating that these systems are not as effective for Group communications. Only Discord [5] scored (3) for the "Community /server" feature, which shows that Discord is the best out of all the chat systems for hosting communication between large groups. On average, the chat systems scored 4 for basic group chat sub-features including the ability to make a group chat and set the group name and picture and all chat systems scored 3 for "joining/adding to chat" which shows that all the chat systems could support basic group communications to a degree.

File-Sharing and Media On average the chat systems scored 8 for this feature which shows that most of them could facilitate the sharing of different file types including PDFs, images and videos. Snapchat [24] scored 0 and Messenger [7] scored 1 for the "file-sharing" feature, which means that these chat systems would not be useful for sharing documents that are not images or videos, e.g. students would not be able to share PDFs of University-related material with each other.

Calls: Discord [5] had the greatest score for both audio-only and video calls, which implies that Discord would be the best chat system for students to use for calling one another. Apart from overall, the greatest standard deviation of scores was for calling features, where the systems showed a range of performance from Kik[14] and GroupMe[11] scoring '0' as (they had no calling functionality) all the way through to Discord which scored the highest (9) and was the only chat system to have a feature for cancelling out background noise. Therefore, Discord is the best system for calling, both audio-only and video. In terms of audio-only calls, all chat systems (apart from GroupMe and Kik) were equally-equipped (scoring 2) to support audio-calls between two users and for groups. Similarly, all chat systems (apart from GroupMe and Kik) scored minimum '4' for video calls, indicating they could support basic video calling functionality.

Non-Functional: Overall, WhatsApp, Skype and Kakotalk scored the highest in terms of non-functional requirements and Kik scored the lowest Most chat systems (10/15) scored a 1 for 'security' as they had end-end encryption for some or all messages. WeChat [29] scored the lowest overall in terms of usability, this is mainly due to scoring partially on speed and reliability because the app was slow and crashed multiple times during the account verification process.

6.4 Discussion

6.4.1 Summary

The chat systems with the best functionality overall were WhatsApp [30], Telegram [26] and Skype [22]. WhatsApp ranking highest aligns with the results from the user study and systematic review, which showed WhatsApp was the most popular chat system for facilitating student social interaction during the COVID-19 pandemic. Telegram and Skype ranking highly in terms of functionality but not being as favoured amongst students in the user study indicates the apps are used less because their user base is smaller and not because the functionality is poor compared to others. Despite not ranking in the top 4 overall, as was the case in both the user study and systematic review, Discord [5] proved to be the best chat system for facilitating group messaging and calling which conforms to the results from the user study and systematic review that identified Discord's group hosting functionality as being a key reason students favoured the app for socialising with others during the pandemic.

6.4.2 Limitations

The evaluation is subject to some bias as I was already familiar with using some of the systems prior to conducting this research, therefore this is likely to have impacted how easy I perceived using the chat systems' features to be.

There was also some difficulty in identifying the features and sub-features during the evaluation due to some overlap between features' capabilities and also the fact that features named the same name may have had different meanings across the different platforms, for example the "Status" feature of WhatsApp[30] is more akin to the story-sharing features of Snapchat [24] and WeChat [29]. This means that the results are subject to a degree of human error, as some features may have been missed or their purpose misunderstood. However, that is why I looked up some features via Google[8] in order to provide further clarification on these features.

Chapter 7

Design Recommendations

The following chapter outlines an answer to RQ4.

7.1 Chat system specific recommendations

The following are recommendations for additional features to enhance WhatsApp [30], Telegram [26] and Skype [22] based on which features were missing in the chat system evaluation results. For all three apps, the following features were identified as important based on results from the user study A.36:
Provide the option of users registering vie email or phone
Add background noise cancellation for audio and video calls.

Whatsapp
Ability to edit a message after sending[41]
Add a feature to support proper formatting of code snippets [102] A.36
Provide option to translate messages A.36
Add a chatbot[1] A.28
Allow users to share their screen during video calls A.36
Add feature to recommend contacts to the user [112]A.36

Telegram
Adding a feature to share stories [101] [?]
Add a feature to support proper formatting of code snippets [102] A.36
Add a feature to bookmark messages [?]
Add feature to recommend contacts to the user [112]A.36
Add a function to report a user.

Skype
Adding a feature to share stories [101] [?]
Allow users to delete messages from their chat without it deleting the message for everyone in the chat [96]
Add a community/server feature [1], A.36
Add a broadcast feature [102]A.36
Add a function to report a user [102]

7.2   General recommendations

A detailed rationale for the features included in the chat system evaluation is shown here **??**. Based on the results from the previous stages of this project, the following are general recommendations of features to prioritise when designing chat systems - with a summary of the rationale behind each feature focusing on how they can better facilitate student social interactions.

Multimodality[41]A.36 Students should have the option to communicate via different modes, which can enhance their online interactions. This means including graphics, voice messages, calls, media files and not just text as forms of communication in a chat system. Graphics (e.g. emojis, GIFs) can replicate the effect of non-verbal communication such as body language and facial expressions found in F2F interactions, which can help students express themselves and reduce message ambiguity. Voice messages and calls can achieve the same effect, as social cues can be indicated by pitch and tone of voice, as well as visual cues in video calls.

Customisation[62] A.36 Providing options for students to customise features has two main benefits. Firstly, it can help limit potential issues students face when using chat systems, e.g. giving the user the option to the option to enable/disable Read receipts/Online status[33]A.36 reduces the likelihood the user will feel pressured to reply to messages when others can see when they are only and have read a message. Secondly, it can motivate students to use chat systems for their social interactions as features such as options to change chat wallpaper, organise layout of chats and change profile picture or status makes the experience of socialising more personal and interactive.

Group Communication [92][112] Being able to facilitate effective group interactions is another key component a chat system should have, especially as students can find group communications challenging due to the frequency and volume of messages. Therefore, features such as message reactions, chat-specific replies, muting, servers/channels and a poll can help ease group interactions for students. Chat specific replies and message reactions are useful for helping students keep track of a conversation and ensure messages aren't missed. The option to mute chat notifications can help reduce the risk of a student feeling overloaded by multiple messages. Servers and channels can allow students to sort different chats based on shared interests, and polls can help ease the process of decision-making for students. Overall, effective implementation of features to improve group communication can enhance both non-academic and academic-related social interactions between students, such as casual conversation and group work.

Chapter 8

Conclusion and Discussion

This chapter provides a conclusion, discussion of the limitations and implications of this project, as well as potential future work.

8.1 Conclusion

Overall, this project involved conducting a literature review, systematic review, user study and software evaluation to answer four research questions and the following section summarises the answers to each question based on the results obtained.

RQ1 What are the characteristics of a beneficial online social interaction? The most important characteristics of beneficial online social interactions for students identified in the user study and systematic review can be split into 3 categories: positive feelings, negative feelings, and types of people students want to interact with. In terms of positive feelings and emotions a sense of belonging or community was a key theme. This fits in with research highlighting a sense of belonging is vital to students' HE experience[62] [75]. Regarding negative feelings students wished to avoid, the main characteristic in this category was students' desire to avoid feelings of loneliness and isolation. This aligns with results from literature that indicate students, particularly aged 18-29 are particularly susceptible to feelings of loneliness and isolation which are connected to their strong desire for social connectedness (or sense of belonging and community)[72]). In the third category, positive relationships with fellow students, family and friends were highlighted as an important characteristic of beneficial online social interactions.

RQ2 In what ways did students make use of chat systems for social interaction during the COVID-19 pandemic? Based on results from both the user study and systematic literature review, students mainly used chat systems to maintain pre-existing relationships or form new ones. In particular, students valued being able to provide social support for their fellow students both for academic purposes e.g. assistance with University-work[67], [1] and non-academic purposes such as casual conversation[80]. One main conflict between the user study and systematic review is that the user study identified students as using chat systems primarily for informal extracurricular interactions amongst their peers, whereas the literature identified most chat system social

interactions to be for academic purposes, many of these interactions involving the instructor, therefore more research is needed to provide more conclusive results.

RQ3.1 Which chat systems did students find most effective for facilitating social interaction? From the User study and systematic review, WhatsApp[30] was identified as the most popular chat system used by students to facilitate online social interaction during the COVID-19 pandemic. The results of the evaluation supported this result, as WhatsApp ranked the highest out of the chat systems, indicating that the app is most effective for facilitating student social interaction. This result is consistent with similar research on the topic that also identified Whatsapp as one of the top chat systems for student social interactions, both in terms of popularity[45][100] [67] and effectiveness[102] [49]. Messenger, didn't rank as highly in the evaluation but ranked in the top four systems in both the User Study and Systematic review. Despite lacking some key sub-features such as the ability to share documents e.g. PDFs or format text, unique features such as the ability to find users via Facebook [6] still make the app stand out. Discord ranked in the top 4 for the user study and also received a score only 5.5 points less than WhatsApp in the evaluation, ranking the highest out of all the chat systems for calling features and was also identified in the user study for being good at hosting large groups of students and allowing them to organise their conversations in channels and servers. Snapchat ranked in the top 4 of the user study, but did not perform as well in the systematic review and evaluation. Nevertheless, what makes the chat system unique is its ability to facilitate fun and spontaneous interactions, lending itself to beneficial usage amongst close friendship groups of students.

RQ3.2 Which features of chat systems did students use, and what made them more or less beneficial for social interaction? Overall, chat systems host many features that aided student social interactions, including the ability to send graphics such as emojis, multimedia files, voice messages and make calls with both audio and video. The options to utilise the different modes of communication highlights how students found multimodality to be an integral part of their socialising via chat systems.[41] The main benefit of these features was the fact they helped students enhance their online interactions through virtual representations of traditional in-person forms of communication e.g. non-verbal and social cues that are usually missing from traditional text-based messages[72] thus helping to mitigate limitations of the medium such as message ambiguity. The other main feature identified as important for facilitating student social interaction was group messaging in the form of group chats or communities and servers, which helped students maintain friendships and form new connections via their courses or student groups during the pandemic. With these different forms of communication came some limitations mainly attributed to elements of technostress, e.g. ambiguity and overload. Finally, students also felt that how easy it was to use a chat system, and having a large user-base were both important factors in facilitating their online social interactions as it motivated them to keep using the app to communicate with other students on the same platforms.

RQ4 What guidelines can be derived for design practices to better facilitate beneficial social interaction between students via chat systems From the results of this study one can conclude the overall impact of a chat system feature is determined by the selection of sub-features included - these either increase or limit the benefit of the feature

and the chat system as a whole. To enhance student social interactions, designers should prioritise including features that: allow multiple modes of communication between students e.g. texting, voice messages and video calls, facilitate group communication especially for large groups of students and allow students to customise and personalise their experiences. Additionally, when including multiple features, designers should ensure the system does not become over-complicated as a result because how easy a system is to use is a major factor in student motivation to socialise via the app[1] [107].

8.2 Limitations

The main limitation of this project is the size, i.e. the small sample of UofE students involved in the user study, the small number of articles included in the systematic review and the small number of chat systems and features included in the evaluation. However, efforts were made to maximise these numbers within the constraints of time and lack of funding for this project.

8.3 Future Work

With access to funding and more time, a wider range of free and paid chat system features could be evaluated on different platforms as part of a systematic review to gain more insight into what is currently available in the market. From the review results, more comprehensive design recommendations and student usage guidelines for chat systems could be made. Some further extensions to this project include exploring how the experience with and expectations of socialising for distance-learners/online-only students was, compared with students that expected fully in-person or hybrid learning after the start of the pandemic. One could also focus on gathering data from a more balanced sample of students from a range of different demographics and compare how these factors might affect their experience of socialising via chat systems. E.g. students from Widening-Participation backgrounds as an extension of similar work done, [93] as well as looking at age, gender and/or ethnicity. This time interviews, focus groups or even a longitudinal study could be conducted to gain more detailed insight into the student experience. A prototype for an "ideal chat system for facilitating student social interaction" including features identified as most beneficial could also be designed. In future one could also perform a systematic review without the constraints detailed in this project of literature on student usage of different types of ICTs - broadening the scope beyond chat systems, In this way, student behaviours and attitudes towards different ICTs such as social media and discussion forums could be explored to see if the experience is similar to or differs from the ways students socialise via chat systems. Altogether, this project has shown that although chat systems are not perfect for online social interaction between students, if designed effectively they can greatly improve the quality of students' social interactions. Therefore, software designers can use this project's findings to upgrade existing chat systems or create new ones to better facilitate students' social interactions. Additionally, the findings of this project could be presented in educational research publications and the University of Edinburgh's Learning and Teaching Conference, for which the abstract of this project has been accepted.

