

*Jonas Frich (2021): Is brainstorming the final frontier in the digitalization of design work?. In: Proceedings of the 19th European Conference on Computer-Supported Cooperative Work: The International Venue on Practice-centred Computing on the Design of Cooperation Technologies - Exploratory Papers, Reports of the European Society for Socially Embedded Technologies (ISSN 2510-2591), DOI: 10.18420/ecscw2021-p19*

# Is brainstorming the final frontier in the digitalization of design work?

Jonas Frich

Centre for Digital Creativity, Aarhus University

*frich@cc.au.dk*

**Abstract.** This work explores the publicly available annual Design Tools Survey from 2017 to 2020 to find that brainstorming and ideation consistently appear to be the only activity where professional designers make elaborate use of analog tools, like pens, paper, and whiteboards. Furthermore, this predisposition for the analog appears to be reliable for both freelancers designers to larger design teams, as well as novice to very seasoned designers. These findings are discussed in relation to collaborative design work and the interactive qualities of the tools.

## Introduction

For around two decades, CSCW and HCI have developed technologies intended to support and augment collaborative design ideation (Frich et al., 2019b). However, the often collaborative practice of brainstorming and sketching new ideas using pen, paper, sticky-notes, and whiteboards is not easily improved by the introduction of digital equivalents as evidenced in work by e.g. Møller Jensen et al. (2018); Hilliges et al. (2007). These efforts are often situated in design, where work-practices often involve the prototypical activities of brainstorming and ideation (Newman and Landay, 2000; Smit et al., 2019; Vyas et al., 2009). Within

this context, a large survey of the most prominent tools used in the design industry is conducted every year (Palmer, 2020). The survey was initially launched in 2015 and exhibits a considerable focus on digital tools, as most of the designers surveyed are designing web applications, websites, or mobile applications (ibid). The survey provides an opportunity to explore the broad tendencies and development in the tools used for creative, collaborative design work.

In this work, I explore the publicly available data-sets of the Annual Design Tools Survey from 2017 to 2020. I present and discuss three insights relevant to the areas of HCI and CSCW concerned with studying and developing tools for collaborative design ideation. These data-sets are openly available online, and the contribution in this work lies in exploring development and relationships in the data and connecting these to the research efforts of the research community.

## Motivation

I have been following the Annual Design Tools survey for years now, and the birds-eye-view of what tools design practitioners work with has always provided me with a satisfying counter-balance to ethnographically inspired studies or experimental setups investigating a specific intervention which are popular in HCI and CSCW (Blomberg and Karasti, 2013; Wallace et al., 2017). In addition, the respondents in the survey are professional designers, who at least in relation to creativity support tools, are actually studied less often (Frich et al., 2019b).

Finally, and what initially led me to explore these data-sets more thoroughly, was my impression that brainstorming and ideation, at least anecdotally, appeared to be the final remaining frontier in terms of digitizing creative design work - analog tools such as sticky notes, pen, paper, and whiteboard seemed to still be an integrated part of office landscapes.

## Analysis and Results

It is unlikely that the Design Tools Survey was conducted with academic or scholarly goals in mind, and several limitations apply to the following analysis. The wording of some categories changes slightly from year to year, and the demographic, while stable across years, is skewed towards respondents from Europe and North America. Some of these limitations are taken into consideration in the individual parts of my analysis, and so the sample size may vary slightly. I return to the limitations of the dataset in the discussion.

I include the surveys from 2017, 2018, 2019, and 2020, as they appear to be completed by the same author and are close to similar in structure. Together, they contain almost 12,000 responses by relatively experienced designers, with the most respondents having 3-5 years of experience. The most common title for designer across the years are *UX designers*, *Product designers*, *Web designers*, and *Graphic designers*, and so the survey is also sometimes referred to as the UX design tools survey.

