

**PROMOTING GREEN BRAND OF UNIVERSITY IN SOCIAL MEDIA: TEXT MINING
AND SENTIMENT ANALYSIS**

Yana Us, Tetyana Pimonenko, Oleksii Lyulyov, Yang Chen, and Tatjana Tambovceva

Abstract. Combating climate change and mitigating its negative consequences requires enhancing awareness of sustainable development. It is believed the education sector is an excellent trigger for green transformations. In turn, since social media has become a fundamental part of people's everyday lives, they are considered to be an effective tool in engaging the broader audience to green problems. In this view, this paper aims to analyze the social media activity of world-leading green universities in gaining the university community's commitment to sustainable development principles. This study involved text mining, statistical, content, and sentiment analyses to achieve the study aim and answer the following research questions: 1) What is the social media performance of the green universities? 2) What is a difference in the social media parameters used by the green universities involving the academic community and stakeholders to account for environmental issues? The research objects are five top-ranked sustainable universities worldwide according to the UI GreenMetric World University Rankings in 2021 and Sumy State University (as the first Ukrainian university listed by the mentioned above ranking). The study period covers data as of May 10, 2022. The data was retrieved from the analyzed universities' social media sites (Twitter, Facebook, LinkedIn, YouTube, Instagram, etc.). The findings confirmed the research hypothesis that the social media activity of green universities could be a driving force in gaining sustainable development goals and promoting an eco-friendly lifestyle worldwide. Based on the obtained results, the authors provided some recommendations regarding strengthening the universities' social media activity towards increasing the green awareness of netizens.

Keywords: social media, sentiment, engagement, green university, green transformation

JEL Classification: Q01, Q56, Q57

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1. Introduction

Climate change, environmental degradation, resource depletion, and biodiversity loss issues are on the global agenda. In 2019, the European Commission presented the European Green Deal (EGD) to raise the world's attention to intensify the efforts in mitigating and combating climate change, developing resource- and energy-efficient economy, its decarbonization, etc. Indeed, achieving sustainable development goals requires technological development, political regulation, and financial mechanisms. However, there is a critical need to formulate an eco-friendly mindset and attitude (Arefieva et al., 2021; Dalevska et al., 2019; Bogachov et al., 2020; Cyfert et al., 2021; Dzwigol, 2020; Kharazishvili et al., 2020; 2021; Kuzior & Kwilinski 2022; Kwilinski & Kuzior 2020; Kuzior et al., 2021a; 2021b; Kwilinski et al., 2019a; 2019b; 2019c; 2019d; 2021; 2022a; 2022b; Lyulyov et al., 2021; Miśkiewicz, 2021; Miśkiewicz et al., 2022).

According to the above, the commitment to sustainable development significantly impacts the education sector. Correspondence to economic, environmental, and social changes requires the growth of green awareness, implementation of the courses on sustainability into the study process; creation of a demand for the development of new green knowledge and skills, advanced training and retraining of employees; closer collaboration between business, research centers, higher education institutions, etc. (Czyzewski and Polcyn, 2016).

Even though the national governments express consent regarding the general sustainable development concept, there is not a unique education model for sustainable development (Khalaim et al., 2021; Tambovceva et al., 2018; Dimante et al., 2016; Tkachenko et al., 2019). Each country has its own national approaches to education, depending on the local specificities and priorities.

The international community believes that education could inculcate green values, eco-friendly attitudes, behavior, and lifestyle to ensure sustainability in the future (Orangzab et al., 2021). In turn, sustainable education gives the knowledge on decision-making to gain the long-term development of the economy, ecology, and society.

Kakalejcik et al. (2021) noted that the country of origin has an important impact on the consumer choice of brand. In this line, the consumer perception of a national image could influence the choice of higher education. On the contrary, green universities are the driving force of green transformation in the country (Czyzewski et al., 2016). Therefore, the universities should pay more attention to building a strong green brand.

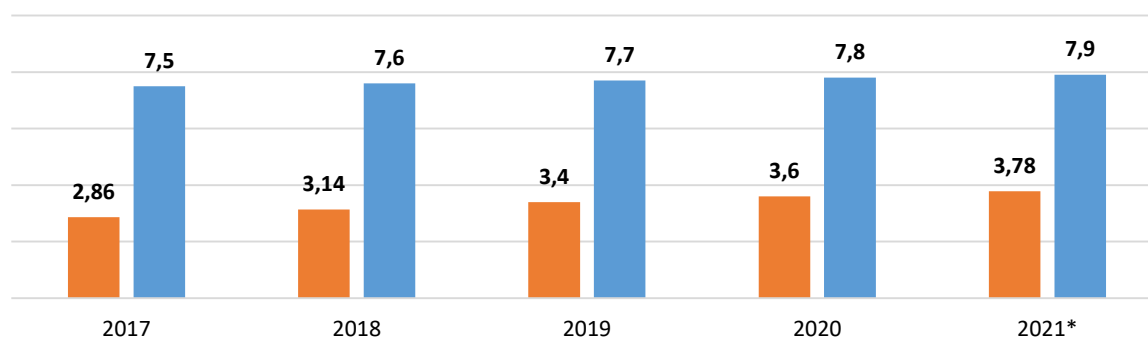


Figure 1. Population and number of social network users worldwide, in billions (2017-2022)

Note: * is a forecast value.