Bibliography

[1] Edubots best practices, prepared by faculty of organization and informatics, in collaboration with the consortium partners in the project, 2022.

[2] Android, 2023.

[3] Blackberry messenger, 2023.

[4] Differ, 2023.

[5] Discord, 2023.

[6] Facebook, 2023.

[7] Facebook messenger, 2023.

[8] Google, 2023.

[9] Google hangouts, 2023.

[10] Google scholar, 2023.

[11] Groupme, 2023.

[12] Instagram, 2023.

[13] Kakaotalk, 2023.

[14] Kik messenger, 2023.

[15] Line, 2023.

[16] Microsoft excel, 2023.

[17] Microsoft forms, 2023.

[18] Nvivo, 2023.

[19] Reddit, 2023.

[20] Samsung, 2023.

[21] Signal, 2023.

[22] Skype, 2023.

[23] Slack, 2023.

[24] Snapchat, 2023.

[25] Teams, 2023.

[26] Telegram, 2023.

[27] Tencent qq, 2023.

[28] Viber, 2023.

[29] Wechat, 2023.

[30] Whatsapp, 2023.

[31] Zoom, 2023.

[32] Ahrefs. Google advanced search operators: The complete list, 2021.

[33] Alberto Ardèvol-Abreu, Patricia Delponti, Helena Bonache, and Carmen Rodríguez-Wangüemert. Mobile instant messaging uses and technostress: a qualitative approach. *International Journal of Human–Computer Interaction*, pages 1–13, 2022.

[34] Michael Argyle. *Social interaction*. Routledge, 2017.

[35] Edoardo Aromataris and Alan Pearson. The systematic review: an overview. *AJN The American Journal of Nursing*, 114(3):53–58, 2014.

[36] Diganta Baishya and Saurabh Maheshwari. Whatsapp groups in academic context: Exploring the academic uses of whatsapp groups among the students. *Contemporary Educational Technology*, 11(1):31–46, 2020.

[37] Naomi S Baron. Instant messaging. *Pragmatics of computer-mediated communication*, 9, 2013.

[38] Jessie S Barrot. Social media as a language learning environment: a systematic review of the literature (2008-2019). *Computer assisted language learning*, pages 1–29, 2021.

[39] Melissa Bond, Svenja Bedenlier, Katja Buntins, Michael Kerres, and Olaf Zawacki-Richter. Facilitating student engagement in higher education through educational technology: A narrative systematic review in the field of education. *Contemporary Issues in Technology and Teacher Education*, 20(2):315–368, 2020.

[40] Virginia Braun and Victoria Clarke. Using thematic analysis in psychology. *Qualitative research in psychology*, 3(2):77–101, 2006.

[41] Shin Yi Chew and Lee Luan Ng. *Interpersonal Interactions and Language Learning: Face-to-Face Vs. Computer-Mediated Communication*. Springer, 2021.

[42] Alton Chua. The influence of social interaction on knowledge creation. *Journal of Intellectual capital*, 2002.

[43] Lawrence Chung, Brian A Nixon, Eric Yu, and John Mylopoulos. *Non-functional requirements in software engineering*, volume 5. Springer Science & Business Media, 2012.

[44] Sheldon Cohen, Drury R Sherrod, and Margaret S Clark. Social skills and the stress-protective role of social support. *Journal of personality and social psychology*, 50(5):963, 1986.

[45] Miguel Á Conde, Francisco J Rodríguez-Sedano, Francisco J Rodríguez Lera, Alexis Gutiérrez-Fernández, and Ángel Manuel Guerrero-Higueras. Whatsapp or telegram. which is the best instant messaging tool for the interaction in teamwork? In *Learning and Collaboration Technologies: New Challenges and Learning Experiences: 8th International Conference, LCT 2021, Held as Part of the 23rd HCI International Conference, HCII 2021, Virtual Event, July 24–29, 2021, Proceedings, Part I*, pages 239–249. Springer, 2021.

[46] Domenico Cucinotta and Maurizio Vanelli. Who declares covid-19 a pandemic. *Acta Bio Medica: Atenei Parmensis*, 91(1):157, 2020.

[47] Mary Czerwinski, Edward Cutrell, and Eric Horvitz. Instant messaging: Effects of relevance and timing. In *People and computers XIV: Proceedings of HCI*, volume 2, pages 71–76, 2000.

[48] Dawn Elizabeth Dane. *A qualitative study about first year students' experiences of transitioning to higher education and available academic support resources*. PhD thesis, University of Glasgow, 2022.

[49] Gabriella Rodrigues de Oliveira. *Smart Education? Understanding the impact of the COVID-19 pandemic in higher education institutions*. PhD thesis, Universidade do Porto (Portugal), 2020.

[50] Collins Dictionary. Collins english thesaurus, Accessed 2023.

[51] Emily Ford, N Foster, Z Giannas, H Gill, M Lee, Z Safi, C Sall, P Sharma, and A Smith. App use during covid-19: Nursing student perceptions of mental wellness. *Canadian Journal of Nursing Informatics*, 16(2), 2021.

[52] Rudolf J Freund and William J Wilson. *Statistical methods*. Elsevier, 2003.

[53] Sanjana Gautam and Mary Beth Rosson. Exploring feelings of student community across a geographically distributed university. *Proceedings of the ACM on Human-Computer Interaction*, 5(CSCW1):1–16, 2021.

[54] Holly Hartman. PRISMA Flow Diagram. `https://hollyhartman.shinyapps.io/PRISMAFlowDiagram/`, Accessed 2023, April 12.

[55] SHAO HONGQUAN. The use of digital media among china students in belarusian state university during covid-19 pandemic. *Higher Education and Oriental Studies*, 1(4), 2021.

[56] Sara H Hsieh and Timmy H Tseng. The effects of emoticons and text-messaging on social interaction: Playfulness in mobile instant messaging. 2015.

[57] R Humayon, M Afzal, and MS Hussain. A critical analysis of conversational floors in post-corona digital. 2020.

[58] Tzung-Jeng Hwang, Kiran Rabheru, Carmelle Peisah, William Reichman, and Manabu Ikeda. Loneliness and social isolation during the covid-19 pandemic. *International Psychogeriatrics*, 32(10):1217–1220, 2020.

[59] Napat Jitpaisarnwattana, Hayo Reinders, and Pornapit Darasawang. Learners' perspectives on interaction in a language mooc. *JALT CALL Journal*, 17(2):158–182, 2021.

[60] Burke Johnson and Lisa A Turner. Data collection strategies in mixed methods research. *Handbook of mixed methods in social and behavioral research*, 10(2):297–319, 2003.

[61] Reynol Junco, Greg Heiberger, and Eric Loken. The effect of twitter on college student engagement and grades. *Journal of computer assisted learning*, 27(2):119–132, 2011.

[62] Bohee Jung, Hanku Kim, and Seung Hwan Lee. The impact of belongingness and graphic-based emoticon usage motives on emoticon purchase intentions for mim: an analysis of korean kakaotalk users. *Online Information Review*, 46(2):391–411, 2022.

[63] Ella R Kahu. Framing student engagement in higher education. *Studies in higher education*, 38(5):758–773, 2013.

[64] Robin H Kay and Sharon Lauricella. Investigating and comparing communication media used in higher education. *Journal of Communication*, 2(1):1–20, 2015.

[65] Saadeddine KHELALFA. *Investigating Student's Attitudes Towards the Use of Social Media for Learning Purposes: A Case Study of EFL Students at the University of Ghardaia*. PhD thesis, , 2022.

[66] Jeffrey W. Knopf. Doing a literature review. *PS: Political Science Politics*, 39(1):127–132, 2006.

[67] Idowu Febishola Kutu. *The use of social media for academic purposes by postgraduate Information Studies students at the University of KwaZulu-Natal*. PhD thesis, 2021.

[68] Lisa Lacher and Cydnee Biehl. Using discord to understand and moderate collaboration and teamwork. In *Proceedings of the 49th ACM Technical Symposium on Computer Science Education*, pages 1107–1107, 2018.

[69] Search Engine Land. 20 of google's limits you may not know exist, 2018.

[70] Sharon Lauricella and Robin Kay. Exploring the use of text and instant messaging in higher education classrooms. *Research in Learning Technology*, 21, 2013.

[71] Emily Long, Susan Patterson, Karen Maxwell, Carolyn Blake, Raquel Bosó Pérez, Ruth Lewis, Mark McCann, Julie Riddell, Kathryn Skivington, Rachel

Wilson-Lowe, et al. Covid-19 pandemic and its impact on social relationships and health. *J Epidemiol Community Health*, 76(2):128–132, 2022.

[72] Madelyne M Losby. *Emoji use in online communication with emerging adults: The impact on ambiguity, affect, and social connection*. PhD thesis, Iowa State University, 2022.

[73] Áine MacDermott, Howard Heath, and Alex Akinbi. Disappearing messages: Privacy or piracy? 2022.

[74] Michael Malschützky, Alexandra Reher, and Andrea Schröder. Scholarship of teaching and learning - a way to identify inclusion opportunities and exclusion risks in digital learning scenarios. In *2021 World Engineering Education Forum/Global Engineering Deans Council (WEEF/GEDC)*, pages 1–7, 2021.

[75] Sazan M Mandalawi, Robyn Henderson, Henk Huijser Dr, and Megan Yih Chyn A Kek. Issues of belonging, pedagogy and learning in doctoral study at a distance. *Journal of University Teaching & Learning Practice*, 19(4):15, 2022.

[76] Florence Martin, Lynn Ahlgrim-Delzell, and Kiran Budhrani. Systematic review of two decades (1995 to 2014) of research on synchronous online learning. *American Journal of Distance Education*, 31(1):3–19, 2017.

[77] Merriam-Webster. Merriam-webster thesaurus, Accessed 2023.

[78] Shweta Mishra. Social networks, social capital, social support and academic success in higher education: A systematic review with a special focus on 'under-represented' students. *Educational Research Review*, 29:100307, 2020.

[79] Grace A Morris. *A new first-year experience: How the COVID-19 classroom fosters social integration and affects first-year students' perceived persistence to degree completion*. PhD thesis, Kent State University, 2021.

[80] Anu Muhonen and Elisa Räsänen. " kaikille okei?" everyone all right? shifting topics and practices in language students' chats during the global covid-19 pandemic. *Journal of Teaching and Learning with Technology*, 10:258–278, 2021.

[81] Herri Mulyono, Gunawan Suryoputro, and Shafa Ramadhanya Jamil. The application of whatsapp to support online learning during the covid-19 pandemic in indonesia. *Heliyon*, 7(8):e07853, 2021.

[82] Amy Wanyu Ou, Mingyue Michelle Gu, and John Chi-Kin Lee. Learning and communication in online international higher education in hong kong: Ict-mediated translanguaging competence and virtually translocal identity. *Journal of Multilingual and Multicultural Development*, pages 1–14, 2022.

[83] Matthew J Page, Joanne E McKenzie, Patrick M Bossuyt, Isabelle Boutron, Tammy C Hoffmann, Cynthia D Mulrow, Larissa Shamseer, Jennifer M Tetzlaff, Elie A Akl, Sue E Brennan, et al. The prisma 2020 statement: an updated guideline for reporting systematic reviews. *Systematic reviews*, 10(1):1–11, 2021.

[84] Elise Paradis, Bridget O'Brien, Laura Nimmon, Glen Bandiera, and Maria Athina Martimianakis. Design: Selection of data collection methods. *Journal of graduate medical education*, 8(2):263–264, 2016.

