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Happy or lonely? Investigating mental well-being using remote methods during the COVID-19 pandemic in The Netherlands

Marije Kanis* M.KANIS@HVA.NL
Marijn Schraagen** M.P.SCHRAAGEN@UU.NL
Shihan Wang** S.WANG2@UU.NL
Erik Tjong Kim Sang*** E.TJONGKIMSANG@ESCIENCECENTER.NL

* *Amsterdam University of Applied Sciences, The Netherlands*

** *Utrecht University, The Netherlands*

*** *eScience Center, The Netherlands*

Abstract

Understanding the unprecedented impact of COVID-19 on mental health and digital interactions is crucial, but also difficult to study in times of physical distancing. This paper contributes to the understanding of well-being in The Netherlands during the pandemic by employing mixed-remote methods. Sentiments of the Dutch public expressed on X (formally Twitter) are analyzed with AI techniques. Additionally, co-creative toolkits and probes, such as diaries, were used with older adults and students for detailed in-situ capturing. The AI approach provides general insights, while toolkit studies can address interpersonal variation and provide non-automated individual feedback. Findings indicate that (1) the pandemic has impacted the expressed emotional states of 'loneliness' and 'happiness', (2) this varied over time, for example related to pandemic announcements, (3) there are differences between groups (such as young and old), and (4) the toolkits provided contextual self-reflective insights and active inspiration in support of mental well-being.

1. Introduction

In March 2020, the COVID-19 pandemic was announced by the World Health Organisation (WHO). The pandemic and its distancing regulations made physical and social interactions more challenging. Consequently, the ways of being (co-)creative and conducting user research needed to be adapted (Dalsgaard et al. 2020, Bosch et al. 2019, le Glaz et al. 2021, BNO and Stedelijk Museum Amsterdam 2020). The pandemic also impacted mental health, which this paper investigates using mixed-remote research methods.

By mixing methodological remote approaches, this paper contributes to a better understanding of the impact on mental health in times of pandemic. The study analysis explores the different ways in which the COVID-19 pandemic has impacted dimensions of mental health of the Dutch public, specifically focusing on the concepts of *happiness* and *loneliness*. Two methods of remote research were used for collecting data on people's well-being from a distance: Tweet analysis for a large sample of the population, and the deployment of a remote co-creation toolkit 'One week/day in the life of' with elderly adults and students. The paper provides the two methods as a complementary approach. The tweet analysis provides a broad overview of mental health aspects, and the remote toolkits provide a detailed image of the well-being of a small group from a specific demographic. The paper connects themes found in both research interventions. In doing this, the research endeavors to both address the impact on participants' emotional well-being resulting from the global pandemic, and the methodological challenges coming with that.

2. Related Work

According to Aristotle, the highest and most important goal for human beings is happiness (Aristotle 350 B.C.). Indeed, many studies have underlined the importance of happiness (Diener 2000, Danner et al. 2001, Fredrickson and Joiner 2002, Lyubomirsky et al. 2005a, Lyubomirsky et al. 2005b, Waugh and Fredrickson 2006). Consequently, a variety of philosophical, religious, psychological and biological approaches have been taken to identify happiness and its sources, e.g., (Diener and Seligman 2004, Haring 2007, Lyubomirsky et al. 2005a).

Well-being and happiness benefit from social interaction (Baumeister and Leary 1995, Diener and Seligman 2002) and physical activity (Jakobsson et al. 2020, Nauta et al. 2021, Lades et al. 2020), which can be more challenging during a pandemic (Bas et al. 2020, Jakobsson et al. 2020). For example, because of social distancing regulations during the pandemic many group sport activities were canceled, with less opportunities for face-to-face contact and social connectedness as a result.

Social isolation and loneliness correlate substantially with well-being (Baumeister and Leary 1995), and increase the risk of psychological problems and low life satisfaction (Bowling et al. 1989).

Several studies have targeted the impact of mental health during the COVID-19 pandemic (Lades et al. 2020, Maalouf et al. 2021), often using surveys (Rezapour and Hansen 2022) and social media analysis (Garg 2023, Al Banna et al. 2023, Das Swain et al. 2024). Various groups and contexts have been studied specifically, such as older adults (Lebrasseur et al. 2021, Yang et al. 2021) or the rural versus urban population (Zhong et al. 2020, Wang et al. 2020). Insights from these surveys have been inconclusive or contradictory, as defined groups are often heterogeneous, and COVID-19 regulations and experiences vary by area. A Dutch survey study (Reep and Hupkens 2021) showed a particular negative impact of the COVID-19 crisis on young (age 18-25) and single older adults (65+). The actual experience of quarantine and a COVID-19 infection is shown to also influence mental health (Wang et al. 2021, Brooks et al. 2020). Given the large amount of people worldwide who have contracted COVID-19 infections, and the general importance of happiness, understanding and supporting mental health issues will remain relevant presently and in the future.

Remote toolkits with probes such as diaries have been used for studying emotional well-being in-situ (e.g. (Bosch et al. 2019)). The act of expressive writing can have a positive impact on people's well-being, particularly when focusing on positive emotions (e.g. (Kanis and Brinkman 2010, Lyubomirsky et al. 2005b)). However, such methods have not been extensively explored in times of COVID-19.

Machine Learning and Natural Language Processing have been used to investigate emotional well-being (le Glaz et al. 2021, Thieme et al. 2020, Zhang et al. 2022, Arowosegbe and Oyelade 2023, Sedgwick et al. 2023, Yang et al. 2023), for which social media analysis (SMA) has proven useful (e.g., (Garg et al. 2023, Oliveira and Paraboni 2024)). Social media was studied in the context of previous pandemics such as H1N1 (Chew and Eysenback 2010). For COVID-19, the general emotional response to government policies has been measured using SMA (Addawood et al. 2020) as well as specific phenomena such as mass fear and panic (Samuel et al. 2020). This type of analysis generally contains term frequency analysis, topic associations, sentiment analysis and demographic analysis, similar to the techniques used in the current paper. However, combining such techniques with qualitative methodologies seems less well investigated.

3. Methodology

This paper studies the mental states 'happiness' and 'loneliness' of the Dutch during the COVID-19 pandemic, using (1) a content analysis on tweets, and (2) the deployment of remote co-creative toolkits and probes with students and older adults. The quantitative tweet analysis spans one year, while the qualitative approach with toolkits was applied for short periods of time. The tweet analysis aims to reveal general trends, while the toolkits facilitate capturing more personal and contextual insights.