Source: developed by the authors based on the data (Statista, 2022; Worldometer, 2022).

Figure 1 demonstrates the annual growth of the world population and the number of social network users. Thus, in 2021, the number of social network users increased by 32.2% compared to 2017. Besides, the social network users' share of the total population increased by 9.7% in 2021 (47.8%) compared to 2017 (38.1%). Therefore, considering the above statistical data and snowballing digitalization processes, the scientific community place greater focus on building the communication strategies and engaging the broader audience on the Internet, especially using the social media networks. Based on the above, designing the university's profile suitable for promotion through different digital channels increases the university's brand recognition (Kuzior et al., 2019; Titko et al., 2021; Verina et al., 2021). As a result, it could grab the attention of green transformation.

Thus, this paper aims to analyze the social media activity of world-leading green universities in gaining the university community's commitment to sustainable development principles. To accomplish this aim, the remaining paper structure is as follows: Section 2 provides the results of the literature review; Section 3 presents the data and methods used in the study; Section 4 is about the empirical results; Section 5 provides the research conclusions.

2. Literature Review

With growing concern on the adverse climate change, economic, environmental, and social pressure, the issues of green transformations penetrate all economic sectors. The international academic community raises the attention to building an effective strategy to combat and mitigate the consequences of destructive climate change (Hussain et al., 2020; Czyżewski et al., 2020). In this view, many scientists worldwide consider universities to play a critical role in mitigating ecological effects, achieving sustainable goals, and building green countries. Thus, Wang et al. (2013) emphasized that building a green society should start with green universities and promoting education for sustainable development. In turn, Parra et al. (2018) concluded that higher education institutions require more study programs in sustainability since the ecological footprint of the university community is high. Vaisi et al. (2021) visualized the ecological footprint map that allows controlling the level of sustainable performance of university campuses based on the developed ecological footprint index.

Alves-Pinto and Giannetti (2019) noted that students as future leaders should get the principal knowledge of sustainable development during their studies at the university to be environmentally solidary and prioritize eco-friendliness. In this line, Ribeiro et al. (2019) analyzed the opinion of students of the Business Department at the South American University concerning the environmental, economic, and social impacts of green university infrastructure. Based on their findings, the scholars gave some recommendations to promote green initiatives in higher education.

To detect the main research directions and trends in the investigations regarding the green universities, this study retrieved the scientific papers indexed in the Web of Science database by the keywords "green university" and "sustainable university". The obtained results unveiled 236 relevant articles published from 2000 to 2021. Further, the method of visualization of similarities was applied to calculate the similarities between keywords and visualize the network map of keyword co-occurrences.

As a result, Figure 2 demonstrates six clusters indicating the main research streams in the analyzed scope of scientific papers. Thus, the biggest (red) cluster consists of 18 keywords. This cluster addresses mainly the administration issues in prioritizing sustainability in higher education institutions.

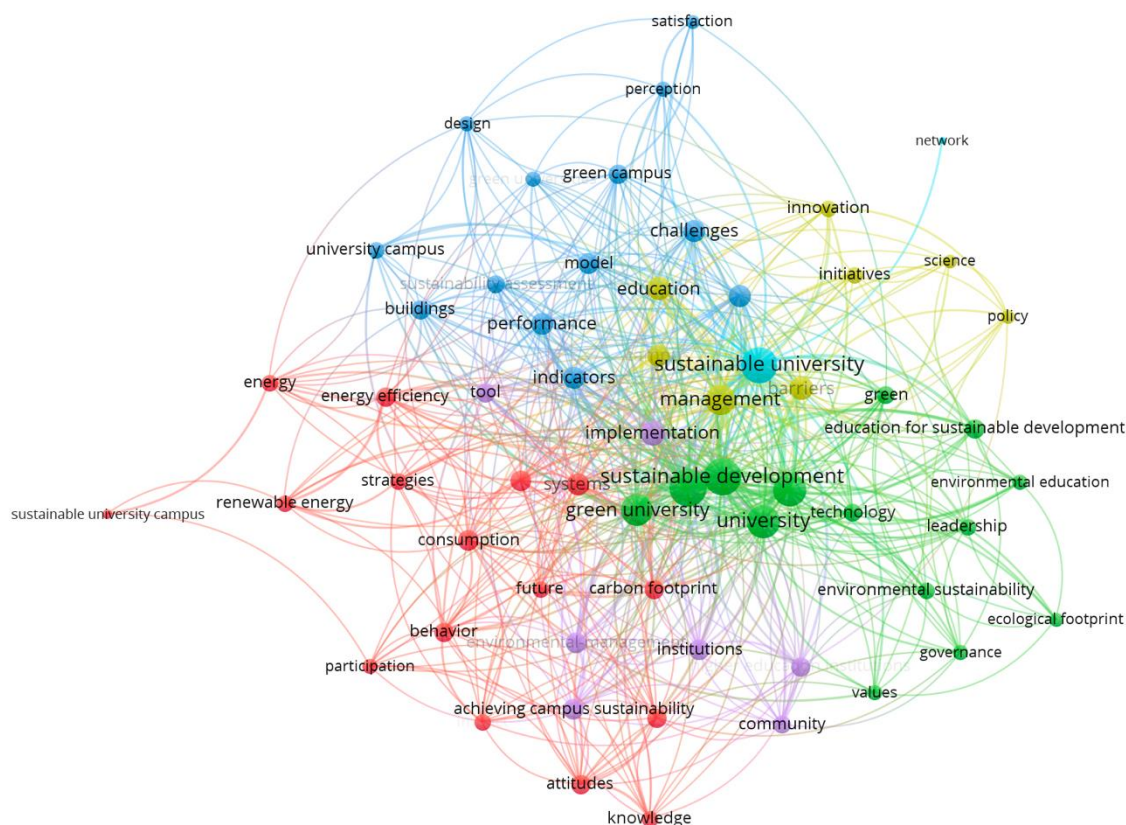


Figure 2. The network visualization of keywords' co-occurrences.