[85] James R Perkins. *Millennial Experiences in Cohort-Based Higher Education Programs*. University of Hartford, 2020.

[86] Christoph Pimmer, Florian Brühlmann, Titilayo Dorothy Odetola, Oluwafemi Dipeolu, Urs Gröhbiel, and Ademola J Ajuwon. Instant messaging and nursing students' clinical learning experience. *Nurse education today*, 64:119–124, 2018.

[87] Christoph Pimmer and P Rambe. The educational role of mobile instant messaging. findings from a systematic review. *New Trends and Issue Proceedings on Humanities and Social Sciences*, 11:153–161, 2016.

[88] Quality and Qualifications Ireland. The impact of covid-19 modifications to teaching, learning and assessment in irish further education and training and higher education a qqi evaluation. `https://www.qqi.ie/`, 2020.

[89] Anabel Quan-Haase. Instant messaging on campus: Use and integration in university students' everyday communication. *the information society*, 24(2):105–115, 2008.

[90] Parmeswar Ramkissoon, Louis Jinot Belle, and Trishnee Bhurosy. Perceptions and experiences of students on the use of interactive online learning technologies in mauritius. *International Journal of Evaluation and Research in Education*, 9(4):833–839, 2020.

[91] Ruqin Ren and Bei Yan. Personal network protects, social media harms: Evidence from two surveys during the covid-19 pandemic. *Frontiers in Psychology*, 13, 2022.

[92] Murad Abdu Saeed, Mohammed Abdullah Alharbi, and Amr Abdullatif Yassin. Sustaining synchronous interaction effectiveness in distance writing courses: A mixed method study in a ksa university. *Sustainability*, 13(24):13675, 2021.

[93] Melanie Sage and Sebrena Jackson. A systematic review of internet communication technology use by youth in foster care. *Child and Adolescent Social Work Journal*, pages 1–16, 2021.

[94] Pradeep Sahu. Closure of universities due to coronavirus disease 2019 (covid-19): impact on education and mental health of students and academic staff. *Cureus*, 12(4), 2020.

[95] Johnny Saldana. *The coding manual for qualitative researchers / Johnny Saldana*. SAGE, Los Angeles, fourth edition. edition, 2021.

[96] Theodor Schnitzler, Christine Utz, Florian M Farke, Christina Pöpper, and Markus Dürmuth. Exploring user perceptions of deletion in mobile instant messaging applications. *Journal of Cybersecurity*, 6(1):tyz016, 2020.

[97] Martin Schrepp. User experience questionnaire handbook. *All you need to know to apply the UEQ successfully in your project*, 2015.

[98] Kasturi Sivabalan and Zuraina Ali. Mobile instant messaging as collaborative tool for language learning. *International Journal of Language Education and Applied Linguistics*, pages 99–109, 2019.

[99] Suzanne Stone and Anna Logan. Exploring students' use of the social networking site whatsapp to foster connectedness in the online learning experience. *Irish Journal of Technology Enhanced Learning Ireland*, 3(1):42–55, 2018.

[100] Ahmad Sugianto and Ahmad Bukhori Muslim. Gazing at 'the-you-know-who/what'in whatsapp: Deixis used in online learning amid covid-19 pandemic. *LLT Journal: A Journal on Language and Language Teaching*, 25(1):45–62, 2022.

[101] Peng Sun, Lu Xing, Junhui Wu, and Yu Kou. Receiving feedback after posting status updates on social networking sites predicts lower loneliness: A mediated moderation model. *Applied Psychology: Health and Well-Being*, 2023.

[102] Tole Sutikno, Lina Handayani, Deris Stiawan, Munawar Agus Riyadi, and Imam Much Ibnu Subroto. Whatsapp, viber and telegram: Which is the best for instant messaging? *International Journal of Electrical & Computer Engineering (2088-8708)*, 6(3), 2016.

[103] Ying Tang and Khe Foon Hew. Is mobile instant messaging (mim) useful in education? examining its technological, pedagogical, and social affordances. *Educational Research Review*, 21:85–104, 2017.

[104] Ying Tang and Khe Foon Hew. Does mobile instant messaging facilitate social presence in online communication? a two-stage study of higher education students. *International Journal of Educational Technology in Higher Education*, 17(1):1–17, 2020.

[105] Ying Tang and Khe Foon Hew. Effects of using mobile instant messaging on student behavioral, emotional, and cognitive engagement: a quasi-experimental study. *International Journal of Educational Technology in Higher Education*, 19(1):1–22, 2022.

[106] Shqiponja Telhaj. Do social interactions in the classroom improve academic attainment? *IZA World of Labor*, 2018.

[107] Adrianne Aiko Thompson. *Using a Class WhatsApp™ Group with EAP Students: Sense of Community, Benefits, and Challenges*. PhD thesis, University of Florida, 2022.

[108] Brian Thoms. A dynamic social feedback system to support learning and social interaction in higher education. *IEEE Transactions on Learning Technologies*, 4(4):340–352, 2011.

[109] E Towner, L Tomova, D Ladensack, KA Chu, and B Callaghan. Virtual social interaction and loneliness among emerging adults amid the covid-19 pandemic. 2021.

[110] Patti M Valkenburg and Jochen Peter. Online communication among adolescents: An integrated model of its attraction, opportunities, and risks. *Journal of adolescent health*, 48(2):121–127, 2011.

[111] Arnold POS Vermeeren, Effie Lai-Chong Law, Virpi Roto, Marianna Obrist, Jettie Hoonhout, and Kaisa Väänänen-Vainio-Mattila. User experience evaluation methods: current state and development needs. In *Proceedings of the 6th Nordic conference on human-computer interaction: Extending boundaries*, pages 521–530, 2010.

[112] Jesper Wedin and Daniel Saxin. Collaboration use in e-learning: An interview study on how learners use collaboration software in higher education. 2020.

[113] Rick W Wright, Richard A Brand, Warren Dunn, and Kurt P Spindler. How to write a systematic review. *Clinical Orthopaedics and Related Research (1976-2007)*, 455:23–29, 2007.

[114] Lee Chin Yin. Adoption of whatsapp instant messaging among students in ipoh higher education institutions. *Unpublished Master Thesis). Malaysia: Wawasan Open University. woulibrary. wou. edu. my/theses-project/MED2016_ CYLEE. pdf*, 2016.

Appendix A

User Study Questionnaire Questions and Results

Rationale/Research Question	Questionnaire Questions
Demographic Information	Which gender do you identify as?
	What is your age?
	Please select all of the years you have been a student at the University:
	What is your current level of study?
	What is your student status?
	Which school is your degree a part of?
RQ1: Defining Characteristics of Beneficial Social Interactions	Please state 1-3 things that come to mind when you think of a positive online social interaction? (For example, how it makes you feel, what impact it has.)
RQ2: Ways students used chat systems	Do you have experience using chat systems (also known as instant messaging apps) ?
	Please select all of the chat systems you have experience with using
	How often did you use chat systems in general to interact with other students during the pandemic?
	During the pandemic, how often did you use chat systems to interact with other students for academic-related purposes (e.g. exchanging course materials, group work etc.) vs non-academic-related purposes?
	How did your use of chat systems affect the quality of your social interactions with other students during the pandemic?
	Were there any ways chat systems helped you to socially interact with other students during the pandemic? If so, please detail, if not say 'None'
	Were there any challenges you faced in using chat systems to socially interact with students during the pandemic? If so, please detail, if not say 'None'
RQ3.1: Which chat systems students found most effective	Which chat system did you prefer to use the most for socialising with other students during the pandemic?
	Please explain why you chose that option
RQ3.2: Which features students found more or less beneficial	Please suggest 1-3 features you think are important for a chat system to help facilitate social interaction with other students
	Please state your reasoning for choosing these features:
	Below are some common features of chat systems, please rate them based on how beneficial you feel they were with facilitating social interaction with other students during the pandemic
Additional space for students to add more information if needed:	Do you have any additional comments?

Figure A.1: Above is a table mapping the questionnaire questions to their respective RQs

1. Please tick below if you agree to ALL of the following statements:

   - I have read and understood the above information.
   - I understand that my participation is voluntary, and I can withdraw at any time.
   - I consent to my anonymised data being used in academic publications and presentations.
   - I allow my data to be used in future ethically approved research.

More Details

- I agree   110
- I disagree   0

Figure A.2: Above is a screenshot of the results of question 1 from the questionnaire.

2. Which gender do you identify as?

More Details

Female	68
Male	34
Non-binary	4
Prefer not to say	4

Female: 68 (62%)
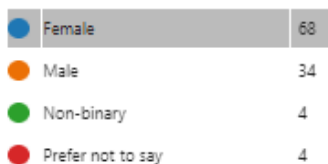
Figure A.3: Above is a screenshot of the results of question 2 from the questionnaire.

3. What is your age?

More Details

Below 15 (If you are this age the...	0
15-18	5
18-21	64
21-25	37
Above 25	4
Prefer not to say	0
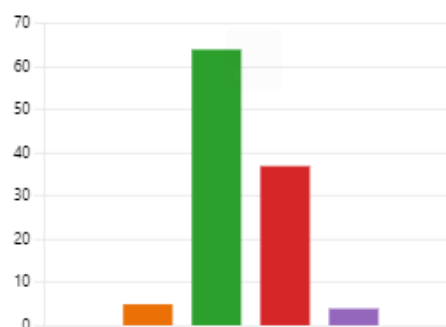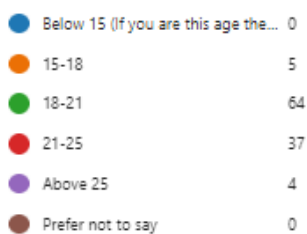
Figure A.4: Above is a screenshot of the results of question 3 from the questionnaire.

4. Please select all of the years you have been a student at the University:

More Details

- 2020   84
- 2021   92
- 2022   107

Figure A.5: Above is a screenshot of the results of question 4 from the questionnaire.

5. What is your current level of study?

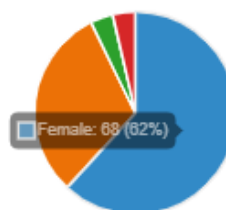More Details

- Undergraduate   97
- Masters   10
- PhD   3

Figure A.6: Above is a screenshot of the results of question 5 from the questionnaire.

6. What is your student status?

More Details

- Scottish (Home) Student   40
- Rest of UK (RUK) student   26
- International Student   44

Figure A.7: Above is a screenshot of the results of question 6 from the questionnaire.
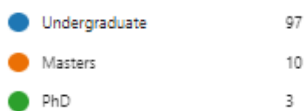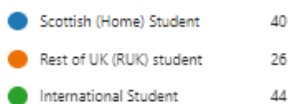
7. Which school is your degree a part of?

More Details

● Business School	2
● School of Divinity	0
● School of Economics	1
● Edinburgh College of Art	7
● Moray House School of Educati...	1
● School of Health in Social Science	1
● School of History, Classics and A...	4
● School of Law	3
● School of Literatures, Language...	4
● School of Philosophy, Psycholog...	6
● School of Social and Political Sci...	6
● Centre for Open Learning	0
● Edinburgh Medical School	11
● Royal (Dick) School of Veterinar...	0
● School of Biological Sciences	1
● School of Chemistry	2
● School of Engineering	8
● School of GeoSciences	2
● School of Informatics	35
● School of Mathematics	14
● School of Physics and Astronomy	2
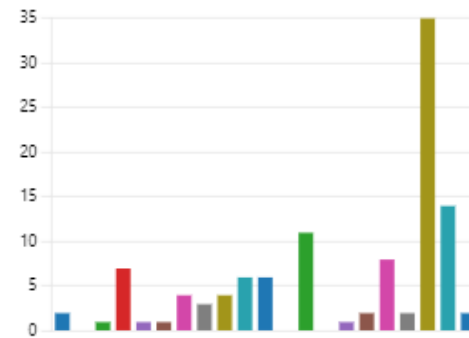
Figure A.8: Above is a screenshot of the results of question 1 from the questionnaire.