3.1 Social media analysis

Social media analysis was performed using a data set consisting of Dutch language tweets from The Netherlands. Tweets related to loneliness and happiness were collected for the years 2019-2021, which included the start of the COVID-19 pandemic in The Netherlands in March 2020. The specific concepts of happiness and loneliness were chosen as aspects of well-being and social connectedness that are suitable for keyword-based social media analysis. The data was analyzed to show the development of the topics *happiness* and *loneliness* over time. A detailed annotation procedure shows the proportion of people who actually express their own mental state as opposed to talking about the concepts in a more abstract way. Further analysis (Section 4.1) shows a number of demographic groups in the topics of happiness and loneliness.

Relevant messages have been collected by filtering all Dutch language tweets from the years 2019-2021 using the keywords *eenzaam* (*lonely*) and *blij* (*happy*) and linguistic variants *blije* and *eenzam*. The two keywords were carefully selected from 42 Dutch mental-health-related terms occurring in Dutch tweets in the year 2020. The selection was based on frequency in the tweets and lack of ambiguity. For example, the frequent keyword *alleen* (*lonely*) was considered as well, but rejected because of semantic ambiguity due to the alternate meanings *alone* and *only*. We attempted to exclude spam, bot tweets and non-human tweets by considering only users using first person pronouns or second person pronouns in at least half of their tweets. Retweets were not explicitly removed. Duplicate tweets are included, because we consider these informative in a frequency analysis. We focused on self-referring emotions by only counting tweets with the keywords that also included a first person pronoun, *ik* (*I*) or *mij/me* (*me*). The numbers of selected users for 2019, 2020 and 2021 were 144,502, 156,532 and 141,676 respectively, while the number of selected tweets were 42 , 50 and 48 million.[1].

An additional manual annotation procedure was performed of a random sample of counted tweets, which contained the keywords *eenzaam* or *blij* in addition to a first person pronoun. The annotation task identified all messages in the sample that specifically describe the mental state of the message author[2]. Due to resource constraints, the annotation was performed by a single annotator. Therefore, the consistency of the annotation cannot be measured by means of inter-annotator agreement, which is a limitation that should be addressed in future work on the specific topic of identifying the target of mental state descriptions.

3.2 Remote toolkit for older adults

The toolkit for older adults (65+) aimed to gain contextual understanding and to challenge participants to come up with ideas for using technology and digital applications for supporting emotional and physical well-being (Nauta et al. 2021).

Participants were recruited through an online survey, and various on- and offline special interest groups for older adults. To avoid potential biases, the authors were not direct part of the recruitment, for which an occupational therapist was involved, with specific experience with engaging the target group. The toolkit contained a custom designed activity diary, activity rating cards, an elastic fitness band and a booklet containing exercise tutorials, tips for video conferencing, apps for physical and mental well-being etc. (Figures 5 to 10). Fifteen participants returned the toolkit (5 male, 10 female, μ age=70, σ=4.6). They used the toolkits in two batches during the Summer 2020 lockdown (June 20-September 7). Participants were instructed to use the diary for one week.

Daily questions prompted reflections on well-being and plans for the day, through assignments such as making a collage, selecting an activity from the booklet, or drawing a figure to indicate the strong and weak parts of their body. Participants filled in activity cards for each activity indicating

1. Our Python code for selecting and counting the tweets is available: `https://github.com/puregome/notebooks/blob/master/chatting_users.ipynb`
2. Our Python code for processing annotated self-referenced emotion tweets is available: `https://github.com/puregome/notebooks/blob/master/annotated-graphs.ipynb`

Figure 1: Frequency of Loneliness and Happiness topics. Top: Frequencies in the years 2019–2021 based on keyword search. Note that the graphs have different scales, reflecting the overall higher frequency of happiness. Bottom: Manually annotated subset from 2020 depicting people expressing their own mental state versus other uses of the sentiment words. Happiness tweets more frequently focus on the author than loneliness tweets.

how they felt. The toolkit contained an instruction manual, and a dedicated contact point was provided. Finally, the diary also included questions related to the experience with the toolkit itself for methodological evaluation.

The diaries and activity cards were first transcribed, photographed and coded. Thematic analysis was used to identify patterns and themes in the data (Braun and Clarke 2006). Two coders, including one author, conducted the thematic analysis following the guidelines of Braun and Clarke. The initial phase involved open coding, in which key themes were identified using post-it notes. These categories were then iteratively refined and structured through a digital coding process in Excel. To enhance clarity and consistency in coding, color coding was employed, allowing for a structured organization of themes and sub-themes. This helped visually distinguish different conceptual categories and track relationships across the dataset, ensuring a systematic analysis. Coding consistency was ensured through an iterative, consensus-based approach. Both coders engaged in multiple rounds of discussion, refining the coding framework until mutual agreement was reached. Themes that emerged included physical and digital activities, technology and digital usage (for physical well-being), mental well-being (motivation & meaning), and user experiences with the toolkit.

3.3 Remote toolkit for students

A class of third-year students developed their own well-being toolkits in March 2021. In groups of two, 21 students deployed the toolkits for 24 hours. This timeframe and approach was chosen as to fit the practical and education settings as being part of a course on creative research methods, while also considering participant burden. The students evaluated their toolkits with at least six other student participants. The exercise aimed to 1) gain further understanding of student well-being during COVID-19, 2) inspire solutions for supporting student well-being, 3) teach students the use

	User type		
Tweets	Happiness	Loneliness	General
1	45.0%	62.3%	61.0%
2	15.7%	16.4%	14.7%
3	8.4%	7.4%	6.2%
4	5.4%	4.0%	3.5%
5	3.8%	2.4%	2.2%
6	2.8%	1.6%	1.5%
7	2.2%	1.2%	1.1%
8	1.7%	0.8%	0.9%
9	1.4%	0.6%	0.7%
10	1.2%	0.5%	0.6%
> 10	12.4%	2.8%	7.6%

Table 1: Number of tweets posted in 2020 for general users and users having posted at least once about happiness or loneliness.

of toolkits and probes, and 4) learn from this pilot study on how such toolkit studies could work and be valuable in practice.

During the first day, the students used an online whiteboard to answer questions regarding their own well-being and COVID-19 (Figure 11). This exercise provided an initial idea of the students' well-being and inspired interactive discussion and follow-up actions.