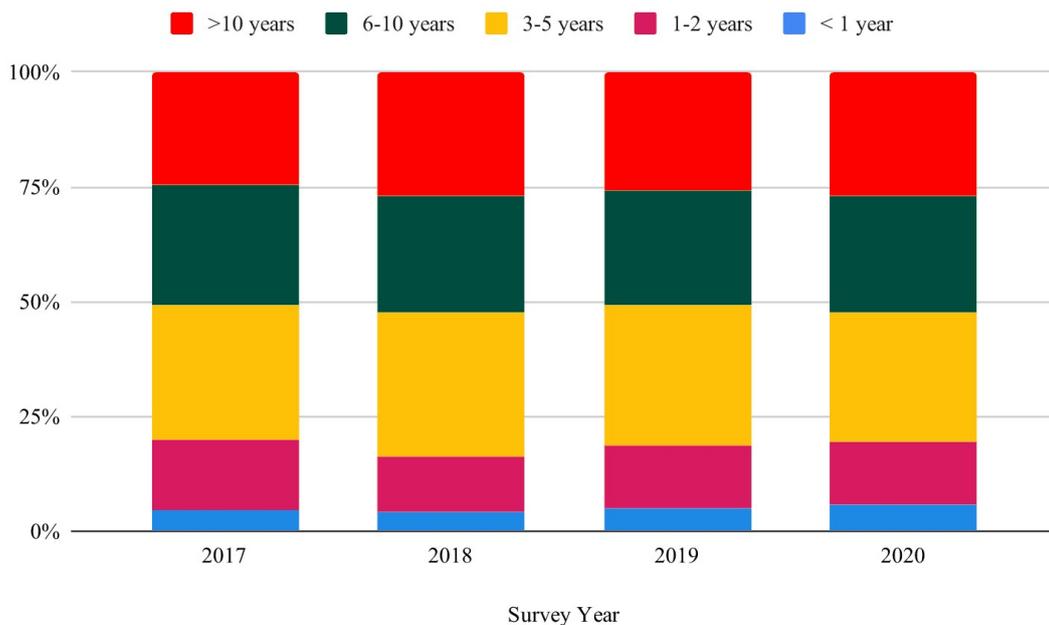


Figure 1. The experience of the designers taking part in the surveys.

### Analog Tools are preferred for Brainstorming and Ideation

The surveys from 2017-2020 all inquire about what tools are used for different types of design work. The Activities are consistent from year to year, with slight changes and the addition of user testing in the 2019 survey and removal of "wireframing" in 2020. The activities included in this analysis are the ones marked with bold in table I below.

2017	2018	2019	2020	<b>"brainstorming/ideation"</b> ↔ <i>"brainstorming and ideation"</i>
	2018	2019	2020	<b>"user flows, site maps, and flow charts"</b> ↔ <i>"user flows and site maps"</i>
2017	2018	2019	2020	<b>"wireframing"</b> "-"
2017	2018	2019	2020	<b>"interface design"</b>
2017			2020	<b>"prototyping"</b> ↔ <i>"UI prototyping"</i>
2017				<b>"version control and file management"</b>
2017	2018	2019	2020	<b>"manage design systems"</b> ↔ <i>"manage your design systems"</i> ↔ <i>"manage design systems"</i>
		2019	2020	<b>"user testing"</b>
2017	2018	2019	2020	<b>"handoff"</b> ↔ <i>"developer handoff"</i>
2017	2018	2019	2020	<b>"monitoring"</b> ↔ <i>"experience monitoring"</i>

Table I. Activities covered by the Design Tools Surveys 2017-2020.

Across the last four years, designers appear to prefer analog tools either solely or in combination with digital tools for brainstorming and ideation activities. There is a striking preference for the analog tools like pen, paper, and whiteboards over digital tools like Sketch, Figma, and Miro for this activity compared to other activities like prototyping or user testing. Designers also employ analog tools to do mapping of user flows, wireframing, and prototyping, but to a much lesser degree as the share of designers solely relying on analog tools or analog in combination with digital tools never reaches above 15% in any of the last four years of the survey. Illustration 2 indicates the share of analog tools across the different activities surveys split into years. In this case, analog tools refer to the sole use of analog tools (analog only) as well as the use of analog tools together with digital (mix).

The yearly split also suggests a decrease in the use of analog tools for brainstorming over the last four years, with 2020 being an outlier likely due to the COVID-19 Pandemic (Wikipedia, 2019), where more work has been taken virtually as offices and countries have been closed and travels have been limited.