		N (out of 110)	Percent			N (out of 110)	Percent
Years at University				**Degree Type:**			
	2020 - 2022;	79	71.82%		**College of Science and Engineering (total)**	64	58.18%
	2022;	15	13.64%		School of Informatics	35	31.82%
	2021- 2022;	10	9.09%		School of Mathematics	14	12.73%
	2020;2022	3	2.73%		School of Engineering	8	7.27%
	2020 - 2021	2	1.82%		School of Chemistry	2	1.82%
	2021;	1	0.91%		School of Geosciences	2	
					School of Physics and Astronomy	2	1.82%
Student Status					School of Biological Sciences	1	0.91%
	International	44	40.00%				
	Scottish	40	36.36%		**College of Arts, Humanities and Social Sciences**	35	31.82%
	Rest of UK	26	23.64%		Edinburgh College of Art	7	6.36%
					School of Philosophy, Psychology and Language	6	5.45%
Level of Study					School of Social and Political Science	6	5.45%
	Undergrad	97	88.18%		School of History, Classics and Archeology	4	3.64%
	Masters	10	9.09%		School of Literatures, Languages and Cultures	4	3.64%
	PhD	3	2.73%		School of Law	3	2.73%
					Business School	2	1.82%
					School of Economics	1	0.91%
					Moray House School of Education and Sport	1	0.91%
					School of Health in Social Science	1	0.91%
					College of Medicine & Vet Medicine (total)	11	10.00%
					Edinburgh Medical School	11	10.00%

Figure A.9: Demographics Summary based on results from questions 2-7 of the questionnaire:

8. Please state 1-3 things that come to mind when you think of a positive online social interaction? (For example, how it makes you feel, what impact it has.)

More Details

110
Responses

Latest Responses
"Good flow of information, breakrooms, allowing individual interaction betw...
"Happy cause I am talking with someone, Makes me feel less lonely, and wis...
"You feel connected with the other person. You feel like you are being heard ...

Figure A.10: Above is a screenshot of the results of question 1 from the questionnaire.

9. Do you have experience using chat systems (also known as instant messaging apps) ?

More Details

● Yes   108
● No   2
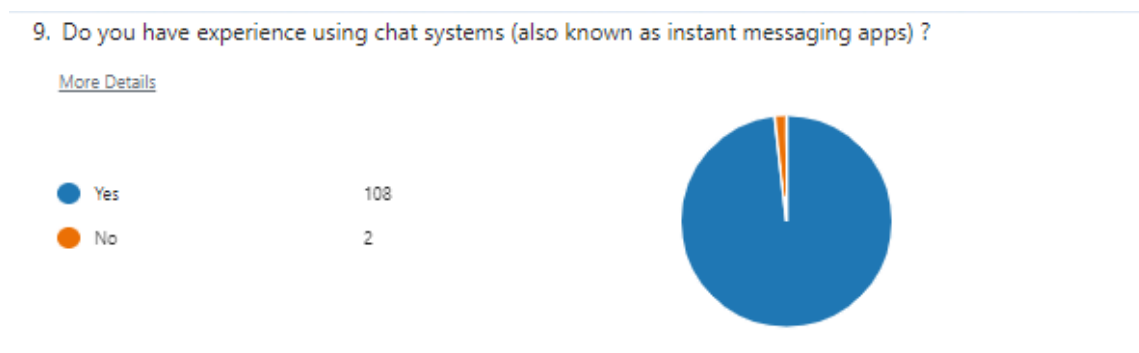
Figure A.11: Above is a screenshot of the results of question 1 from the questionnaire.

10. Please select all of the chat systems you have experience with using

More Details

Blackberry Messenger	11
Discord	70
eBuddy XMS	0
Facebook Messenger	90
Google Hangouts	19
iMessage	52
KakaoTalk	3
Kik Messenger	13
Line	7
Signal	9
Skype	56
Slack	21
Snapchat	74
Telegram	24
Tencent QQ	3
Viber	17
Whatsapp	104
WeChat	18
Other	19
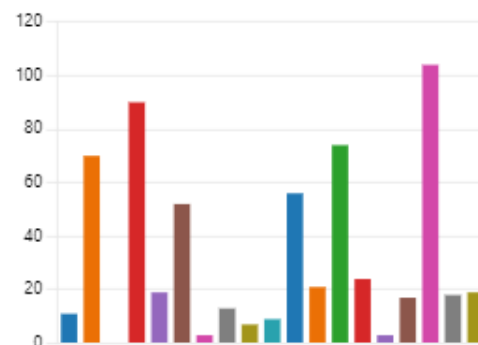
Figure A.12: Above is a screenshot of the results of question 1 from the questionnaire.

11. How often did you use chat systems in general to interact with other students during the pandemic?

More Details

Rarely	3
Once or twice a month	2
A few times a month	5
Once or twice a week	7
A few times a week	16
Once or twice a day	7
A few times a day	13
Multiple times a day	55

Figure A.13: Above is a screenshot of the results of question 1 from the questionnaire.

12. During the pandemic, how often did you use chat systems to interact with other students for academic-related purposes (e.g. exchanging course materials, group work etc.) vs non-academic-related purposes (e.g. casual conversation with friends)?

More Details

- 🔵 Only used them for academic-re... 3
- 🟠 Mostly academic-related, occasi... 23
- 🟢 Equally used them for both aca... 31
- 🔴 Mostly non-academic related, o... 46
- 🟣 Only used them for non-acade... 5
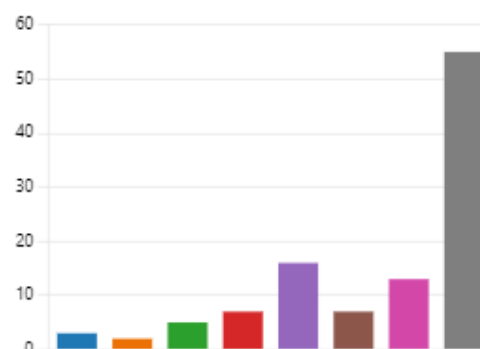

Figure A.14: Above is a screenshot of the results of question 1 from the questionnaire.

Chat System usage frequency	N (out of 108)	Percentage		
Multiple times a day	55	50.93%	Mean	13.50
A few times a week	16	14.81%	Median	7.00
A few times a day	13	12.04%	Mode	7.00
Once or twice a week	7	6.48%	SD	16.31
Once or twice a day	7	6.48%		
A few times a month	5	4.63%		
Rarely	3	2.78%		
Once or twice a month	2	1.85%		
Purpose of social interaction				
Mostly non-academic related, occasionally academic- related purposes	46	42.59%	Mean	21.60
Equally used them for both academic-related and non-academic-related purposes	31	28.70%	Median	23.00
Mostly academic-related, occasionally non-academic related purposes	23	21.30%	Mode	#N/A
Only used them for non-academic related purposes	5	4.63%	SD	16.17
Only used them for academic-related purposes	3	2.78%		
Perceived quality of interactions				
It improved the quality	43	39.81%	Mean	18.00
It had no effect	22	20.37%	Median	20.00
It Improved the quality a lot	20	18.52%	Mode	#N/A
It decreased the quality	15	13.89%	SD	13.32
I don't know	7	6.48%		
It decreased the quality a lot	1	0.93%		
Students that felt it improved the quality	63	58.33%		
Students that felt it decreased the quality	16	14.81%		

Figure A.15: Above is a screenshot of the results of question 1 from the questionnaire.

Experience with Chat Systems (results from q10)				Preferred chat system (results from q13)		
	N (out fo 108)	Percentage			N (out of 108)	Percentage
Whatsapp	104	96.30%		Whatsapp	46	42.59%
Facebook Messenger	90	83.33%		Discord	24	22.22%
Snapchat	74	68.52%		Facebook Messenger	14	12.96%
Discord	70	64.81%		Snapchat	11	10.19%
Skype	56	51.85%		Other	5	4.63%
iMessage	52	48.15%		Google Hangouts	2	1.85%
Telegram	24	22.22%		iMessage	2	1.85%
Slack	21	19.44%		WeChat	2	1.85%
Google Hangouts	19	17.59%		Signal	1	0.93%
Other	19	17.59%		Skype	1	0.93%
WeChat	18	16.67%		Blackberry Messenger	0	0.00%
Viber	17	15.74%		eBuddy XMS	0	0.00%
Kik Messenger	13	12.04%		KakaoTalk	0	0.00%
Blackberry Messenger	11	10.19%		Kik Messenger	0	0.00%
Signal	9	8.33%		Line	0	0.00%
Line	7	6.48%		Slack	0	0.00%
KakaoTalk	3	2.78%		Telegram	0	0.00%
Tencent QQ	3	2.78%		Tencent QQ	0	0.00%
eBuddy XMS	0	0.00%		Viber	0	0.00%
Mean	32.11			Mean	5.68	
Median	19.00			Median	1.00	
Mode	19.00			Mode	0.00	
SD	31.07			SD	11.32	

Figure A.16: The table above displays a statistical summary of the results from questions 10 and 13 from the questionnaire.

13. Which chat system did you prefer to use the most for socialising with other students during the pandemic?

More Details

● Blackberry Messenger	0	
● Discord	24	
● eBuddy XMS	0	
● Facebook Messenger	14	
● Google Hangouts	2	
● iMessage	2	
● KakaoTalk	0	
● Kik Messenger	0	
● Line	0	
● Signal	1	
● Skype	1	
● Slack	0	
● Snapchat	11	
● Telegram	0	
● Tencent QQ	0	
● Viber	0	
● Whatsapp	46	
● WeChat	2	
● Other	5	
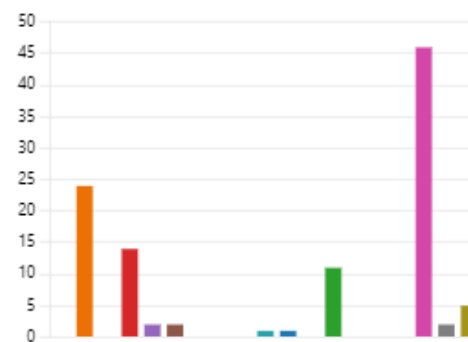
Figure A.17: Above is a screenshot of the results of question 1 from the questionnaire.

14. Please explain why you chose that option

More Details

108
Responses

Latest Responses

"It's a lot easier with straight communication and video conferencing when n..."

"I was living in China at the time"

"Because Discord is where the majority of my communication takes place on..."

Figure A.18: Above is a screenshot of the results of question 1 from the questionnaire.

15. How did your use of chat systems affect the quality of your social interactions with other students during the pandemic?

More Details

It Improved the quality a lot   20
It improved the quality   43
It had no effect   22
It decreased the quality   15
It decreased the quality a lot   1
I don't know   7

Figure A.19: Above is a screenshot of the results of question 1 from the questionnaire.