4. Data Analysis and findings

4.1 Social media analysis

Figure 1 shows the topic frequency for happiness and loneliness, based on Dutch tweets from 2019–2021 from selected users containing the (sub)string *eenzaam* or the variant *eenzam* (for loneliness) or words ending in *blij* or *blije* (for happiness), as well as a first person pronoun. The graphs show the median[3] frequencies for a moving window of 61 days. The loneliness graph shows that this topic was more prevalent in the spring and autumn of 2020 as compared to the years 2019 and 2021, corresponding to the start of national lockdowns (March 12th, 2020 and October 14th, 2020). The happiness graph is relatively stable over the years.

The bar charts show a random selection of tweets containing one of the two keywords and the first person singular pronouns *ik*, *mij* or *me*, annotated to show whether the tweet was expressing the emotional state of the author or a more general statement. This analysis shows that the actual percentage of tweets about personal circumstances and experiences is relatively stable over the months of 2020: 46±6% for loneliness tweets and 72±9% for happiness tweets, which indicates that the graph shapes in the top graphs are reliable.

Note that Figure 1 shows loneliness and happiness as co-existing rather than purely opposite emotions, consistent with a generally heightened expression of mental state during the pandemic.

Two specific aspects were selected for further analysis: mentions of particular groups in society and user recurrence. Group mentions (Figure 2) were analyzed using the monthly frequency of a single keyword indicative of the group. The selection of groups is based on domain knowledge and preliminary data exploration. The analysis was performed separately for the happiness and loneliness categories. The figure shows that parents and children are often mentioned in relation

3. By using median frequencies rather than average frequencies, we hope to minimize the effect of the typical frequency spikes in social media data.

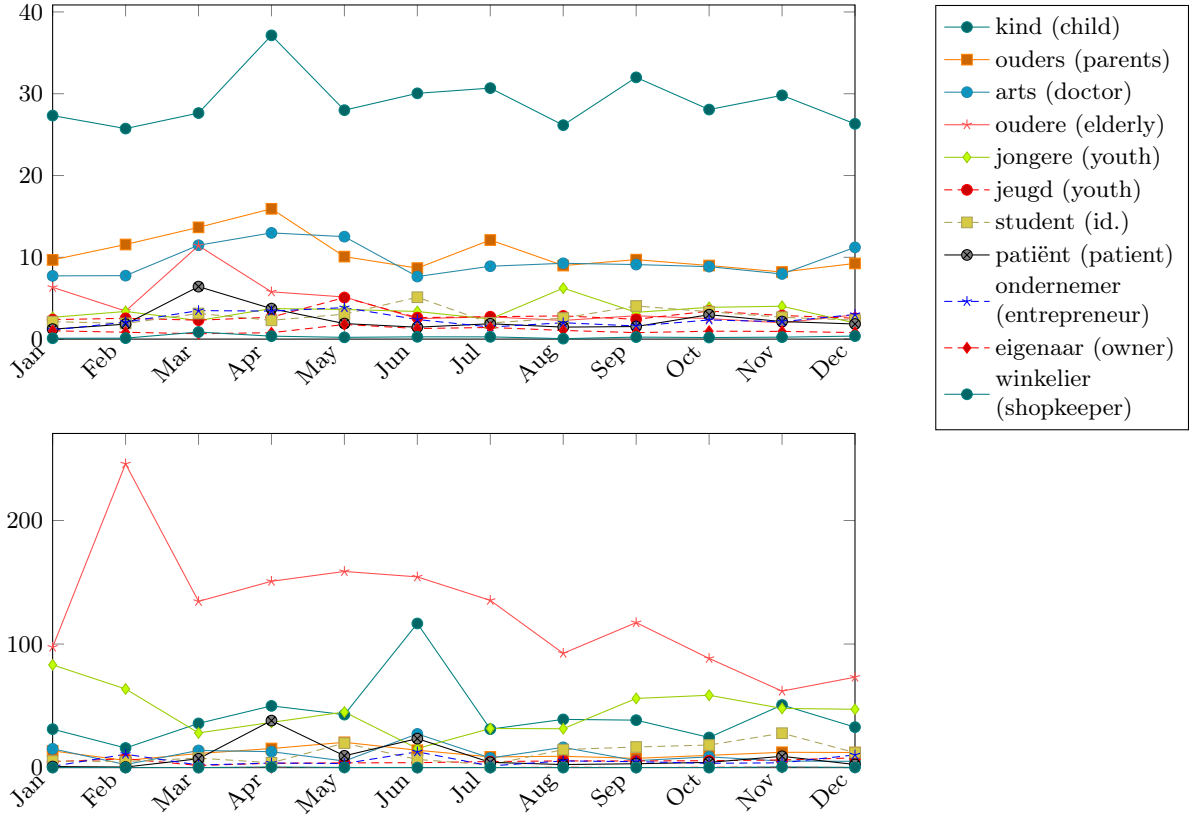

Figure 2: Group mentions within tweets in 2020. The graphs show the frequency per 1000 tweets for happiness (top) versus loneliness (bottom).

to both categories. Keywords associated to teenagers, young adults and students are less frequent than the keyword associated to younger children. Business-related concepts such as *shopkeeper* or *entrepreneur* are mentioned much less frequently. An interesting contrast is found for the *elderly* and *youth* keywords, which are both more prevalent for loneliness.

User recurrence was measured by the amount of messages posted by the same individual user during the year 2020. This measurement was performed for messages containing a happiness keyword, a loneliness keyword, and for all messages. Table 1 shows that people who discuss the topics of happiness write more messages than the average X user. Happiness and loneliness users are defined as users that have posted about happiness or loneliness, respectively, at least once during 2020. The overlap between happiness and loneliness users is small (0.1% of both sets of users combined).

4.2 Findings from toolkits with older adults

The diary for elderly people with activity assignments gave contextual daily insights into participants' physical and mental well-being, as a research outcome, but also in terms of awareness and reflection for the participants themselves. Digital activities did not seem to play a major role for participants, yet they stated that the toolkit had made them more aware of possibilities such as installing health-oriented apps. Participants were also enthusiastic about the fitness band that came with the toolkit, in wanting to keep on using it. While using YouTube and Facebook was mentioned by participants, nobody indicated using X, which affirms the notion that the tweet content-analysis does not always reach all groups of people in terms of remote methodology.