Source: developed by the authors based on the Web of Science data using the VOSviewer software toolkit.

Under this direction, the scholars investigated the campus sustainability, carbon footprint, implementation of energy-efficient technologies and environmental management, consuming renewable energy, increasing the sustainable performance and building the practical strategies, leadership, technological development, etc.

The second (green) cluster unveils the studies devoted to environmental issues in the academic community. The studies addressed the academic community's attitude and behavior, sustainable consumption, the impact of the higher education sector, etc. The third (blue) cluster shows the research streams in promoting environmental education, building green universities, increasing the scientific activity on environmental issues, providing efficient policy at the universities, etc.

The fourth (yellow) cluster mainly addresses the challenges in green transformation, promoting environmental sustainability, decreasing the ecological footprint, estimating sustainable values, green perception, satisfaction in green universities, etc.

Therefore, the visualization of keywords' co-occurrences showed that the scholars investigated the green universities raise the issues of energy, management, consumption, carbon footprint, achieving campus sustainability, the role of education in sustainable development, etc.

Nagy and Somosi (2020) emphasized that modern fourth-generation higher education universities should take responsibility for growing the green generation and meeting sustainable goals. Therefore, it is essential to measure and promote sustainability performance in the higher education sector. Having applied the importance-performance analysis and sustainable university scale, Nagy and Somosi (2020) estimated the sustainability progress at the university and the student attitude towards sustainable issues. Li et al. (2012) summarized the international experience in building green universities. The scholars applied the concordance analysis to construct the evaluation index, estimating the universities' green advantages and disadvantages based on their green scientific activity, green social services, green plan foundation, green campus, and education.

Carpenter et al. (2016) highlighted that social media is an effective instrument to promote sustainable behavior, disseminate relevant information, and engage the students and other stakeholders in green matters. Yang et al. (2021) integrated social media mining into a value-belief-norm model to measure the public concerns about the environmental issue, particularly air pollution, and suggest some insights into the general pro-environmental behavior.

Therefore, the green universities could greatly benefit from using social media. In this line, Mehmood et al. (2022) mentioned that similar to commercial brands, the universities launch social media marketing campaigns to promote their brand, enroll more students, raise awareness of the particular issues, etc.

Several studies on social data analysis in the education sector have already been performed. Besides, the impact of the COVID-19 pandemic boosted the studies devoted to the examination of social media performance in the education sector. Imran et al. (2021) applied a hybrid approach to analyze the effectiveness of the online education system during COVID-19 based on the learners' reviews on Twitter. Using the machine learning approach, Mujahid et al. (2022) analyzed the polarity and subjectivity score of 17,155 tweets' text about e-learning. Having applied a content analysis, Bularka et al. (2022) found that the European universities are more active on Facebook, while their messages regarding sustainability mainly concern the environmental protection actions carried by the university.

The main hypothesis of this research is as follows:

H1: The social media activity of green universities could be a driving force in gaining sustainable development goals and promoting an eco-friendly lifestyle worldwide.

3. Methods

This study involved the text mining, statistical, content, and sentiment analyses (Fig. 3) to answer the following research questions:

- 1) What is the social media performance of the green universities?
- 2) What is the difference in the social media parameters used by the green universities involving the academic community and stakeholders to account for environmental issues?

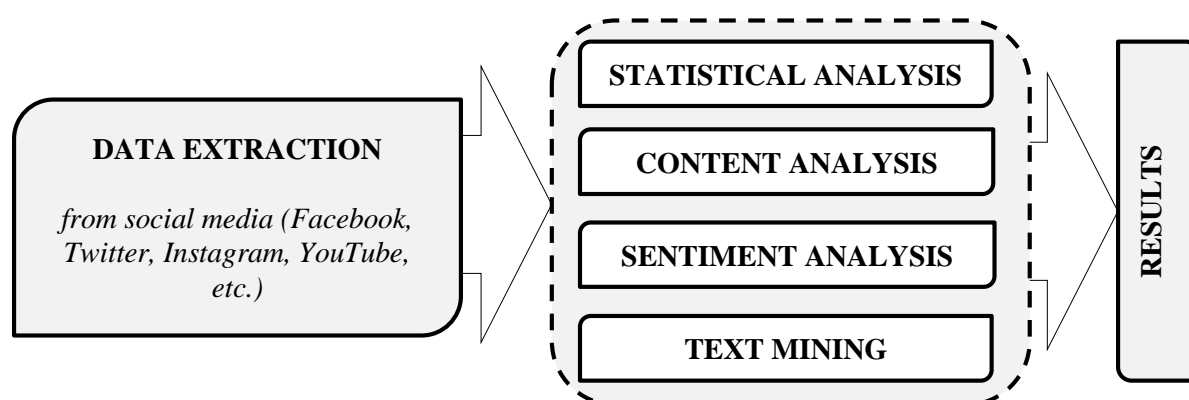


Figure 3. The empirical research structure.