16. Were there any ways chat systems helped you to socially interact with other students during the pandemic? If so, please detail, if not say 'None'

More Details

108
Responses

Latest Responses
"We were able to build good connections from a distance "
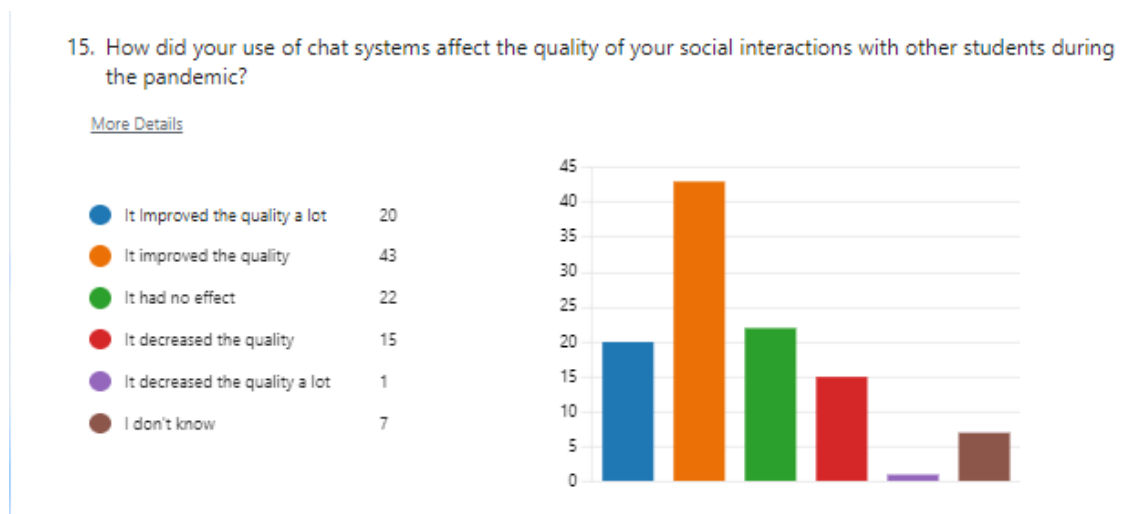"Since we weren't in class together I couldn't talk to people that I wasn't as cl...
"None"
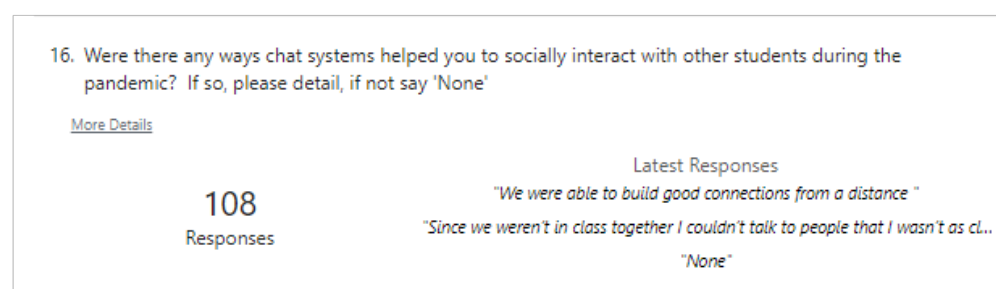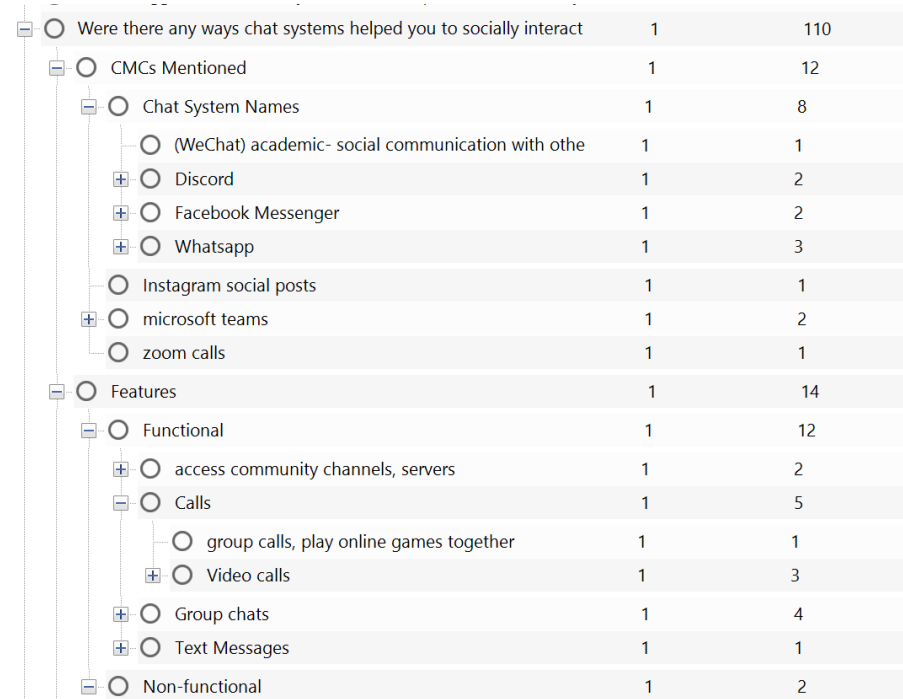
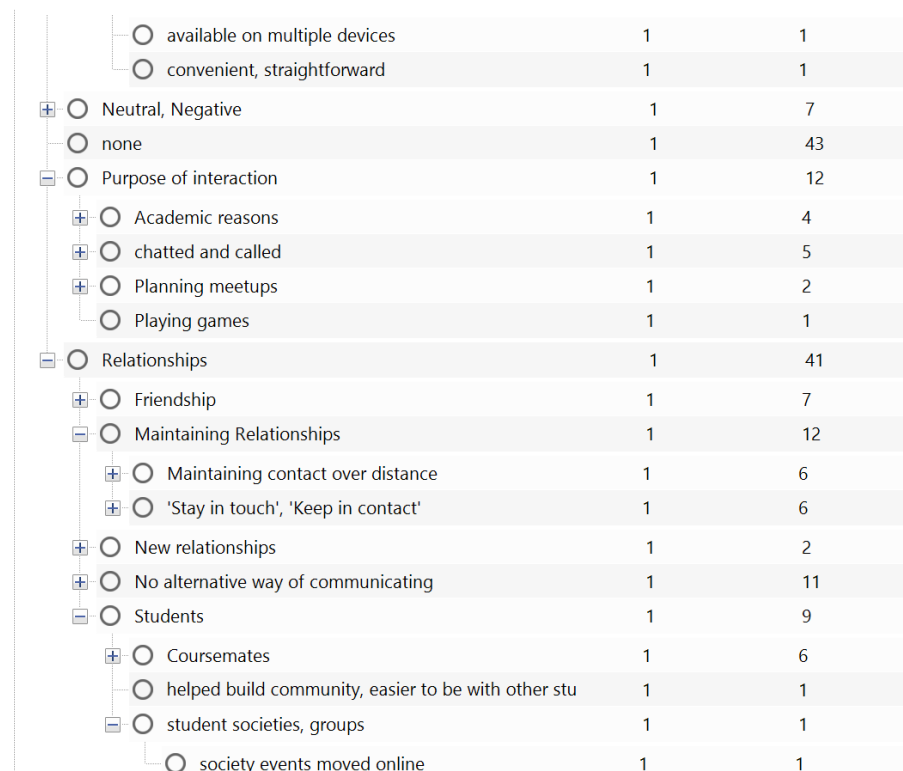Figure A.20: Above is a screenshot of the results of question 1 from the questionnaire.

Were there any ways chat systems helped you to socially interact	1	110
CMCs Mentioned	1	12
Chat System Names	1	8
(WeChat) academic- social communication with othe	1	1
Discord	1	2
Facebook Messenger	1	2
Whatsapp	1	3
Instagram social posts	1	1
microsoft teams	1	2
zoom calls	1	1
Features	1	14
Functional	1	12
access community channels, servers	1	2
Calls	1	5
group calls, play online games together	1	1
Video calls	1	3
Group chats	1	4
Text Messages	1	1
Non-functional	1	2

Figure A.21: Above is a screenshot of the themes and subthemes identified from the answers to q16

available on multiple devices	1	1
convenient, straightforward	1	1
Neutral, Negative	1	7
none	1	43
Purpose of interaction	1	12
Academic reasons	1	4
chatted and called	1	5
Planning meetups	1	2
Playing games	1	1
Relationships	1	41
Friendship	1	7
Maintaining Relationships	1	12
Maintaining contact over distance	1	6
'Stay in touch', 'Keep in contact'	1	6
New relationships	1	2
No alternative way of communicating	1	11
Students	1	9
Coursemates	1	6
helped build community, easier to be with other stu	1	1
student societies, groups	1	1
society events moved online	1	1

Figure A.22: Above is a screenshot of the themes and subthemes identified from the answers to q16 cont.

17. Were there any challenges you faced in using chat systems to socially interact with students during the pandemic? If so, please detail, if not say 'None'

More Details

108
Responses

Latest Responses

"It's hard to have food related social events as this is impossible online where..."

"Sometimes people wouldn't answer."

"Yes, in my opinion texting and even video calling is very different to face-to..."

Figure A.23: Above is a screenshot of the results of question 1 from the questionnaire.

Were there any challenges you faced in using chat systems to soci	1	110
Different to or not replacing in-person interactions	1	27
Ambiguity (Difficulty communicating, miscommunication	1	11
difficult to chat online, not seeing people	1	1
harder to explain sometimes in person	1	1
Lack of social cues, body language	1	6
struggle reading tone in text	1	2
hard to have food related social	1	1
Impersonal	1	3
Lack of authenticity	1	1
limiting feeling of barrier of not meeting students in pers	1	1
maths discord, if don't know person well before interacti	1	1
not quite same as in-person meeting,	1	1
not the same as seeing people irl (in class, around camp	1	1
Preference for in-person	1	4
'time difference'	1	2
Distraction	1	1
extreme amount of them, alll do same, without any real bene	1	1
Group chat issues	1	2
Messages ignored,missed	1	4
Negative Emotions	1	13
'Anxiety'	1	2

Figure A.24: Above is a screenshot of the themes and subthemes identified from the answers to q17.

Negative Emotions	1	13
'Anxiety'	1	3
'Awkward'	1	3
'Depressed'	1	1
Overload	1	3
exhausting always looking at screen and being in be	1	1
Multiple conversations	1	1
'Scared'	1	1
'Troubling, worrisome'	1	1
Neutral, Positive	1	3
none	1	54
Relationships	1	11
Difficulty contacting new people	1	5
Difficulty maintaining relationships	1	1
others preferred using chat systems I didn't really use	1	1
Strangers	1	4
Tech issues	1	3
audio issues, had to get mic	1	1
Connectivity issues	1	2

Figure A.25: Above is a screenshot of the themes and subthemes identified from the answers to q17 cont.

18. Please suggest 1-3 features you think are important for a chat system to help facilitate social interaction with other students

More Details

108 Responses

Latest Responses

"Should have a more friendly app, should be able to video conference, shoul..."

"Able to see old messages, Emojis/GIFS, and able to video call"

"Servers with different categories for work/casual. Robust video chatting soft..."

Figure A.26: Above is a screenshot of the results of question 1 from the questionnaire.

19. Please state your reasoning for choosing these features:

More Details

108 Responses

Latest Responses

"It makes life alot easier "

"So you can remember what you sent, have fun and call with people"

"Keeping work and play separate is important and it helps to declutter the c..."

Figure A.27: Above is a screenshot of the results of question 1 from the questionnaire.

Name	Files	References
⊖ ○ Please explain why you chose that option	1	110
⊖ ○ Whatsapp	1	79
⊖ ○ Features	1	49
⊖ ○ Non-functional	1	29
⊖ ○ Perspicuity	1	11
⊞ ○ Easy	1	10
⊞ ○ most simple to use	1	1
⊖ ○ Familiarity	1	7
⊞ ○ most familiar	1	5
⊞ ○ used to it	1	2
○ Clean design	1	6
⊞ ○ 'convenient'	1	4
○ Free	1	1
⊖ ○ Functional	1	20
⊖ ○ Send files,media	1	5
⊞ ○ File-Sharing	1	3
○ Send photos	1	2

Figure A.28: Above is a screenshot of the themes and subthemes identified from the answers to q19

Name	Files	References
⊞ ○ File-Sharing	1	3
○ Send photos	1	2
⊞ ○ Calls	1	4
⊖ ○ Group chats	1	3
⊞ ○ Most used for group chats	1	4
⊞ ○ Messaging	1	3
⊞ ○ Multimodality	1	2
○ separates documents easier, more used to it	1	1
○ message encryption	1	1
○ Stickers	1	1
⊖ ○ Relationships	1	24
⊞ ○ Popular with others	1	14
○ Student Groups	1	4
⊞ ○ Family	1	2
○ Friends	1	2
⊞ ○ mostly used in personal life	1	2
⊖ ○ Misc	1	6
⊞ ○ Less distracting, annoying	1	3
○ Casual chat	1	1
○ More formal	1	1
○ 'like their platforms'	1	1

Figure A.29: Above is a screenshot of the themes and subthemes identified from the answers to q19