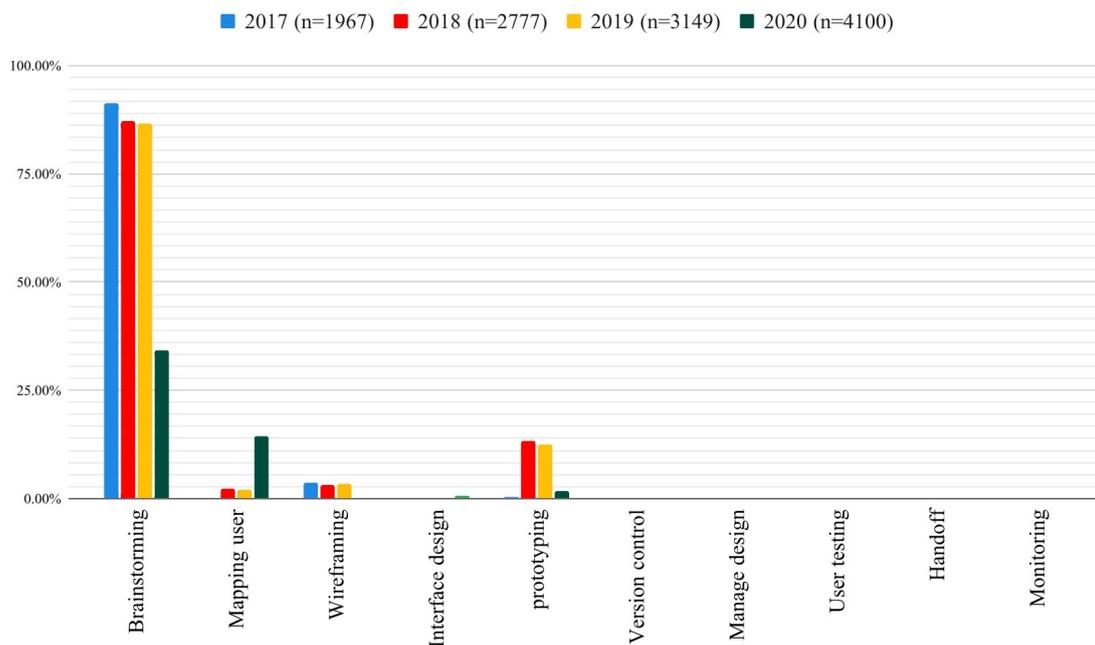


Figure 2. The percentage of analog only or analog in combination with digital tools for 10 different activities split into four years.

Design practitioners' preference for analog tools has previously been pointed out by e.g. Harboe and Huang (2015) or Møller Jensen et al. (2018), who based their claims on a qualitative, interview study of 13 designers and a case study at a design company, respectively. The finding here corroborates these existing claims using a much larger sample and provides clear indications of the magnitude of the matter in contrast to other designerly activities.

### Novice and experienced designers prefer analog tools for brainstorming to the same degree

The finding that brainstorming and ideation appears to be the only activity dominated by analog tools prompts further investigation. Within this activity category, I further examined whether the saying 'old habits die hard' may be at play in the preference for tools. The underlying conjecture is, that because tools like Miro ([www.miro.com](http://www.miro.com)), Milanote ([www.milanote.com](http://www.milanote.com)) and Mural ([www.mural.co](http://www.mural.co)) –which to some degree mimic analog whiteboard–have only recently (<5-10 years) gained traction, it may be that the designers educated or trained a long time ago have developed a preference for analog tools which persists into the current, where digital alternatives could be expected to be offering more opportunities.

To investigate this, the data was split into experience from less than 1 year (<1 year) to more than ten years (>10 years) of experience.<sup>1</sup> The result is illustrated in the following figure , and while there was a significant relationship between tool preference and experience for 2018 and 2020, where the effect size of these are not interpreted as great (small=0.05 and medium=0.15 at df=4 (Kim, 2017)).

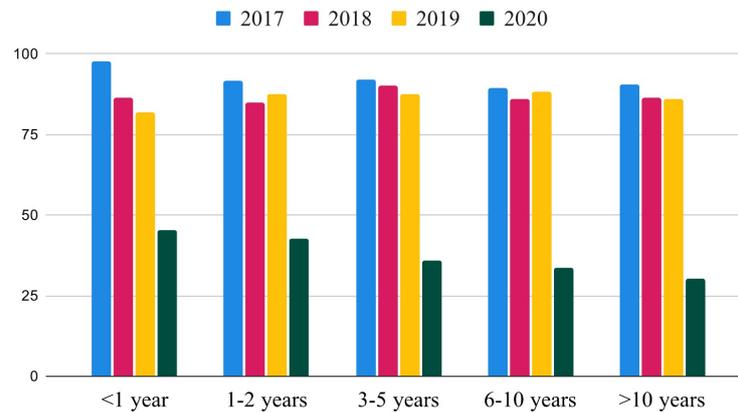


Figure 3. The percentage of designers in each experience category who prefers analog (only or mix) tools for brainstorming.