Source: developed by the authors.

The social media search engine “Social Searcher” was run to extract data. Further, having applied the statistical analysis, this study summed up the number of mentions and users on social media sites, determined the type of posted content, and measured posting frequency by weekday and hours.

The sentiment analysis was applied to detect the general online representation of the benchmark green universities based on the sentiments of users' comments regarding the university. Following Pang and Lee (2008), the sentiment analysis is conducted in two stages:

opinion extraction and sentiment classification. Thus, firstly, this study extracted the social media mentions expressing the subjective opinion words towards each university. Then, the obtained opinions were divided into three sentiment groups: positive, negative, and neutral. As a result, the brand reputation of involved universities was estimated. The sentiment of posts was detected using the social media search engine “Social Searcher”.

Further, following Mehmood et al. (2022), the text mining method was approached to unveil the main insights and patterns in textual data associated with each university. The text cloud maps visualizing the post thematic on social media were built using an online media monitoring tool “Mediatoolkit”.

This study analyzes the real cases of the social interactions of top-ranked sustainable universities worldwide according to the UI GreenMetric World University Rankings in 2021. The general sentiments for green universities were analyzed using the Tweet Sentiment Visualization tool. The study period covers data as of May 10, 2022. The dataset used hereinafter was retrieved from the social media (Twitter, Facebook, LinkedIn, YouTube, Instagram, etc.) of the five top-ranked sustainable universities (Wageningen University & Research (WUR), University of Nottingham (UN), University of Groningen (UG), Nottingham Trent University (NTU), the University of California, Davis (UC Davis), and Sumy State University (SumDU) (as the first Ukrainian university listed by UI GreenMetric World University Rankings).

It is worth mentioning this ranking collects the data on the sustainability of the environment and related economic and social issues under six categories (setting and infrastructure; energy and climate change; waste; water; transportation; and education) to increase the attention to combating climate change and green transformation.

Table 1. The universities involved in the study

University	Short title	Country	No. of students	Total score	Established
Wageningen University & Research	WUR	Netherlands	12800	9300	1918
University of Nottingham	UN	United Kingdom	47000	8850	1881
University of Groningen	UG	Netherlands	35000	8800	1614
Nottingham Trent University	NTU	United Kingdom	35800	8750	1843
University of California, Davis	UC Davis	USA	38400	8750	1905
Sumy State University	SumDU	Ukraine	12000	6125	1948

Source: developed by the authors based on (UI, 2022).

According to Table 1, WUR in the Netherlands had the best green performance in 2021. Noteworthy here, this university has the best performance in the categories “Energy & Climate Change” and “Research & Education”. In turn, UG has the highest score in “Transportation” category, UN in the United Kingdom – “Setting and Infrastructure”. The categories “Waste” and “Water” are led by the top 3 universities (WUR, UN, and UG).

4. Results and Discussion

Social media have significantly penetrated ordinary life (Metzker et al., 2021; Machova et al., 2021). As mentioned above, approximately 48% of the world's population uses social media for communication, sharing content, business promotion, etc. Noteworthy here, each social media has its own specific. However, the most interesting for businesses are relationship networks such as Twitter, Facebook, LinkedIn, etc. One of the Twitter advantages is active brand monitoring by detecting the brand's negative attitude and getting feedback. Therefore, this study applied the Interactive Tweet Sentiment Visualization tool to determine the social media attitude toward green universities worldwide. The extracted tweets were categorized by four quadrants of sentiments (pleasant, unpleasant, sedate, and active tweets). Figure 4 concludes that green universities are of good standing worldwide since most tweets belong to pleasant and subdued sentiments. In turn, they have a calm and relaxed tone. Therefore, these findings confirm the social media activity of green universities could drive gaining sustainable development goals and promoting an eco-friendly lifestyle worldwide.