Name	Files	References
More formal	1	1
'like their platforms'	1	1
Discord	1	62
Features	1	46
Functional	1	30
Many features	1	7
Servers, Channels	1	6
voice chat good	1	3
Desktop compatibility	1	3
Video conferencing	1	3
Call	1	2
Bots	1	2
File-sharing	1	1
Mute notifications	1	1
Nitro	1	1
'like the UI'	1	1
Non-functional Requirements	1	16
Relationships	1	14
Student Groups	1	6
Most people use	1	3
Friends	1	3

Figure A.30: Above is a screenshot of the themes and subthemes identified from the answers to q19

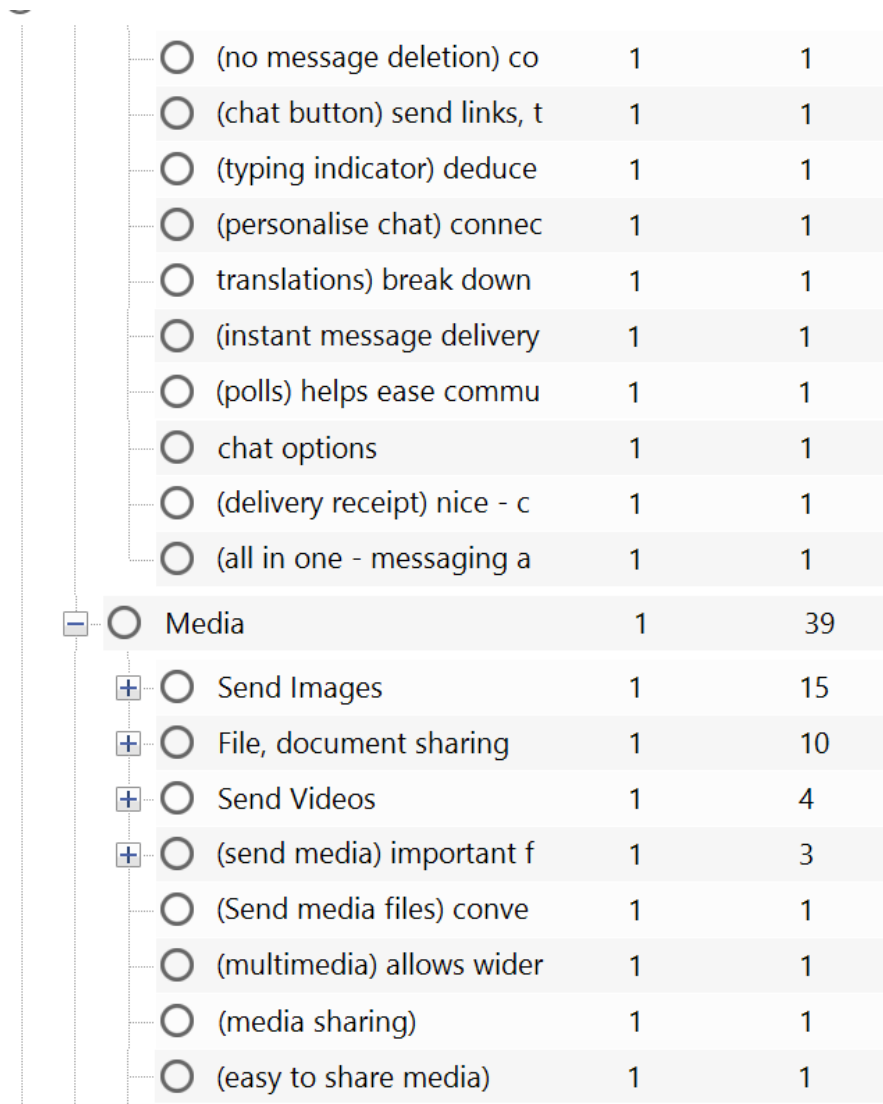| Name	Files	References
○ Friends	1	3
○ use a lot outside of school	1	1
○ Helped keep in touch	1	1
⊞ ○ Gaming	1	2
○ Facebook Messenger	1	24
○ Features	1	12
⊞ ○ Messaging	1	4
⊞ ○ Easy to make groups	1	3
⊞ ○ Calls	1	2
○ Overlay Feature	1	1
○ 'Intuitive UI'	1	1
○ Online Status	1	1
⊞ ○ Most people have facebook account	1	9
⊞ ○ Easy to find people without phone numbers	1	3
○ Snapchat	1	14
○ Popularity	1	7
⊞ ○ most friends active on	1	2
○ a lot of other people used	1	2
○ Most people I know use	1	1
○ still in high school, have all friends on snapchat so	1	1
⊞ ○ No justification	1	2

Figure A.31: Above is a screenshot of the themes and subthemes identified from the answers to q14

Figure A.32: Above is a screenshot of the themes and subthemes identified from the answers to q14

⊟ ○ Please state your reasoning for choosi	1	110
⊟ ○ Functional	1	200
⊟ ○ Chat, Messaging	1	74
⊞ ○ Graphics	1	23
⊞ ○ Voice Notes, Voice Messa	1	13
⊞ ○ Message Reactions	1	9
⊞ ○ (read receipts)	1	4
⊞ ○ Muting Chat	1	3
⊞ ○ Reply to Specific Messag	1	3
⊞ ○ Visible Chat History	1	3
⊞ ○ Text Formatting	1	2
○ text messaging - core co	1	1
○ (direct message) helps m	1	1
○ (private messaging) talk	1	1
○ (messages)	1	1
○ (no message deletion) co	1	1
○ (chat button) send links, t	1	1
○ (typing indicator) deduce	1	1

Figure A.33: Above is a screenshot of the themes and subthemes identified from the answers to q19

○ (no message deletion) co	1	1
○ (chat button) send links, t	1	1
○ (typing indicator) deduce	1	1
○ (personalise chat) connec	1	1
○ translations) break down	1	1
○ (instant message delivery	1	1
○ (polls) helps ease commu	1	1
○ chat options	1	1
○ (delivery receipt) nice - c	1	1
○ (all in one - messaging a	1	1
○ Media	1	39
○ Send Images	1	15
○ File, document sharing	1	10
○ Send Videos	1	4
○ (send media) important f	1	3
○ (Send media files) conve	1	1
○ (multimedia) allows wider	1	1
○ (media sharing)	1	1
○ (easy to share media)	1	1

Figure A.34: Above is a screenshot of the themes and subthemes identified from the answers to q19

○ (send variety of things e.	1	1	25/01/20	MK	25/01/2	MK
⊟ ○ Group chat	1	30	19/01/20	MK	21/01/2	MK
⊞ ○ Uni-related collaboration	1	8	30/03/20	MK	30/03/2	MK
⊞ ○ Servers, channels	1	7	21/01/20	MK	21/01/2	MK
⊞ ○ Chatroom	1	3	22/01/20	MK	22/01/2	MK
⊞ ○ Simultaneity	1	2	30/03/20	MK	30/03/2	MK
⊞ ○ 'Community feature'	1	2	25/01/20	MK	25/01/2	MK
○ (create group) helps ease	1	1	20/11/20	MK	24/01/2	MK
○ (create group)	1	1	24/01/20	MK	24/01/2	MK
○ (remove from chat) anno	1	1	20/11/20	MK	02/04/2	MK
○ (restrictions in busy chats	1	1	24/01/20	MK	24/01/2	MK
○ (group chat) for feeling o	1	1	22/01/20	MK	22/01/2	MK
○ (invite only) so others are	1	1	24/01/20	MK	24/01/2	MK
○ (facility to host large gro	1	1	30/03/20	MK	30/03/2	MK
○ (group quizzes) easy to le	1	1	24/11/20	MK	24/11/2	MK
⊟ ○ Calls	1	28	19/01/20	MK	21/01/2	MK
⊞ ○ Video Calls	1	20	21/01/20	MK	22/01/2	MK
⊞ ○ call	1	8	30/03/20	MK	02/04/2	MK

Figure A.35: Above is a screenshot of the themes and subthemes identified from the answers to q19

⊞ ○ Organisation, layout	1	3
⊞ ○ (simple UI)	1	2
⊞ ○ (user interface 'easy to use')	1	2
⊞ ○ 'clear UI'	1	2
○ (good interface up-to-date) easier talking on aesth	1	1
○ (decorative add-on like changing wallpaper) keeps	1	1
○ (intuitive UI) if don't like look then won't use	1	1
⊟ ○ Notifications	1	4
⊞ ○ (working notifications) so alerted on time if someo	1	2
○ (notifications) enables real-time conversations	1	1
○ (fine tune notifications e.g. allow dm notifications	1	1
⊟ ○ Non-functional	1	34
⊞ ○ 'Ease of use' , 'easy to use'	1	13
⊞ ○ Security, Privacy	1	4
⊞ ○ Accessibility	1	4
⊞ ○ Speed	1	3
⊞ ○ Mood	1	3
⊞ ○ Compatibility	1	2
⊞ ○ Popularity	1	2
⊞ ○ Reliable, Robust	1	2
○ (free) everyone in year can use same service	1	1

Figure A.36: Above is a screenshot of the themes and subthemes identified from the answers to q19
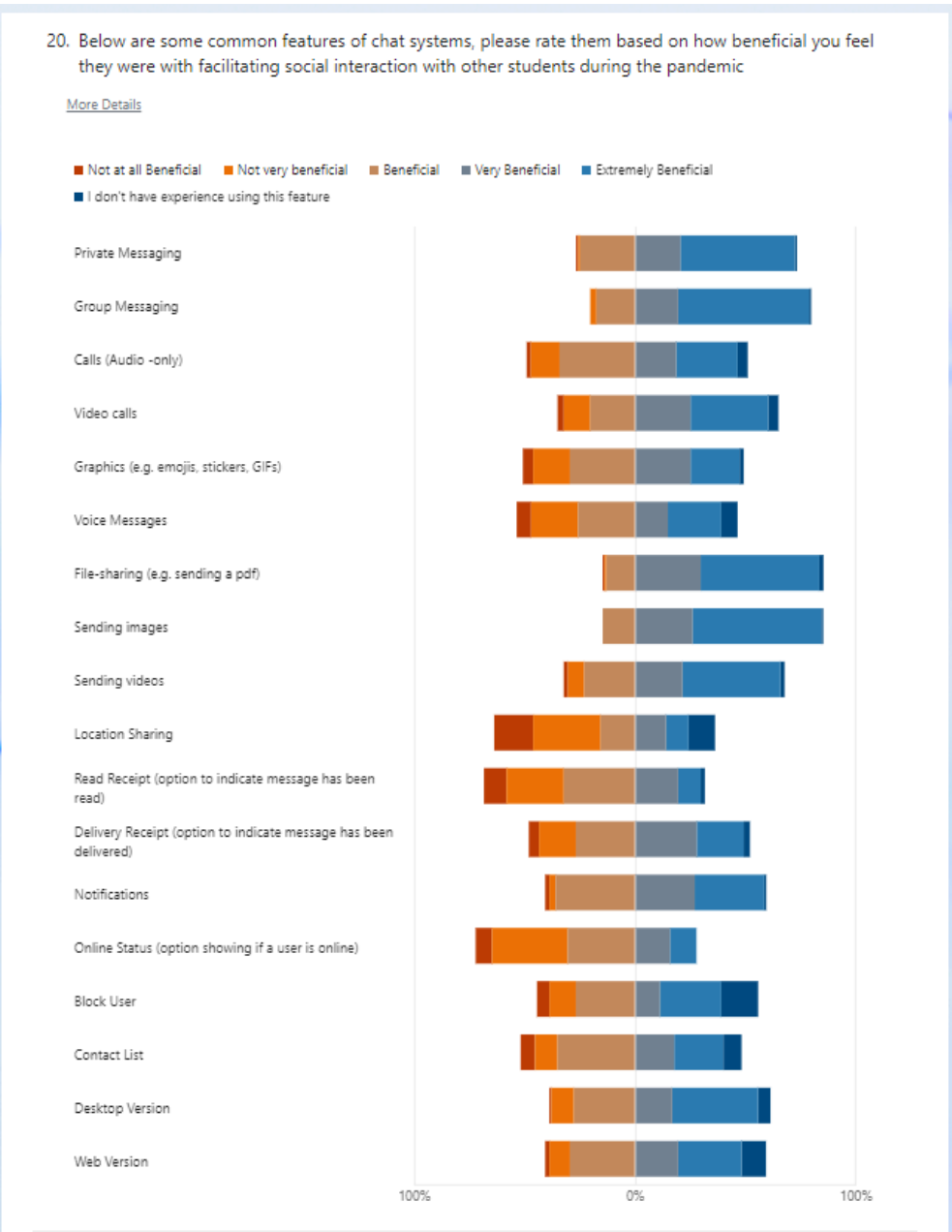
Figure A.37: Above is a screenshot of the results of question 1 from the questionnaire.