Year		Value	df	p	Cramer's V
2017	N=1961	X <sup>2</sup> 7.808	4	0.099	0.063
2018	N=2732	X <sup>2</sup> 10.140	4	0.038	0.061
2019	N=3083	X <sup>2</sup> 5.125	4	0.275	0.041
2020	N=3729	X <sup>2</sup> 34.124	4	< .001	0.096

Table II. Chi-Squared Tests of the relationship between tools preference and experience of the designers..

Two speculative interpretation to these tendencies can be offered: First, it may be the case, that more seasoned designers were more inclined to leave the analog tools completely when the COVID-19 pandemic hit, and secondly that the slight decrease in preference for the analog illustrated in the previous figure 2 in the three pre-covid years is mainly driven by the relatively 'new' designers with little experience.

### Working in teams and the inclination towards using digital

Another way of investigating the particular case of analog tool preference for brainstorming and ideation relates to the collaborative nature of such activities.

<sup>1</sup> I excluded 'students' as this data was only available in '19 and '20, and a mistake was made in 2017 and part of 2018 as some respondents could choose 5-10, which overlaps with 3-5. I coded this data as 6-10 to fit with the remaining, correct, responses.

One way of dealing with this, is by asking whether team-size matters here? One of the potential benefits of the digital is the shareability across remote team-members (Everitt et al., 2003; Vyas et al., 2009), and so the share of teams leveraging digital tools either alone or in combination with analog tools would potentially be larger than the share of individuals. In other words, you could expect more digital tools used in collaborative constellations.

The design-team size variable is not optimal in 2017, as there are non-exclusive categories (10-15 and 11-100) as well as a 1-10 category making it impossible to distinguish between working individually and in a team of i.e. three. For 2020 the wording of the questions is essentially different, as it asks about designers at the place of employment, rather than the size of a design team. Consequently, this part of this analysis only leverages the 2018 and 2019 data. Furthermore, very few respondents are in design teams larger than 10, as 88% and 83% for 2018 and 2019 respectively are either working alone or in teams sized 2-10 as illustrated in figure .



Figure 4. The percentage distribution of design team sizes for 2018 and 2019.

Whether designers are working individually (i.e. as freelancers or as a single designer in an organization) or in design teams does not appear to play a large role in whether digital tools are used for brainstorming and ideation. For 2018 the difference between individual designers and those in teams was approximately four percentage points and in 2019 it was half a percentage point. The relationship between team/individual and tool-use was only significant in year 2018  $X^2(1, N = 2710) = 6.64, p = 0.010$ , albeit with a less than small effect size (Cramer's  $V=0.050$ ).

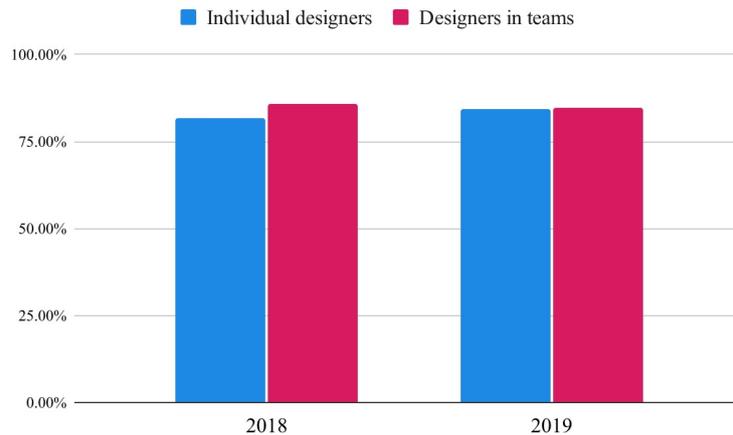


Figure 5. The percentage designers using digital tools (either alone or in combination with analog) for brainstorming and the size of their design team.