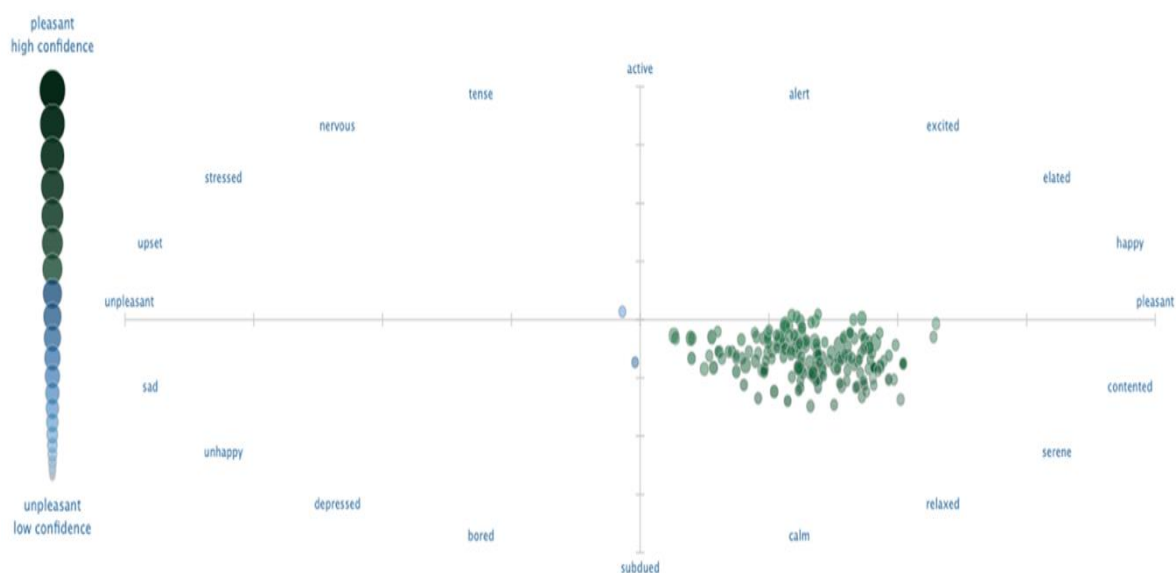


Figure 4. Tweet sentiment visualization.

Source: developed by the authors using Tweet Sentiment Visualization tools.

Figure 5 provides information on the number of followers on the social media of the analyzed universities. As of May 10, 2022, the UN has the biggest student population exceeding 47 thous. (Table 1), and the summarized number of followers – 706.2 thous. The number of

students at UC Davis is 38.4 thous., while the summarized number of followers on social media – 659 thous.

The universities NTU and UG have approximately the same number of students (35.8 and 35 thous.). However, the sum of followers on social media of UG is higher compared to NTU (505.9 and 415.9 thous., respectively). Despite the student populations of WUR and SumDU being almost equal (12.8 and 12 thous., respectively), the number of WUR's followers exceeds the SumDU by 17.6 times. Moreover, SumDU has a relatively small number of followers on Twitter which means its low social activity on this social media.

It stands to mention that LinkedIn is the most popular social media platform for all universities, followed by Facebook, Twitter, Instagram, and YouTube. Noteworthy here, only NTU and UC Davis take initial steps on TikTok.

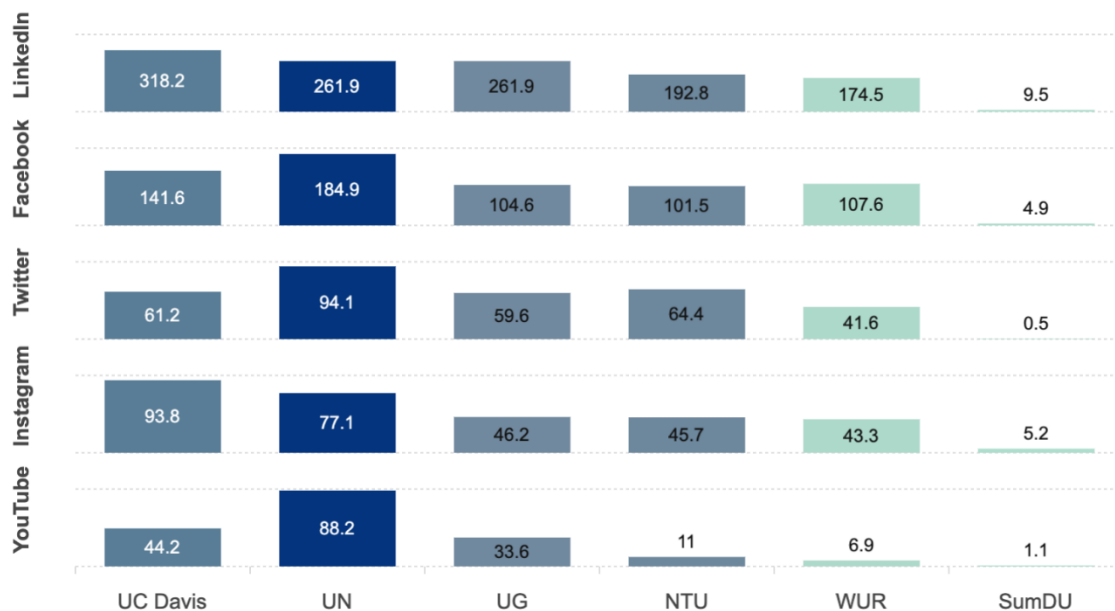


Figure 5. The number of followers on social media, thous. (as of May 10, 2022).

Source: developed by the authors.

According to statistical data (Fig. 6), NTU is the most mentioned university (352 mentions). Moreover, the number of users' social accounts of this university exceeds the rest of the analyzed universities (199 users). In the second place by the number of mentions is the UN in Netherland (261 mentions) with 153 users' social accounts. The third place is occupied by UC Davis (245 mentions and 137 users), followed by UG (194 mentions and 136 users), WUR (126 mentions and 84 users), and SumDU (111 mentions and 90 users).