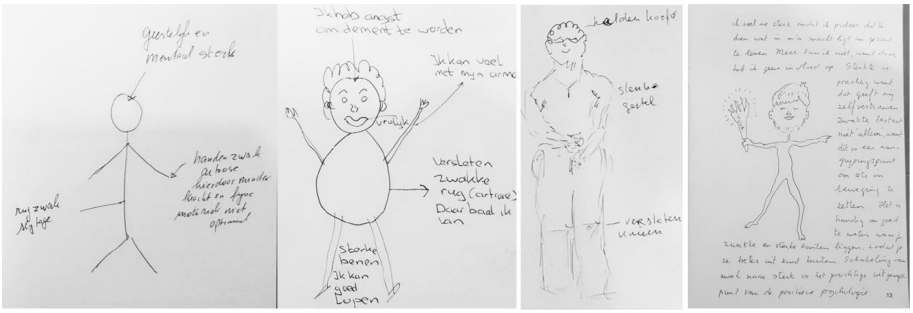

Figure 3: Visual diary output. Detail from drawing task stressing mental strength, as further shown in Fig. 9.

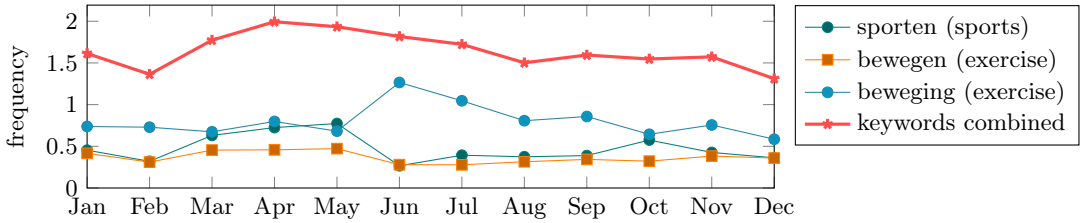

Figure 4: Frequency of sports/exercise keywords per 1000 pandemic tweets (2020).

4.3 Findings from on-line class and toolkits with students

The introductory online session with students prompted the themes *social contact*, *nature*, *sunshine*, *reading*, *writing*, *gaming*, *face masks* and *on-line education*, among others. The theme *being alone* contains nuances inspiring further research regarding desired levels of 'loneliness' and social interaction needed for 'happiness'. Students mentioned the lack of a crowd in public transport and tourist destinations as positive, as well as *saving money instead of spending it all in a bar* and *more time for self-exploration*. On-line education seemingly enabled students to be more flexible and more social at home. This is evidenced by 40 percent of answers relating to less commuting, with a quarter of answers mentioning the advantage of extra time available for being with their closest ones. About a third of the replies indicated students to be fine, another third stated that the pandemic was detrimental to their well-being (*It's going well, but I'm done with the lockdown*), and one third stated not feeling well, e.g., being mentally 'exhausted' or 'drained'.

The students designed toolkits containing diaries to depict positive moments, daily activity schedules with recipes and tea bags, drawing kit assignments, and probes for visual and audio recording. Some toolkits focused on potential solutions for well-being, such as phone lockers for digital breaks, candy for getting into the flow, and checklists in the form of coloring pictures. Students highlighted daily rhythms, physical exercise, getting rest and a healthy diet as positive influences that could be augmented by digital solutions. The collected data provided insights in what made students happy, such as a nostalgic music track, achieving goals or special occasions like a walk to the polling station on election day. Some participants indicated that they lacked specific things such as going to festivals, traveling and physical contact. On the other hand, participants started to experience simple mundane things as positive. They turned out to be able to reflect on such positive moments, and to come up with creative insights and solutions for their well-being. More evaluation and design iterations may further point and strengthen potential solutions for issues like sentiment decline as found in the social media analysis, and supporting happiness overall.

Toolkit keyword	Example tweet (translated and abridged)
grandchildren	Young people can build the economy and we as elderly cannot. Scary, but true. That's why I stay inside. My granddaughter needs me.
social activities	Clubs for elderly are all closed. No theater, concerts, cinema, bridge games, playing jass, playing pool, shuffleboard or going to a bar. Luckily playing golf, taking a walk and bicycle rides are still possible.
dog	A dog can make the owner happy and help elderly people to make contact with others. A smile on the face of a person suffering from Alzheimer's...
swimming	The swimming pool is finally open again for exercise. I hope free swimming will also return soon. The older swimmers really miss this. Some go to the pool daily.
walking	Today I took a walk with an elderly person. I have never seen such a happy person. Such fascination for mundane things like trees and goats.
exercise	I'm an older person myself now. Luckily I just heard that I will get to go out for exercise today – getting my bike ready now.
daily rhythm	I find it very hard to to go to class when it is in the same room as self study and free time. Planning would probably help to sustain a daily rhythm.
enough sleep	First I am going to get enough sleep and then study all night
eating healthy	After a week of unhealthy eating now back to healthy food, studying and daily exercise!

Table 2: Correspondence between remote toolkit keywords and tweets. Top: older adults. Bottom: students.

4.4 Combining toolkits and tweet analysis

The toolkit for older adults asked people to list concepts that make them happy (Figure 8). To connect the toolkit data to the social media data, relevant tweets from the data set were selected, as shown in Table 2. Both elderly people and students mention exercise frequently. This is partially confirmed by the tweet data as the sports topic becomes more frequent at the start of the pandemic (Figure 4). However, public interest in the topic decreases afterwards and stabilizes in late summer and autumn. Comparing toolkit findings to observations and trends on X can guide the interpretation of results for both methods, either to confirm insights or to prompt further investigation for conflicting observations.

The literature has shown the benefits of expressive writing (Burton and King 2004, King 2001), particularly describing the experience of positive emotions, also using digital means (Kanis and Brinkman 2007, Kanis and Brinkman 2008). The tweet results point in that direction in terms of 'happiness users' being more active on X than 'loneliness users', but this should be further studied. In our remote toolkit study, an older adult described in his diary that he had been on social media and engaged in discussion for hours which had negatively contributed to his level of mental well-being on that day and wanting to stop that. This shows that actively reflecting (particularly as done with the toolkit design) is necessary to become more aware of what types of behavior and activity, such as what social media interaction, contributes positively to well-being which can then instigate a positive change.

5. Discussion and Conclusion

This paper combines two remote methods, namely tweet analysis and toolkit studies, for gaining deeper understanding of well-being in The Netherlands during COVID-19. It particularly focused on the mental states of happiness and loneliness.

5.1 Social media analysis

While tweet analysis as such is not novel, the combined methodological approach and focus of this paper on specific concepts related to well-being over time and for particular groups offers new insights, and allows to confirm assumptions on the way people react to pandemic-related measures, using Dutch people as a case study. For example, the concept of 'loneliness' increased in frequency during the first and second lockdown in 2020, as compared to 2019. However, in 2021 the frequency remains more stable, suggesting an habituation effect (Figure 1). Detailed analysis showed that the increase for 'loneliness' is partly caused by people discussing the mental state of others, while for the 'happiness' concept this effect is less pronounced. Regarding groups, parents and children were often discussed in the context of happiness, while youth and elderly people were discussed in the context of loneliness (Figure 2). On an individual user level, the analysis showed that users that mention happiness post messages more frequently than users that mention loneliness, and that only very few users belong to both groups.