While it is quite remarkable that the preferred tool for a highly collaborative activity like brainstorming is unaffected by whether designers work solo or in teams, this may be explained by two considerations: First, as the analysis here is only based on pre-covid years, it is fair to assume that design-teams would often be co-located thus limiting the previously mentioned benefits of the digital to support remote collaboration. Secondly, in 2018 and 2019 the most popular digital design tool was Sketch, which is essentially an interface design tool, that offers a vector-based infinite canvas. It is difficult to see this type of application serve the purpose of e.g. pen and paper or sticky notes and whiteboards. Such a tool would be more similar to the previously mentioned Miro or Mural, which resembles a sort of 'digital whiteboard'.

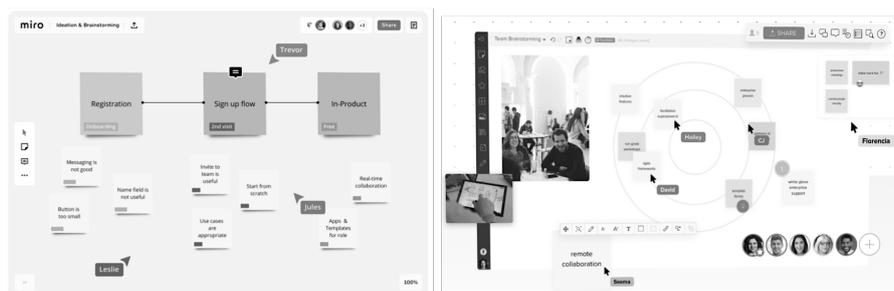


Figure 6. Screens from Miro's ([www.miro.com](http://www.miro.com)) and Mural's website ([www.mural.co](http://www.mural.co)).

This idea is even further supported by the 2020 survey. While the variable for design team size in this survey is incomparable to other years, the survey indicates a dramatic increase in the use of digital whiteboards tools, with Miro seeing massive growth as indicated in table III. This again indicates that, the digital tools used for brainstorming and ideation pre-covid perhaps served a 'different' purpose than pens, paper, whiteboards etc. and that if substitutions for these tools are needed, Sketch, Figma, and Illustrator are not necessarily core brainstorming tools.

	2018	2019	2020
Miro (Prev. named Realtimeboard)	1.5%	5.2%	33.6%
Mural	0.5%	0.5%	4.5%
Milanote	1.4%	1.4%	1.7%

Table III. Percentage of respondents reporting to be using either Miro, Mural or Milanote).

## Summary and Discussion

Brainstorming appears to be the last remaining activity of professional design work that has not yet undergone complete digitalization. And while the pandemic in 2020, has caused a large increase in the use of digital tools, analog tools remain somewhat central for this particular activity. This predisposition for the analog does not appear to be affected to an extensive by the experience of the designers or whether designers work alone or in teams.

It is hard to predict, whether designers will return to their previous practice post-pandemic, or whether a new work-practice around tools like Miro has been established. An additional point to this discussion is that existing research on the difference between analog and digital tools for brainstorming in design appears to lean towards the conclusion that while the process may be affected by the choice of tools, the product (i.e. ideas or creative outcome) remains somewhat similar. For example, Hilliges et al. (2007) found that "that the overall number of ideas generated remained roughly equal" across digital and analog conditions and Møller Jensen et al. (2018) similarly stated that "Although the number of sticky notes created is not significantly different between the physical and the digital setups there is a difference in the interaction with the notes". Recently, my colleagues and I have also examined changes in the process when moving from analog to digital by considering the phenomena of divergent/convergent thinking, finding that the digital setup appears to support convergent thinking to a larger degree (Frich et al., 2021). Keeping these findings in mind, it is easy to imagine a designer trying out a digital tool for brainstorming to discover that it 'feels' differently (due to changes in the process), not willing to jeopardize a given project, the designer falls back to analog tools. Being 'forced' to use digital tools for brainstorming may have some designers realize that similar outcomes are produced and thus, together with the added benefits of e.g. versioning and shareability sway more designers to take up digital tools for brainstorming. Furthermore, and as has been reported from close observations of how designers work with tools and externalizations, creative work often resembles much 'smaller' iterations or view-shifts, whereby new information is obtained from reexamining externalized ideas Suwa and Tversky (1996); Frich et al. (2019a). This further raises the question of whether considering "ideation" or brainstorming as a single activities is reasonable in a practical contexts.