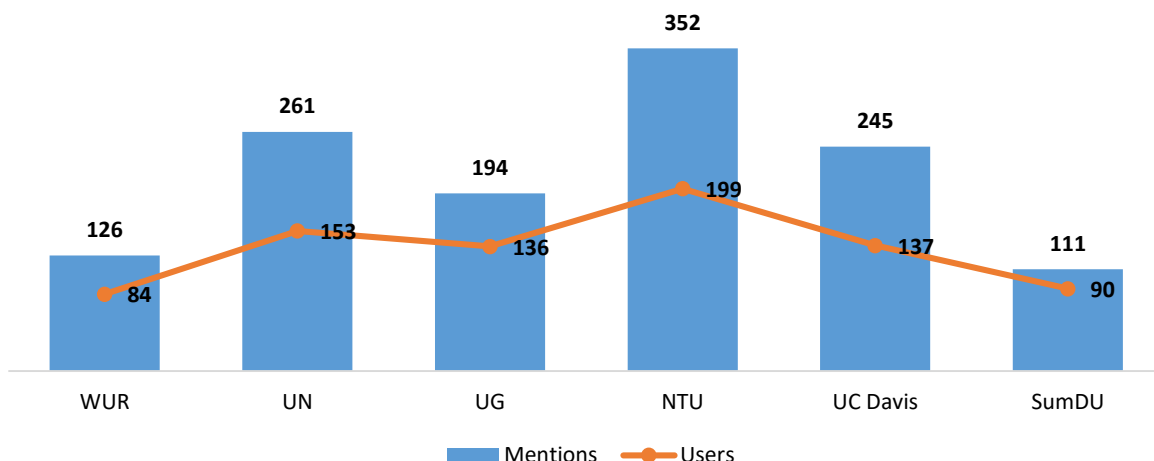


Figure 6. The number of mentions and users (as of May 10, 2022).

Source: developed by the authors based on (Social Searcher, 2022) and the universities’ data.

For detecting the type of content posted by the universities as of May 10, 2022, this study employed the Social Media Search Engine “Social Searcher”. Figure 7 demonstrates the segmentation of the posts published by each university and their summary proportion in the circular diagram.

Thus, all benchmark universities posted links, status, videos, and photos. It could be stated that the most popular content type (38%) is links (the posts with attached links). The share of photo posts is 35% (posts with an attached image or a link with the *.jpg, *.png, *.gif formats), videos (the posts with attached video or links to video web services like Youtube, etc.) – 22%.

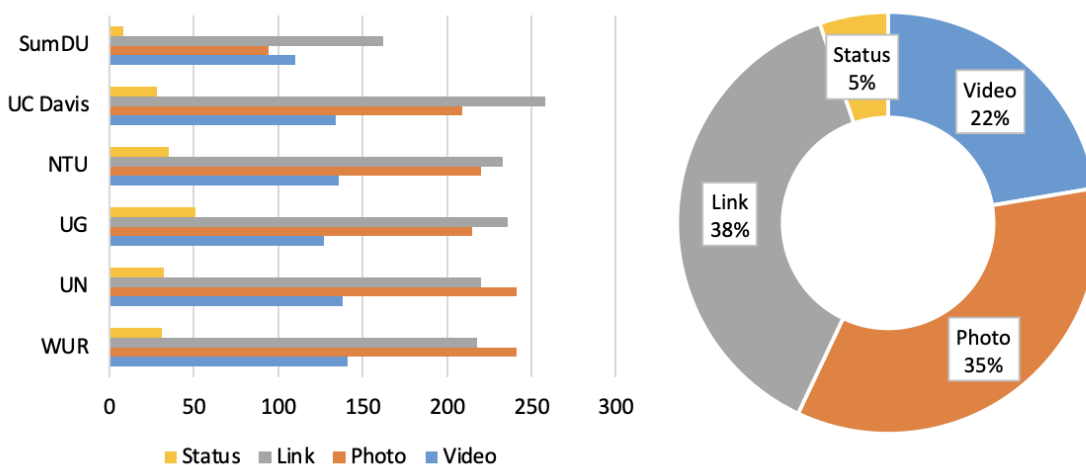


Figure 7. The type of posted content (as of May 10, 2022).

Source: developed by the authors based on data (Social Searcher, 2022).

On the contrary, status had the lowest popularity among all universities. However, Figure 8 shows the slight difference between the five top-ranked green universities and SumDU in the share of posted content since SumDU posts more videos than photos.

This study reveals some statistics on the frequency of posting by weekday. Table 2 shows that Wednesday is the most popular day for posting on social media.

Table 2. The frequency of posts by the weekday, no. of posts (as of May 10, 2022).

University	MON	TUE	WED	THU	FRI	SAT	SUN
WUR	6	19	51	4	3	10	7
UN	6	21	48	4	3	9	9
UG	6	18	35	12	8	14	7
NTU	8	21	32	5	8	16	10
UC Davis	11	23	33	8	7	10	8
SumDU	3	7	64	6	10	3	7

Source: developed by the authors based on data (Social Searcher, 2022).

The summarization of posts indicated that the top-5 green universities are most active on social media on Wednesday, Tuesday, Saturday, and Sunday (in decreasing order). Noteworthy here, the Ukrainian university is more active on Wednesday and Friday.