The number of X users in The Netherlands is relatively high, which allows for analysis in a wide variety of topics. However, X users are not a representative sample of the Dutch or global population, which is a limitation of this approach. Another limitation is the use of keywords for linguistic analysis, which does not include phenomena such as emojis, metaphors, or sarcasm, which limits the accuracy of the observation. Such limitations can be addressed by using other mixed approaches in future work. However, keywords do capture a large amount of messages expressing emotions. Using a large amount of data, as in the current study, provides further robustness to the keyword approach for identifying trends over time and across demographic groups.

In recent years many approaches to social media analysis have been proposed using several techniques such as topic modeling, sentiment analysis, and sarcasm detection, implemented using established algorithms, supervised learning approaches, or prompt-based Large Language Models (Corti et al. 2022, Zhang et al. 2024). Such techniques can address a number of issues associated with keyword analysis, for example people who express their own mental state versus talking about other people as illustrated in Figure 1, or issues regarding keyword ambiguity as discussed in Section 3.1. Keyword analysis, on the other hand, has the advantage of being highly efficient on large amounts of data (i.e., 140 million tweets in the current experiments), as well as being reproducible and transparent, while still being able to provide valuable insights on topics and trends in the data that are required for the current study.

5.2 Toolkit studies

Qualitative toolkit studies require substantial time and effort, but provide valuable personal glances and contextual perspectives of particular groups. The student class exercise and toolkits emerged as interesting methods for remote expression and (visual) data collection, and gaining complementary perspectives on different nuances of well-being. The toolkits also inspired personal self-reflection and potential interventions for well-being.

Limitations regarding the toolkit studies include that activities in the study are not fully representative of the daily lives of the whole population, covering only a relatively short amount of time and a small group of participants which is subject to selection bias. This also makes it more challenging to compare and combine the remote data from different studies. Furthermore, the specific conditions under which this diary study was conducted—during the COVID-19 pandemic—cannot be replicated, which adds to the value of even small-scale data collection. Nevertheless, it remains an open question whether extending the diary period would capture greater temporal fluctuations in well-being, offering a promising avenue for future research.

5.3 Remote mixed methods

This paper discussed the complementing implementation and challenges of two remote methodologies. The study provides the combination of approaches on the methodological level, as well as more concretely, connecting themes found in the toolkit study to corresponding elements within social media discourse (Table 2). The toolkit studies provide context by explicitly probing the emotions and activities of the participants. Observations based on the toolkits can be compared with tweet analysis to investigate general trends.

An example is the frequent mention of sports and exercise in the toolkits. This is also found on X, however there is a clear downwards trend in discussing sports and exercise over time (Figure 4). This might in turn be a seasonal effect, so further research comparing trends to other years is needed. Another example is the finding that X users who discuss happiness wrote more messages than the average user, which opens up directions for future study on exploring benefits of active expression.

Potential further analysis topics within each approach can be selected based on insights from the complementary approach. For example, the social media analysis showed the importance of the topic of children and parents, which could inspire a future toolkit study using children and parents as participants. Such a toolkit can be designed to target themes, attitudes, regions, or interpersonal aspects emerging from the social media data. Trends over time in the social media data can furthermore prompt repeated toolkit studies to investigate longitudinal aspects in a focused way.

For the interpretation of the complementary results it is essential to take the intrinsic differences between the methods into account. The presented toolkit studies are activity-based, with people being prompted to report happiness and loneliness in connection with their private daily routines and events. In contrast, on social media the issue of well-being is often placed in a broader context as part of a discussion, by people that made a spontaneous choice to post a message without being prompted by a researcher, without necessarily disclosing private details related to their mental state. Therefore, both confirmed as well as contrasting insights from the two approaches should be carefully interpreted, taking the means and context of people expressing themselves into account.

In addition, it is important to consider the diverse representativeness of two different remote analysis methods. For example, the majority of social media (X) users are under 60 years old (approximately 92% in 2024), meaning that older individuals' perspectives are less visible online. To address this gap, additional research methods —such as the diaries and toolkits used in this study— are essential to capturing their experiences. This paper therefore argues that there is an essential need for combining small-scale qualitative insights with large-scale computational methods in future research. This could lead to more targeted well-being interventions, in line with the contributions of this work and to complement other existing (NLP) approaches.

Even after the COVID-19 pandemic and X no longer being the prime social micro-blogging medium, people's happiness remain of continued importance -not only in The Netherlands or Europe, but worldwide. This paper showed that combining remote data-driven methods and qualitative toolkit methods has potential in providing a more detailed nuanced understanding and active inspiration towards supporting this global long-term goal.

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References

Addawood, Aseel, Alhanouf Alsuwailem, Ali Alohali, Dalal Alajaji, Mashail Alturki, Jaida Alsuhaibani, and Fawziah Aljabli (2020), Tracking and understanding public reaction during COVID-19: Saudi Arabia as a use case, *Proceedings of the 1st Workshop on NLP for COVID-19 (Part 2) at EMNLP 2020*, Association for Computational Linguistics. https://www.aclweb.org/anthology/2020.nlpcovid19-2.24.

Al Banna, Md. Hasan, Tapotosh Ghosh, Md. Al Jaber Nahian, M. Shamim Kaiser, Mufti Mahmud, Kazi Abu Taher, Mohammad Shahadat Hossain, and Karl Andersson (2023), A hybrid deep learning model to predict the impact of COVID-19 on mental health from social media big data, *IEEE Access* **11**, pp. 77009–77022, IEEE.

Aristotle (350 B.C.), Nicomachean Ethics.

Arowosegbe, Abayomi and Tope Oyelade (2023), Application of natural language processing (NLP) in detecting and preventing suicide ideation: A systematic review, *International Journal of Environmental Research and Public Health*, MDPI. https://www.mdpi.com/1660-4601/20/2/1514.

Bas, Daniela, Melissa Martin, Carol Pollack, and Robert Venne (2020), The impact of COVID-19 on sport, physical activity and well-being and its effects on social development, *UN Department of Economic and Social Affairs (DESA) Policy Briefs*, United Nations. https://www.unilibrary.org/content/papers/27081990/16.