# Acknowledgments

Thanks to Taylor Palmer (2020) for putting together the survey every year and for putting it online. This research has been funded by The Velux Foundations grant: Digital Tools in Collaborative Creativity and AUFF: Creative Tools.

# References

'Free Online Brainstorming Tool For Creative Teams: Miro'.

Blomberg, J. and H. Karasti (2013): 'Reflections on 25 years of ethnography in CSCW'. *Computer supported cooperative work (CSCW)*, vol. 22, no. 4-6, pp. 373–423.

Everitt, K. M., S. R. Klemmer, R. Lee, and J. A. Landay (2003): 'Two worlds apart: bridging the gap between physical and virtual media for distributed design collaboration'. In: *Proceedings of the SIGCHI conference on Human factors in computing systems*. pp. 553–560.

Frich, J., M. M. Biskjaer, L. MacDonald Vermeulen, C. Remy, and P. Dalsgaard (2019a): 'Strategies in Creative Professionals' Use of Digital Tools Across Domains'. In: *Proceedings of the 2019 on Creativity and Cognition*. pp. 210–221.

Frich, J., L. MacDonald Vermeulen, C. Remy, M. M. Biskjaer, and P. Dalsgaard (2019b): 'Mapping the landscape of creativity support tools in HCI'. In: *Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems*. pp. 1–18.

Frich, J., M. Nouwens, K. Halskov, and P. Dalsgaard (2021): 'How digital tools impact convergent and divergent thinking in design ideation'. In: *Proceedings of the 2021 CHI Conference on Human Factors in Computing Systems*.

Harboe, G. and E. M. Huang (2015): 'Real-world affinity diagramming practices: Bridging the paper-digital gap'. In: *Proceedings of the 33rd annual ACM conference on human factors in computing systems*. pp. 95–104.

Hilliges, O., L. Terrenghi, S. Boring, D. Kim, H. Richter, and A. Butz (2007): 'Designing for collaborative creative problem solving'. In: *Proceedings of the 6th ACM SIGCHI conference on Creativity & cognition*. pp. 137–146.

Kim, H.-Y. (2017): 'Statistical notes for clinical researchers: Chi-squared test and Fisher's exact test'. *Restorative dentistry & endodontics*, vol. 42, no. 2, pp. 152.

Klemmer, S. R., M. W. Newman, R. Farrell, M. Bilezikjian, and J. A. Landay (2001): 'The designers' outpost: a tangible interface for collaborative web site'. In: *Proceedings of the 14th annual ACM symposium on User interface software and technology*. pp. 1–10.

Møller Jensen, M., S.-K. Thiel, E. Hoggan, and S. Bødker (2018): 'Physical versus Digital Sticky Notes in Collaborative Ideation'. In: *Computer Supported Cooperative Work 27 (3-4)-ECSCW 2018: Proceedings of the 16th European Conference on Computer Supported Cooperative Work*.

Newman, M. W. and J. A. Landay (2000): 'Sitemaps, storyboards, and specifications: A sketch of web site design practice'. In: *Proceedings of the 3rd conference on Designing interactive systems: processes, practices, methods, and techniques*. pp. 263–274.

Palmer, T. (2020): 'Design Tools Survey'.

- Smit, D., A. Lindlbauer, M. Murer, B. Hengeveld, and M. Tscheligi (2019): 'Let the Bot Take Care of It: Exploring# CapIt, a Whiteboard Table Capture System'. In: *Proceedings of 17th European Conference on Computer-Supported Cooperative Work*.
- Suwa, M. and B. Tversky (1996): 'What architects see in their sketches: Implications for design tools'. In: *Conference Companion on Human Factors in Computing Systems*. pp. 191–192.
- Vyas, D., D. Heylen, A. Nijholt, and G. Van Der Veer (2009): 'Collaborative practices that support creativity in design'. In: *ECSCW 2009*. Springer, pp. 151–170.
- Wallace, J. R., S. Oji, and C. Anslow (2017): 'Technologies, methods, and values: changes in empirical research at CSCW 1990-2015'. *Proceedings of the ACM on Human-Computer Interaction*, vol. 1, no. CSCW, pp. 1–18.
- Wikipedia (2019): 'COVID-19 pandemic — Wikipedia, The Free Encyclopedia'. [Online; accessed 16-February-2021].