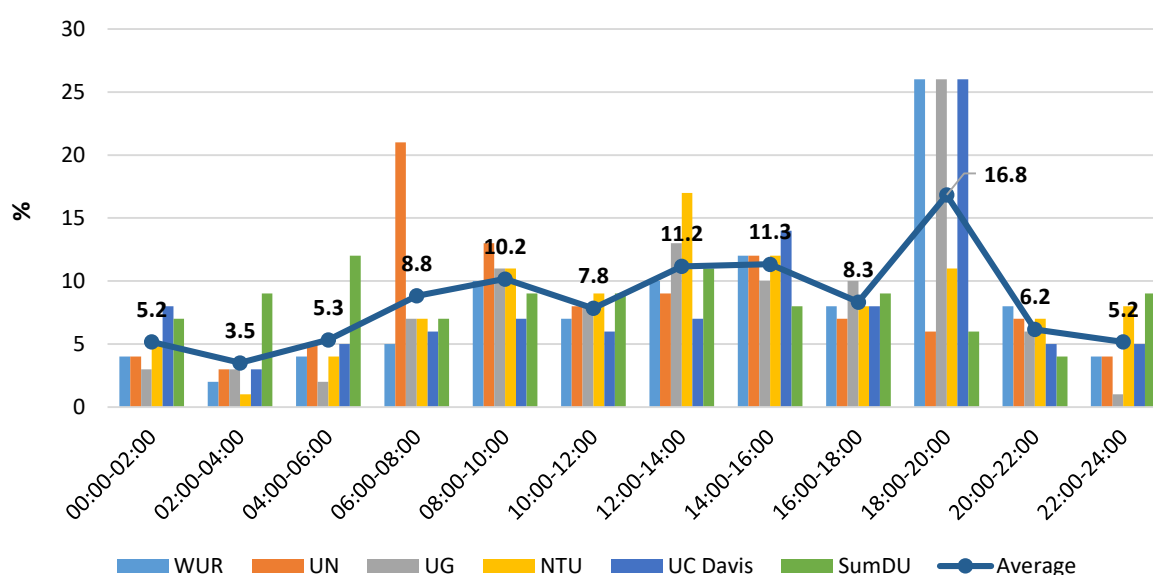


Figure 8. The frequency of posting by hours (as of May 10, 2022).

Source: developed by the authors based on data (Social Searcher, 2022).

Furthermore, Figure 8 shows that the universities post mostly at the end of the working day (17% of posts) from 6 pm till 8 pm, during the lunchtime (11% of posts) from 12 pm till 2 pm, and in the morning (10%) from 8 am till 10 am. However, the posting schedule of the United

Kingdom (UN and NTU) is slightly different. The peak for posting is from 6 am till 8 am for the UN, while from 12 pm till 2 pm – for the NTU.

The sentiment analysis results allowed identifying the tonality and determining the general attitude towards the universities' posts based on the positive and negative word collection. All feedback is divided into three categories (positive, neutral, and negative).

Figure 9 shows no significant variations in feedback among the categories for all benchmark universities. Thus, neutral feedbacks dominate. The highest rate of positive user sentiment had the UG (29%) and UN (28%). These universities are followed by the WUR (26%), UC Davos (25%), SumDU (24%), and NTU (22%). Moreover, the UG has the lowest rate of negative user sentiment, while the rest universities have approximately the same share of negative feedback (11-12%).

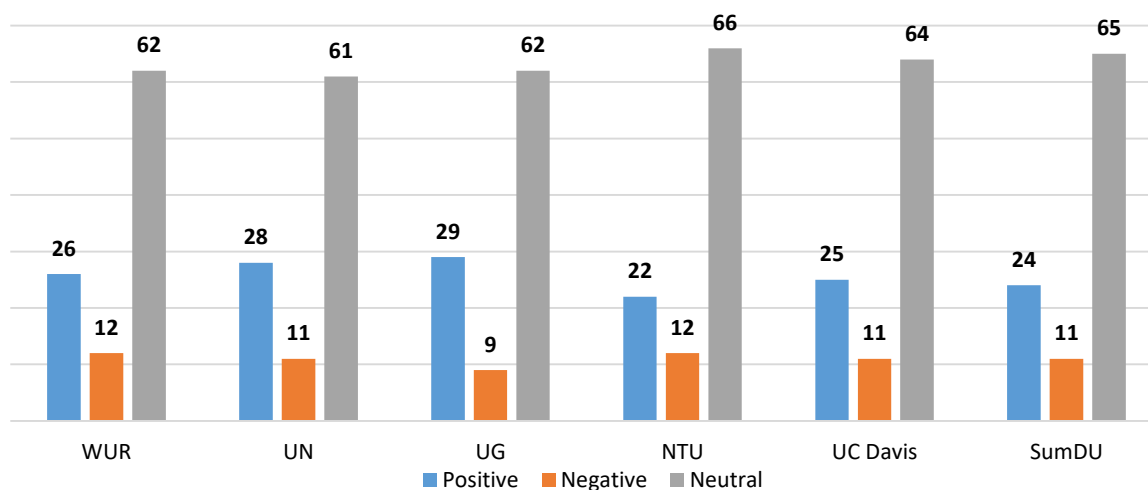


Figure 9. The sentiment ratio of posts, % (as of May 10, 2022).

Source: developed by the authors based on data (Social Searcher, 2022).

This study enrolled the text cloud technique to determine the topics on social media related to the analyzed universities. The findings allow detecting in what context the green universities are being mentioned online in April 2022. Considering Figure 10, the word size shows the frequency of its mentioning. Thus, the bigger the size of the word is, the more popular it is and vice versa.