Baumeister, Roy and Mark Leary (1995), The need to belong: Desire for interpersonal attachments as a fundamental human motivation, *Psychological bulletin* **117**, pp. 497–529, Taylor & Francis.

BNO and Stedelijk Museum Amsterdam (2020), Results of a survey about the implications of the Corona crisis for designers in The Netherlands. https://www.bno.nl/web/image/28462/infographics

Bosch, Lilian, Marije Kanis, Julia Dunn, Kearsley Stewart, and Ben Kröse (2019), How is the caregiver doing? Capturing caregivers' experiences with a reflective toolkit, *JMIR Mental Health, Special issue CHI 2019 4th Symposium on Computing and Mental Health: Designing Ethical eMental Health Service*, JMIR.

Bowling, Ann, Robert Edelmann, Jane Leaver, and Theresa Hoekel (1989), Loneliness, mobility, well-being and social support in a sample of over 85 year olds, *Personality and Individual Differences* **10** (11), pp. 1189–1192, Elsevier.

Braun, Virginia and Victoria Clarke (2006), Using thematic analysis in psychology, *Qualitative Research in Psychology* **3** (2), pp. 77–101, Taylor & Francis.

Brooks, Samantha, Rebecca Webster, Louise Smith, Lisa Woodland, Simon Wessely, Neil Greenberg, and Gideon James Rubin (2020), The psychological impact of quarantine and how to reduce it: rapid review of the evidence, *The Lancet* **395** (10227), pp. 912–920, Elsevier. https://www.sciencedirect.com/science/article/pii/S0140673620304608.

Burton, Chad and Laura King (2004), The health benefits of writing about intensely positive experiences, *Journal of research in personality* **38**, pp. 150–163, Elsevier.

Chew, Cynthia and Gunther Eysenback (2010), Pandemics in the age of Twitter: Content analysis of tweets during the 2009 H1N1 outbreak, *PLoS ONE* **5** (11), pp. e14118, Public Library of Science.

Corti, Luca, Michele Zanetti, Giovanni Tricella, and Maurizio Bonati (2022), Social media analysis of Twitter tweets related to ASD in 2019–2020, with particular attention to COVID-19: topic modelling and sentiment analysis, *Journal of Big Data*, Springer.

Dalsgaard et al., Peter (2020), How researchers and experts in human-computer interaction and interaction design can contribute to the COVID-19 crisis.

Danner, Deborah, David Snowdon, and Wallace Friesen (2001), Positive emotions in early life and longevity: Findings from the nun study, *Journal of personality and social psychology* **80**, pp. 804–813, American Psychological Association.

Das Swain, Vedant, Jingjing Ye, Siva Karthik Ramesh, Abhirup Mondal, Gregory Abowd, and Munmun De Choudhury (2024), Leveraging social media to predict COVID-19–induced disruptions to mental well-being among university students: Modeling study, *JMIR Form Res* **8**, pp. e52316, JMIR Publications.

Diener, Ed (2000), Subjective well-being: The science of happiness, and a proposal for a national index, *American Psychologist* **55**, pp. 34–43, APA.

Diener, Ed and Martin Seligman (2002), Very happy people, *Psychological Science* **13**, pp. 81–84, Sage Publishing.

Diener, Ed and Martin Seligman (2004), Beyond money: Toward an economy of well-being, *Psychological Science in the Public Interest* **5** (1), pp. 1–31, Sage Publishing. PMID: 26158992. https://doi.org/10.1111/j.0963-7214.2004.00501001.x.

Fredrickson, Barbara and Thomas Joiner (2002), Positive emotions trigger upward spirals toward emotional well-being, *Psychological Science* **13** (2), pp. 172–175, Sage Publishing. PMID: 11934003. https://doi.org/10.1111/1467-9280.00431.

Garg, Muskan (2023), Mental health analysis in social media posts: A survey, *Archives of Computational Methods in Engineering* **30** (3), pp. 1819–1842, Springer.

Garg, Muskan, Chandni Saxena, Usman Naseem, and Bonnie Dorr (2023), NLP as a lens for causal analysis and perception mining to infer mental health on social media.

Haring, Bas (2007), *Voor een echt succesvol leven (For successful living)*, Nijgh & Van Ditmar.

Jakobsson, Johan, Christer Malm, Maria Furberg, Ulf Ekelund, and Michael Svensson (2020), Physical activity during the Coronavirus (COVID-19) pandemic: Prevention of a decline in metabolic and immunological functions, *Frontiers in Sports and Active Living* **2**, pp. 57, Frontiers. https://www.frontiersin.org/article/10.3389/fspor.2020.00057.

Kanis, Marije and Willem Paul Brinkman (2007), What do people like? The design of a mobile tool to harness and share positive thoughts, *ECCE '07: Proceedings of the 14th European conference on Cognitive ergonomics: invent! explore!*, Association for Computing Machinery, pp. 191–198. https://doi.org/10.1145/1362550.1362589.

Kanis, Marije and Willem-Paul Brinkman (2008), Designing technologies that encourage the sharing of positive emotions, *Emotion in HCI: Joint Proceedings of the 2005, 2006, and 2007 International Workshops*, pp. 196–197.

Kanis, Marije and Willem-Paul Brinkman (2010), Making mundane pleasures visible: mediating daily likings with lightweight technology, *Personal and Ubiquitous Computing* **14**, pp. 261–269, Springer. http://www.springerlink.com/index/10.1007/s00779-009-0256-1.

King, Laura (2001), The health benefits of writing about life goals, *Personality and Social Psychology Bulletin* **27**, pp. 798–807., Sage Publishing.

Lades, Leonhard, Kate Laffan, Michael Daly, and Liam Delaney (2020), Daily emotional well-being during the COVID-19 pandemic, *Technical report*, Public Policy, University College Dublin. `https://publicpolicy.ie/papers/daily-emotional-well-being-during-the-covid-19-pandemic/`.

Lebrasseur, Audrey, Noémie Fortin-Bédard, Josiane Lettre, Emilie Raymond, Eve-Line Bussières, Nolwenn Lapierre, Julie Faieta, Claude Vincent, Louise Duchesne, Marie-Christine Ouellet, Eric Gagnon, André Tourigny, Marie-Ève Lamontagne, and François Routhier (2021), Impact of the COVID-19 pandemic on older adults: Rapid review, *JMIR Aging*, JMIR Publications.

Lyubomirsky, Sonja, Kennon Sheldon, and David Schkade (2005a), Pursuing happiness: The architecture of sustainable change, *Review of General Psychology* **9**, pp. 111–131, Sage Publishing.