Figure A.38: Above is a screenshot of the results of question 21 from the questionnaire.
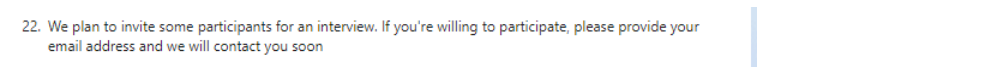
Figure A.39: Above is a screenshot of the results of question 22 from the questionnaire.

Appendix B

Systematic review Results

1. Bohee Jung, Hanku Kim, and Seung Hwan Lee. The impact of belongingness and graphic-based emoticon usage motives on emoticon purchase intentions for mim: an analysis of korean kakaotalk users. Online Information Review, 46(2):391–411, 2022. [62]

2. Alberto Ard 'evol-Abreu, Patricia Delponti, Helena Bonache, and Carmen Rodr ıguez-Wang uemert. Mobile instant messaging uses and technostress: a qualitative approach. International Journal of Human–Computer Interaction, pages 1–13, 2022 [33]

3. Ahmad Sugianto and Ahmad Bukhori Muslim. Gazing at 'the-you-know-who/what'in whatsapp: Deixis used in online learning amid covid-19 pandemic. LLT Journal: A Journal on Language and Language Teaching, 25(1):45–62, 2022 [100]

4. Michael Malsch utzky, Alexandra Reher, and Andrea Schr oder. Scholarship of teaching and learning - a way to identify inclusion opportunities and exclusion risks in digital learning scenarios. In 2021 World Engineering Education Forum/Global Engineering Deans Council (WEEF/GEDC), pages 1–7, 2021. [74]

5. SHAO HONGQUAN. The use of digital media among china students in belarusian state university during covid-19 pandemic. Higher Education and Oriental Studies, 1(4), 2021. [55]

6. Amy Wanyu Ou, Mingyue Michelle Gu, and John Chi-Kin Lee. Learning and communication in online international higher education in hong kong: Ict-mediated translanguaging competence and virtually translocal identity. Journal of Multilingual and Multicultural Development, pages 1–14, 2022 [?]

7. R Humayon, M Afzal, and MS Hussain. A critical analysis of conversational floors in post-corona digital. 2020. [57]

8. Idowu Febishola Kutu. The use of social media for academic purposes by post-graduate Information Studies students at the University of KwaZulu-Natal. PhD thesis, 2021 [67]

9. Christoph Pimmer, Florian Br uhlmann, Titilayo Dorothy Odetola, Oluwafemi

Dipeolu, Urs Grohbiel, and Ademola J Ajuwon. Instant messaging and nursing students' clinical learning experience. Nurse education today, 64:119–124, [51]

10. Anu Muhonen and Elisa R as anen. " kaikille okei?" everyone all right? shift- ing topics and practices in language students' chats during the global covid-19 pandemic. Journal of Teaching and Learning with Technology, 10:258–278, 2021. [80]

11. Murad Abdu Saeed, Mohammed Abdullah Alharbi, and Amr Abdullatif Yassin. Sustaining synchronous interaction effectiveness in distance writing courses: A mixed method study in a ksa university. Sustainability, 13(24):13675, 2021.[92]

12. Sazan M Mandalawi, Robyn Henderson, Henk Huijser Dr, and Megan Yih Chyn A Kek. Issues of belonging, pedagogy and learning in doctoral study at a distance. Journal of University Teaching Learning Practice, 19(4):15, 2022 [75]

13. Napat Jitpaisarnwattana, Hayo Reinders, and Pornapit Darasawang. Learners' perspectives on interaction in a language mooc. JALT CALL Journal, 17(2):158– 182, 2021. [59]

14. Sanjana Gautam and Mary Beth Rosson. Exploring feelings of student community across a geographically distributed university. Proceedings of the ACM on Human-Computer Interaction, 5(CSCW1):1–16, 2021 [53]

15. Gabriella Rodrigues de Oliveira. Smart Education? Understanding the impact of the COVID-19 pandemic in higher education institutions. PhD thesis, Universidade do Porto (Portugal), 2020. [49]

16. Edubots best practices, prepared by faculty of organization and informatics, in collaboration with the consortium partners in the project, 2022 [1]

17. Quality and Qualifications Ireland. The impact of covid-19 modifications to teaching, learning and assessment in irish further education and training and higher education a qqi evaluation. https://www.qqi.ie/, 2020 [88]

18. Madelyne M Losby. Emoji use in online communication with emerging adults: The impact on ambiguity, affect, and social connection. PhD thesis, Iowa State University, 2022 [72]

19. Saadeddine KHELALFA. Investigating Student's Attitudes Towards the Use of Social Media for Learning Purposes: A Case Study of EFL Students at the University of Ghardaia. PhD thesis, , 2022 [65]

20. Jesper Wedin and Daniel Saxin. Collaboration use in e-learning: An interview study on how learners use collaboration software in higher education. 2020. [112]

21. Peng Sun, Lu Xing, Junhui Wu, and Yu Kou. Receiving feedback after posting status updates on social networking sites predicts lower loneliness: A mediated moderation model. Applied Psychology: Health and Well-Being, 2023. [101]

22. James R Perkins. Millennial Experiences in Cohort-Based Higher Education Programs. University of Hartford, 2020. [85]

23. Grace A Morris. A new first-year experience: How the COVID-19 classroom

fosters social integration and affects first-year students' perceived persistence to degree completion. PhD thesis, Kent State University, 2021. [79]

24. Adrianne Aiko Thompson. Using a Class WhatsApp™ Group with EAP Students: Sense of Community, Benefits, and Challenges. PhD thesis, University of Florida, 2022. [107]

25. Ruqin Ren and Bei Yan. Personal network protects, social media harms: Evidence from two surveys during the covid-19 pandemic. Frontiers in Psychology, 13, 2022[91]

26. "Dawn Elizabeth Dane. A qualitative study about first year students' experiences of transitioning to higher education and available academic support resources. PhD thesis, University of Glasgow, 2022." [48]

Appendix C

Chat System Evaluation

Chat system Eligibility Criteria:

The chat systems identified in the User Study and Systematic Review included in this review met the following criteria:

•EC2.1–The chat system must be in English (either originally or have an option to switch to an English version)

• EC2.2- Software is free or accessible via the University Licence. (as this project is non-funded)

• EC 2.3 It must be fully functional

•EC 2.4 It should be available to download from a secure download page or official app store

• EC 2.5 The chat system should have been updated within the past 2 years

•-EC 2.6 the chat systems must fit the definition outlined in the background chapter

Chat system name	URL	Notes/Issues	In English	Freely available	Fully Functional	Available to download	Updated within last 2 years	Primary function is messaging	Private messaging	Group messaging	File-sharing	Sharing images and videos	Chat/Message History
1. Whatsapp	https://www.whatsapp.com/		y	y	y	y	y	y	y	y	y	y	y
2. Facebook Messenger	https://www.messenger.com/		y	y	y	y	y	y	y	y	y	y	y
3. Telegram	https://telegram.org/		y	y	y	y	y	y	y	y	y	y	y
4. Google Chat (formerly Hangouts)	https://support.google.com/chat/answer/7653601?hl=en-GB&co=GENIE.Platform%3DAndroid	Google Hangouts was discontinued in November 2022, the new version of the app is Google Chat	y	y	y	y	y	y	y	y	y	y	y
5. Snapchat	https://www.snapchat.com/		y	y	y	y	y	y	y	y	y	y	y
6. Wechat	https://www.wechat.com/		y	y	y	y	y	y	y	y	y	y	y
7. Viber	https://www.viber.com/en/		y	y	y	y	y	y	y	y	y	y	y
8. Kik Messenger	https://kik.com/		y	y	y	y	y	y	y	y	y	y	y
9. KakaoTalk	https://www.kakaocorp.com/page/service/service/KakaoTalk?lang=en		y	y	y	y	y	y	y	y	y	y	y
10. Line	https://line.me/en/		y	y	y	y	y	y	y	y	y	y	y
11. Discord	https://discord.com/		y	y	y	y	y	y	y	y	y	y	y
12. Slack	https://slack.com/intl/en-gb/features		y	y	y	y	y	y	y	y	y	y	y
13. Skype	https://www.skype.com/en/		y	y	y	y	y	y	y	y	y	y	y
14. Groupme	https://groupme.com/en-US/		y	y	y	y	y	y	y	y	y	y	y
15. Signal	https://signal.org/		y	y	y	y	y	y	y	y	y	y	y
16. iMessage	https://support.apple.com/messages	*Required Apple Device	y	n*	y	n*	y	y	y	y	y	y	y
18. Tencent QQ	https://im.qq.com/		n	y	y	y	y	y	y	y	y	y	y
17. BBM	https://www.blackberry.com/us/en/products/bbm-enterprise-bbme	Unable to sign up for account without asking to pay	y	n	y	y	y	y	y	y	y	y	y
19. eBuddy XMS	https://www.ebuddyxms.com/	Unable to access download page, no mobile version found	y	y	n	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
20. Differ	https://thehub.io/startups/differ	Unable to make account app crashed multiple times	y	y	n	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a

Chat System Features:				
Chat (Private /Direct MEssaging)	Message editability	Edit Message after sending		Allows user to revise messages after they have been sent, making communication easier and reducing ambiguity
		Message deletion	Delete for me	Also gives user control over the message they send
				However there is the potential for users to send messages that have a negative impact on the receiver and utilise the delete functions to "erase" this. Other features can mitigate this issue-, namely the ability to block, report or remove a user from a chat.
			Delete for everyone	
	Replies	Reply to specific message		Useful for helping users to keep track of a conversation and ensure messages aren't missed.
		React to message with emoji		Simulates in-person communication and can be used as proxy for polling feature
	Text formatting (e.g. bold/italics)	is available		Useful for students especially for sharing code
		latex/code support		
	Forward Message			Makes sharing information between students easier
	Voice message/push to talk			Can be used in lieu of text-based messages, can make messages easier to interpret
	Graphics	Emojis		Graphics can represent/replicate the effect of non-verbal communication such as body language and facial expressions found in F2F interactions which can help students convey certain emotions more easily and therefore increase the likelihood that messages are interpreted with the correct tone/meaning . They can also help to create a more friendly, light-hearted atmosphere.
		Stickers		
		GIFs		
	Typing indicator			Promotes synchronous communication
	Favourite/star message/pin			Helps users keep track of messages
	Translation available			This can help students overcome language-barriers thus enhancing their communications
	Location sharing			Can be useful for students when planning in-person meetups
	Change background/ wallpaper			Students will be more interested in and motivated to use the chat system if they can personalise the experience.

Figure C.1: Above is part of a screenshot of the The features for the evaluation which have been included based on results from the literature review, User Study and Systematic Review.