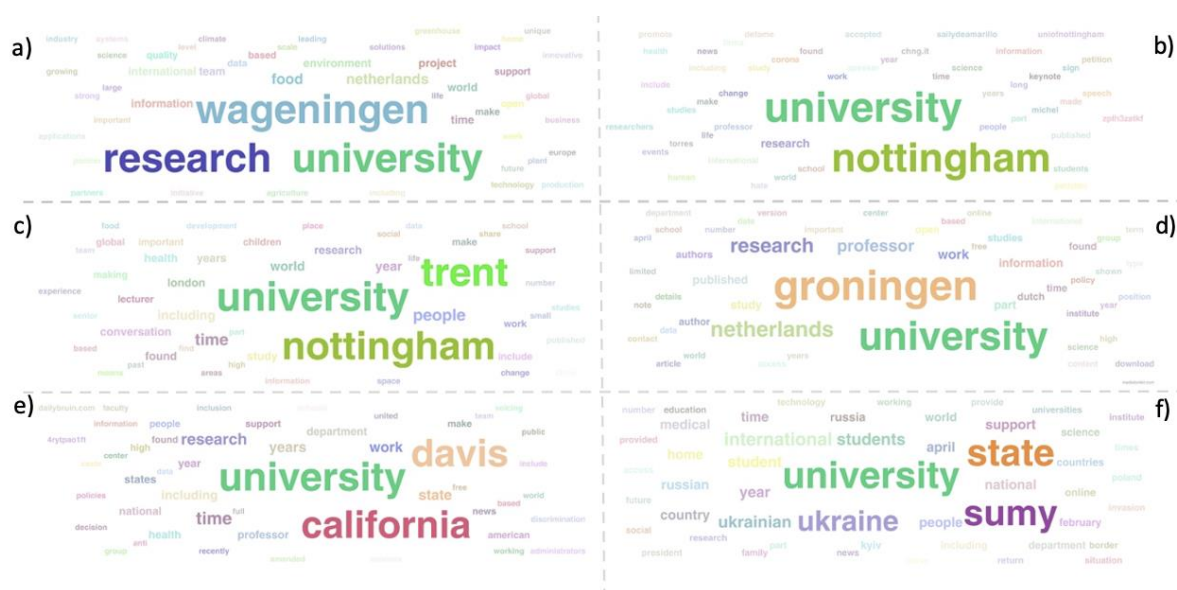


Figure 10. The text cloud map for a) WUR; b) UN; c) NTU; d) UG; e) UC Davis; f) SumDU (as of May 10, 2022).

Source: developed by the authors based on data (Mediatoolkit, 2022).

Figure 10 shows that the main topic of posts mentioning the five top-ranked green universities is research. The findings confirm the WUR green orientation. Thus, WRU is mainly mentioned in the post addressing the environment, climate impact, greenhouse, internationalization, technology, innovations, etc. UN was mentioned in the posts, especially concerning the internationalization, news, corona, etc. The post mentioning the NTU covers globalization, health, data, people, changes, etc. The UG's thematic posts relate to studies, scientific publications, internationalization, professors, etc. Further, UC Davis appeared in the posts about health, news, discrimination, and other university issues. At last, the Ukrainian university SumDU is tagged in the posts covering invasion, support, international students, nationalization, etc.

5. Conclusions

This study examined the social media performance of top-ranked sustainable universities worldwide according to the UI GreenMetric World University Rankings in 2021 (Wageningen University & Research, University of Nottingham, University of Groningen, Nottingham Trent University, and the University of California, Davis, and Sumy State University (as the first Ukrainian university listed by UI GreenMetric World University Rankings)). The findings of the sentiment analysis showed that netizens take well to the green universities' activity on Twitter. The above confirms the research hypothesis that green universities could significantly foster an eco-friendly lifestyle worldwide and contribute to achieving sustainable development goals.

The obtained results showed that the total number of followers on social media of five top-ranked sustainable universities worldwide according to the UI GreenMetric World University

Rankings in 2021 significantly exceeds the number of students. That indicates a good interest in the social media profiles of analyzed universities. Besides, only two universities have created social profiles on TikTok, which is highly popular among youth. There is a low follower base in the Ukrainian university. Therefore, it requires SumDU to strengthen its social presence and activity to broader its social media audience and green impact on society.

The most popular type of content posted by universities was links (38%), photos 35%, and videos (22%), while status had the lowest popularity among all universities. The analysis of posting frequency showed that the top-5 green universities are most active on social media on Wednesday, Tuesday, Saturday, and Sunday. On the contrary, the Ukrainian university is more active on Wednesdays and Fridays.

Furthermore, the benchmark universities post mainly at the end of the working day (17% of posts) from 6 pm till 8 pm, during the lunchtime (11% of posts) from 12 pm till 2 pm, and in the morning (10%) from 8 am till 10 am.

The findings of sentiment analysis showed that the general attitude towards the universities' posts is neutral for all analyzed universities. The highest rate of positive user sentiment had the UG (29%) and UN (28%). Moreover, the UG has the lowest rate of negative user sentiment. Therefore, the above results indicate the necessity to launch an effective marketing campaign to increase the social activity of followers, increase professional engagement and interaction, etc.

The text mining technique showed that the main topic of posts mentioning the top-5 green universities is research. On the contrary, the most sustainable university WUR confirmed its green orientation in social media posts addressing the environment, climate impact, greenhouse, internationalization, technology, innovations, etc. Thus, it indicates the need to increase the number of posts devoted to green issues unveiling the universities activity in its intentions to increase the green awareness of society.

However, it stands to mention these results are limited since they consider only cover only the data for the previous month. Therefore, further studies should cover the broader date range and geography.

6. Presenting the sources of funding

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