Lyubomirsky, Sonja, Laura King, and Ed Diener (2005b), The benefits of frequent positive affect: Does happiness lead to success?, *Psychological bulletin* **131**, pp. 803–855, APA.

Maalouf, Fadi, Bernadette Mdawar, Lokman Meho, and Elie Akl (2021), Mental health research in response to the COVID-19, Ebola, and H1N1 outbreaks: A comparative bibliometric analysis, *Journal of Psychiatric Research* **132**, pp. 198–206, Elsevier. https://www.sciencedirect.com/science/article/pii/S0022395620310219.

Nauta, Berber, Marije Kanis, Bart Visser, Somaya Ben Allouch, and Daniël Bossen (2021), Behoeftes rondom (beweeg) activiteiten bij ouderen in tijden van corona: Contextuele informatie inwinnen over behoeftes rondom bewegen, activiteiten en technologie bij ouderen met een co-creatieve toolkit op afstand (needs regarding (physical) activity with older adults in times of COVID-19), *Nederlands Tijdschrift voor Oefentherapie* **17** (2), pp. 26–31, Performis.

le Glaz, Aziliz, Yannis Haralambous, Deok-Hee Kim-Dufor, Philippe Lenca, Romain Billot, Taylor Ryan, Jonathan Marsh, Jordan DeVylder, Michel Walter, Sofian Berrouiguet, and Christophe Lemey (2021), Machine learning and natural language processing in mental health: Systematic review, *Journal of Medical Internet Research*, JMIR.

Oliveira, Rafael and Ivandré Paraboni (2024), A bag-of-users approach to mental health prediction from social media data, *in* Gamallo, Pablo, Daniela Claro, António Teixeira, Livy Real, Marcos Garcia, Hugo Gonçalo Oliveira, and Raquel Amaro, editors, *Proceedings of the 16th International Conference on Computational Processing of Portuguese - Vol. 1*, Association for Computational Lingustics, pp. 509–514. https://aclanthology.org/2024.propor-1.52.

Reep, Carin and Christianne Hupkens (2021), Ervaren impact corona op mentale gezondheid en leefstijl, *Statische Trends*.

Rezapour, Mostafa and Lucas Hansen (2022), A machine learning analysis of COVID-19 mental health data, *Scientific reports* **12** (1), pp. 14965, Nature Publishing Group UK London.

Samuel, Jim, GG Nawaz Ali, Md. Mokhlesur Rahman, Ek Esawi, and Yana Samuel (2020), Covid-19 public sentiment insights and machine learning for tweets classification, *Information* **11** (6), pp. 314, MDPI.

Sedgwick, Rosemary, André Bittar, Herkiran Kalsi, Tamara Barack, Johnny Downs, and Rina Dutta (2023), Investigating online activity in uk adolescent mental health patients: a feasibility study using a natural language processing approach for electronic health records, *BMJ Open*, British Medical Journal Publishing Group. https://bmjopen.bmj.com/content/13/5/e061640.

Thieme, Anja, Danielle Belgrave, and Gavin Doherty (2020), Machine learning in mental health: A systematic review of the HCI literature to support the development of effective and implementable ML systems, *ACM Transactions on Computer-Human Interaction* **27** (5 (August)), pp. 53, ACM.

Wang, Cuiyan, María López-Núñez, Riyu Pan, Xiaoyang Wan, Yilin Tan, Linkang Xu, Faith Choo, Roger Ho, Cyrus Ho, and Marta García (2021), The impact of the COVID-19 pandemic on physical and mental health in China and Spain: Cross-sectional study, *JMIR Formative Research*, JMIR Publications.

Wang, Yilin, Peijing Wu, Xiaoqian Liu, Sijia Li, Tingshao Zhu, and Nan Zhao (2020), Subjective well-being of Chinese Sina Weibo users in residential lockdown during the COVID-19 pandemic: Machine learning analysis, *JMIR*, JMIR Publications.

Waugh, Christian and Barbara Fredrickson (2006), Nice to know you: Positive emotions, self–other overlap, and complex understanding in the formation of a new relationship, *The Journal of Positive Psychology* **1** (2), pp. 93–106, Routledge. PMID: 21691460. https://doi.org/10.1080/17439760500510569.

Yang, Kailai, Shaoxiong Ji, Tianlin Zhang, Qianqian Xie, Ziyan Kuang, and Sophia Ananiadou (2023), Towards interpretable mental health analysis with Large Language Models, *in* Bouamor, Houda, Juan Pino, and Kalika Bali, editors, *Proceedings of the 2023 Conference on Empirical Methods in Natural Language Processing*, Association for Computational Linguistics, pp. 6056–6077. https://aclanthology.org/2023.emnlp-main.370.

Yang, Xue, Benjamin Yip, Arthur Mak, Dexing Zhang, Eric Lee, and Samuel Wong (2021), The differential effects of social media on depressive symptoms and suicidal ideation among the younger and older adult population in Hong Kong during the COVID-19 pandemic: Population-based cross-sectional survey study, *JMIR Public Health and Surveillance*, JMIR Publications.

Zhang, Tianlin, Annika Schoene, Shaoxiong Ji, and Sophia Ananiadou (2022), Natural language processing applied to mental illness detection: a narrative review, *NPJ digital medicine* **5** (1), pp. 46, Nature Publishing Group UK London.

Zhang, Yazhou, Chunwang Zou, Zheng Lian, Prayag Tiwari, and Jing Qin (2024), SarcasmBench: Towards evaluating large language models on sarcasm understanding. https://arxiv.org/abs/2408.11319.

Zhong, Bu, Zhibin Jiang, Wenjong Xie, and Xuebing Qin (2020), Association of social media use with mental health conditions of nonpatients during the COVID-19 outbreak: Insights from a national survey study, *JMIR*, JMIR Publications.