Chat (Message History)	Disappearing messages			Provides students more control over their chat history, as this feature offers the flexibility to choose how long a message remains visible in the chat. A limitation of this is that if not read within the timeframe a message could be deleted and therefore missed.
	Delivery Receipt			Useful in indicating to the sender their message has been delivered successfully.
	Read Receipts	Visible		Indication of whether a message has been read or not can be useful in promoting synchronous communication between students. However, this can put pressure on users to respond to messages they have opened or read.
		Option to disable		Giving the user the option to disable this feature allows them to view messages at any time without other members of the chat knowing which can thus alleviate pressure to respond.
Chat (Group Messaging)	Community/Server feature	Create community /server		Communities or servers can host large groups of students e.g. a whole year group or cohort, therefore students can be easily connected with others via this feature. One limitation of these large groups is the potential for students to be overloaded with a high volume of messages and notifications.
		Channels	Voice Channel	The option to sort the groups into smaller channels based on different topics or themes can help mitigate this issue so that students can communicate more easily in groups relevant to or that interest them without being distracted by other messages.
			Text Channel	
	Group chat	Make Group chat		Group chats make it easier to facilitate communication amongst multiple students allowing them to socialise and work together.
		Group name		Help to identify and distinguish between groups.
		Group picture		
		Group description		Allows user to stipulate the purpose of a group and set rules/guidelines to govern the group.
	Broadcast			Allows students to message multiple conversations at the same time, making communication across multiple chats easier.
	Message deletion	Delete for group		
	Role setting and permissions	Available		Settings to control chats can be beneficial for students in helping them manage conversations, prevent and control antisocial behaviour.
		Admin Role		
		Remove from Chat		
	Joining/adding to chat	Join		Students should be able to voluntarily join or leave a chat as this helps them control factors of their online interactions such as who they communicate with and when they do so.
		Leave		
		Invite-only option		Allows students to control who can become members of a chat e.g. it can help limit a group chat to only students from a specific course. One limitation of this is that students must already be acquainted with someone in the chat or have access to the invitation before they can join. Therefore maintaining the 'invitation-only' sub-feature as an optional setting and not the only setting can mitigate this.
	Chatbot feature			These can help answer student's questions in a chat and provide additional features such as polling, to enhance social interactions.
	Poll/quiz system			Makes it easier for students to interact especially when it comes to making decisions e.g. when carrying out groupwork.

Figure C.2: Above is part of a screenshot of the The features for the evaluation which have been included based on results from the literature review, User Study and Systematic Review.

File-Sharing and Media	File-sharing	Can send documents e.g. pdf		The ability to share files makes it easier for students to share information
		Can send more than one file at a time		
	Media	Images	Can send images	All of these sub-features allow students the flexibility of communicating via different modes, which enhances their communications
			Can take images in app	
		Videos	Can send videos	
			Can record video in app	
		Can send audio		
		Send links		
Calls	Audio-only	Call 1 person		The option for students to call each other can help ease communication as sometimes students prefer to speak to each other rather than rely on text-based messages. Calls allow students to reduce ambiguity in their conversations as they can interpret factors such as tone of voice and pitch when attempting to understand communications.
		Group call		
		Background noise cancellation		Audio interference during calls can have a great effect on the quality of students' social interactions with each other as it can prove distracting and detract from their conversations.
	Video Calls			VIdeo calls can help make socialising a more lively and interactive experience for students. And the options to mute and/or switch their camera on or off allows students to interact without the pressure to contribute to a conversation
		Call 1 contact		
		Group call		
		Mute		
		Camera on/off		
		Share-screen		This feature makes it easier for students to show each other what they are working on in order to collaborate on University assignments or study together.
		Background noise cancellation		Audio interference during calls can have a great effect on the quality of students' social interactions with each other as it can prove distracting and detract from their conversations.
Account and User Profile	Account	Phone number required		Allowing students to choose which details to include when registering for an account with a chat system makes the onboarding process easier as they can set up/verify their accounts whichever way is easier for them. Requiring one or both options inhibits this.
		Email required		
	Profile	Picture		These sub-features provide students more opportunity to personalise their experience thus enhancing their experience of socialising online
		Bio/caption/status feature		
		Share Story		This sub-feature gives students an avenue to express themselves and share aspects of their lives with other students which can help encourage interactions between them.
		Username		A username as opposed to just using full name allows students to communicate under a pseudonym. The option to socialise

Figure C.3: Above is part of a screenshot of the The features for the evaluation which have been included based on results from the literature review, User Study and Systematic Review.

	Profile	Picture		These sub-features provide students more opportunity to personalise their experience thus enhancing their experience of socialising online
		Bio/caption/status feature		
		Share Story		This sub-feature gives students an avenue to express themselves and share aspects of their lives with other students which can help encourage interactions between them.
		Username		A username as opposed to just using full name allows students to communicate under a pseudonym. The option to socialise without having to share personal details can promote more student interaction as students can communicate without worrying about others' perceptions of them.
		Presence Indicator	Feature exists	Indication of a user's status i.e. whether they are online or offline can be useful in promoting synchronous communication between students when they can see others are currently using the app. However, this can put pressure on users to read and respond to messages.
			Option to change/disable presence visibility	Giving the user the option to disable this feature allows them to use the app without indicating availability to read or receive messages from other users thus alleviating this pressure.
Contacts	Contact list	Feature available		Students require a list of other users to keep track of who they can communicate with.
		Can share Contact Info		This makes it easier for students to exchange contact details with each other and thus form new connections,
		Add contact		
		Option to find contact list from phone		This subfeature allows students to maintain pre-existing relationships with other students.
		Find/Recommed contacts to add/connect with(people you may know)		This makes it easier for students to form new connections with other students online.
		Invite a friend		This subfeature allows students to encourage others to join the same chat systems as them. This is helpful as students are more likely to socialise with each other if they have access to the same chat systems.
	Block/Report User	Block contact		These features help students to avoid potentially harmful social interactions.
		Report contact		
Notifications	Always working Push Notifications			Notifications that are fast and work properly facilitate fast, synchronous communication. Notifications that don't work well, leave risk of delaying conversations or missing messages entirely.
	Customisation	Mute notifications		Allows students to manage their conversations and limits the potential to be overloaded with or distracted by incoming messages.
		Extra ability to customise notifications (e.g.. different ringtone for different chats)		This further enhances the notification feature as students can prioritise messages they wish to read or respond to based on their different alert types

Figure C.4: Above is part of a screenshot of the The features for the evaluation which have been included based on results from the literature review, User Study and Systematic Review.

		Report contact		
Notifications	Always working Push Notifications			Notifications that are fast and work properly facilitate fast, synchronous communication. Notifications that don't work well, leave risk of delaying conversations or missing messages entirely.
	Customisation	Mute notifications		Allows students to manage their conversations and limits the potential to be overloaded with or distracted by incoming messages.
		Extra ability to customise notifications (e.g.. different ringtone for different chats)		This further enhances the notification feature as students can prioritise messages they wish to read or respond to based on their different alert types
UI	Clear/simple			A UI with a clear and simple layout makes it easier for students to use the chat system for social interactions.
	(customisation) Can change wallpaper			Students will be more interested in and motivated to use the chat system if they can personalise the experience.
	Ability to organise/change UI/ layout of messages			By sorting/organising chats into folders, giving them a hierarchy through pinning important chats at the top of the screen or through any other method available in the chat system students can more easily manage multiple conversations. This reduces the likelihood of being overwhelmed.
Non-Functional requirements	Privacy/Security	End-end Encryption		Important for maintaining user privacy
	Compatibility/Portability	Mobile Version		The ability to access the chat system on different platforms is important for increasing accessibility to the software.
		Web Version		
		Desktop Version		
	Usability	(Ease- of-Use) easy		The easier and less complicated the software is to use the more motivated the user will be to keep using it
		Speed Slow/fast		How quickly do messages and calls load and send? Speed facilitates fast synchronous exchanges, any lag or delay can thus hinder communication.
		Friendliness		The friendlier the app is (user-friendly, aesthetically-pleasing interface) the more motivated students will be to use it to communicate with others.
		Reliability/robustness:		Is the app secure and does it work consistently without crashes or errors? I.e. software doesn't crash
				Important to be able to rely on the chat system so that interaction is preserved.

Figure C.5: Above is part of a screenshot of the The features for the evaluation which have been included based on results from the literature review, User Study and Systematic Review.

Figure C.6: The first part of the evaluation results table is shown above

Figure C.7: The second part of the evaluation results table is shown above

Figure C.8: The third part of the evaluation results table is shown above

Appendix D

Participants' information sheet and consent form

Participant Information Sheet

Project title:	Systematic Review of Students' experience with using chat systems for social interaction during the Covid-19 pandemic
Principal investigator:	Cristina Andriana Alexandru
Researcher collecting data:	Muminah Koleoso

This study was certified according to the Informatics Research Ethics Process, RT number 7078. Please take time to read the following information carefully. You should keep this page for your records.

Who are the researchers?

The researchers of this study are Muminah Koleoso who is a 4th year Undergraduate student in the School of Informatics at the University of Edinburgh and Cristina Andriana Alexandru who is her supervisor. This study is being conducted as part of the Undergraduate Final Year project of Muminah Koleoso.

What is the purpose of the study?

The purpose of the study is to gather data from a sample of students to gain insight into their experience of using chat systems and the impact that had on their social interactions during the Covid-19 pandemic. The results gained from analysis of the data will help us better understand how students use chat systems for social interaction, highlight the types of features they find are the best/worst and which systems in particular they find are the best/worst. This will contribute to the formation of criteria for evaluating chat systems, as well as recommendations for design practice and use of the chat systems to improve student social interaction.

Why have I been asked to take part?

You have been asked to take part in this study because you are a University student that has experience of using chat systems to interact with other students.

Do I have to take part?

THE UNIVERSITY *of* EDINBURGH
informatics

Figure D.1: Participant Information Sheet and consent form

No – participation in this study is entirely up to you. You can withdraw from the study at any time, without giving a reason. Your rights will not be affected. If you wish to withdraw, contact the PI. We will stop using your data in any publications or presentations submitted after you have withdrawn consent. However, we will keep copies of your original consent, and of your withdrawal request.

What will happen if I decide to take part?

You will be asked questions as part of a questionnaire using Microsoft Forms regarding your experience of using chat systems for social interaction with other students. Firstly, you'll be asked for your age, gender, which degree you study, and student status followed by general questions about your experience of chat systems, such as the types of systems you're familiar with and have used. Then you will be asked about opinions on your preferred chat systems and well-known features of said systems. The survey will take between 10 and 20 minutes to complete and you may be invited to participate in a follow-up interview.

Are there any risks associated with taking part?

There are no significant risks associated with participation.

Are there any benefits associated with taking part?

If the results of the study are published, you may benefit indirectly from improvements to use of chat systems for facilitation of social interaction amongst students in Higher Education.

What will happen to the results of this study?

The results of this study may be summarised in Muminah Koleoso's Informatics Final Year Project. Quotes or key findings will be anonymized: We will remove any information that could, in our assessment, allow anyone to identify you. With your consent, information can also be used for future research. Your data may be archived for a maximum of 2 years. All data which hasn't already been deleted as part of the anonymization process that may be used to identify a participant, will be deleted during this timeframe.

Data protection and confidentiality.

Your data will be processed in accordance with Data Protection Law. All information collected about you will be kept strictly confidential. Your data will be referred to by a unique participant number rather than by name. Your data will only be viewed by the researcher Muminah Koleoso (s1932280@ed.ac.uk), and her supervisor Cristina Adriana Alexandru (Cristina.Alexandru@ed.ac.uk).

All electronic data will be stored on the School of Informatics' secure file servers. Your consent information will be kept separately from your responses in order to minimise risk.

What are my data protection rights?

You have the right to access information held about you. Your right of access can be exercised in accordance Data Protection Law. You also have other rights including rights of correction, erasure and objection. For more details, including the right to lodge a complaint with the Information Commissioner's Office, please visit www.ico.org.uk. Questions, comments and requests about your personal data can also be sent to the University Data Protection Officer at dpo@ed.ac.uk.

For general information about how we use your data, go to: edin.ac/privacy-research

Who can I contact?

If you have any further questions about the study, contact the Principal Investigator: Cristina Adriana Alexandru (Cristina.Alexandru@ed.ac.uk)

If you wish to make a complaint about the study, please contact inf-ethics@inf.ed.ac.uk. When you contact us, please provide the study title and detail the nature of your complaint.

Updated information.

If the research project changes in any way, an updated Participant Information Sheet will be be emailed to you by Muminah Koleoso s1932280@ed.ac.uk

Consent

By proceeding with the study, I agree to all of the following statements:

- I have read and understood the above information.
- I understand that my participation is voluntary, and I can withdraw at any time.

- I consent to my anonymised data being used in academic publications and presentations.
- I allow my data to be used in future ethically approved research.