Appendix A. Remote toolkits

Figure 5: Toolkit 'One week in the life of' for older adults, including activity cards, diary, fitness band, and Tips & Tricks activity booklet

Figure 6: Activity cards for the daily capturing and rating of different activities in different categories (Outdoor, Indoor, Household, Digital, Relaxation, and Other activities). Left: Rating activity in terms of effort and enjoyment, and indicating whether done 'Alone' or 'Together'. Right: Describing specific activities, such as 'Walking' as Outside activity, and 'Being on the Internet and YouTube' as Digital activity

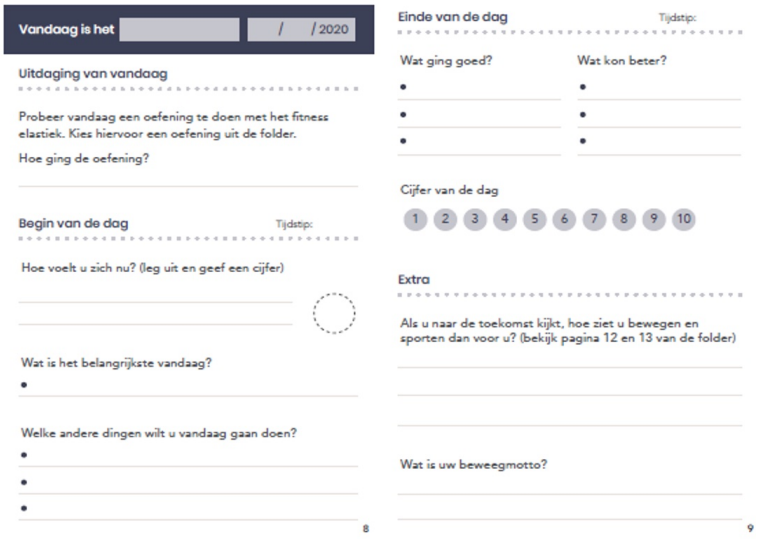

Figure 7: Page from toolkit diary with daily exercises, questions and ratings related to how participants are feeling (e.g. Question about 'What went well?' and 'What could be done better?'). It also includes an assignment to pick an activity from the Tips & Tricks booklet.

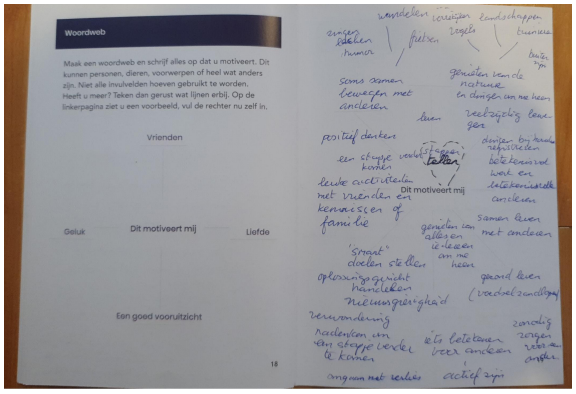

Figure 8: Assignment in diary to write down things that positively motivate the participant. This example contains singing, birds, exercising with others, being outside, etc.

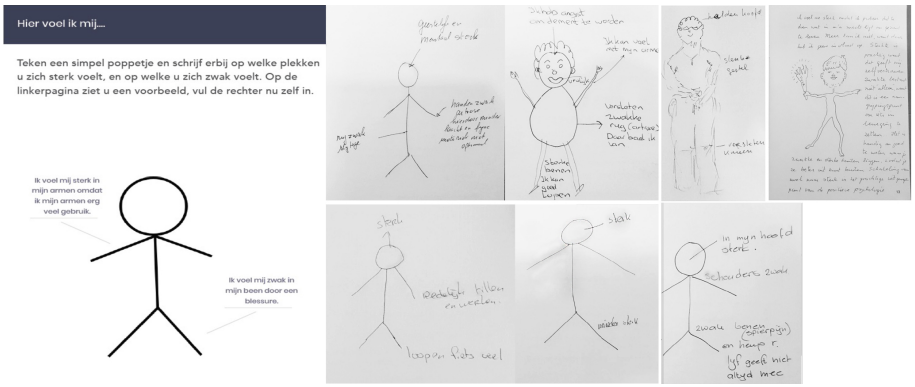

Figure 9: Pages from participants' diaries with assignment to draw a simple figure for indicating their strong and weak parts. In the drawings, participants often featured their mind and mental health as being strong and important.

Figure 10: Collages made by two participants on what they enjoy, such as cycling and being in nature

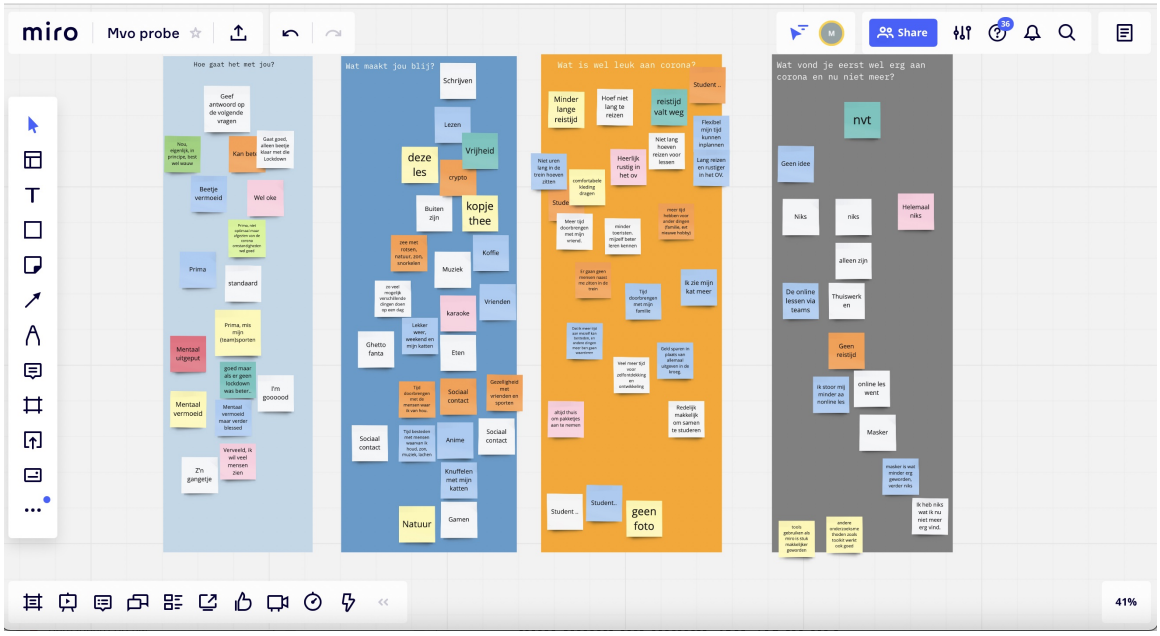

Figure 11: Interactive Miro assignment in introductory on-line class. Students answered questions on post-its with regards to their well-being, namely (1) How are you doing? (2) What makes you happy? (3) What do you like about the COVID-19 pandemic? (4) What did you not like about COVID that has now changed?