The Representation of SDG-Related Research in Bibliometric Databases: Persisting Imbalances and Varying Perspectives

Matteo Ottaviani

ottaviani@dzhw.eu

German Centre for Higher Education Research and Science Studies

Stephan Stahlschmidt

German Centre for Higher Education Research and Science Studies

Research Article

Keywords: Sustainable Development Goals, SDG Classification, Bibliometric Databases, Large Language Models, OpenAlex, Web of Science, Scopus, Information Processing

Posted Date: December 22nd, 2025

DOI: https://doi.org/10.21203/rs.3.rs-8147329/v1

Additional Declarations: No competing interests reported.

The Representation of SDG-Related Research in Bibliometric Databases: Persisting Imbalances and Varying Perspectives

Matteo Ottaviani*[1] and Stephan Stahlschmidt[1,2]

[1]German Centre for Higher Education Research and Science Studies (DZHW), Schützenstr. 6a, 10117 Berlin (Germany)
[2]Unit of Computational Humanities and Social Sciences (U-CHASS), EC3 Research Group, University of Granada, Granada, Spain

November 18, 2025

Abstract

Large bibliometric databases, such as Web of Science, Scopus, and OpenAlex, play a crucial role for decision-makers in science and science policy, as they are used as sources for informing decisions at both national and international levels, in public and private sectors. Although these databases facilitate bibliometric analyses, they are performative, affecting the visibility of scientific outputs and the measurement of participating entities. Recently, they have also incorporated the UN's Sustainable Development Goals (SDGs) into their respective classifications, which have been criticized for their diverging nature. On another note, their infrastructural information processing is, of course, susceptible to emerging technologies. As a matter of fact, AI-supported and -powered tools have recently entered research practice and society at large. Large Language Models (LLMs), the branch of generative AI specifically focused on text, underlie their operation. By leveraging their features (i.e., in particular, mirroring what is thoroughly embedded in their training data under certain conditions), LLMs act as data magnifiers on SDG-classified publications to detect data biases that bibliometric databases are affected by. Within a broader perspective, our general setup serves as a conceptual exercise that characterizes the expected macro-level effects on the representation of SDG-related research in bibliometric databases, originating from the introduction of a generic LLM-based tool. Our analysis shows that the deployment of LLMs in the information processing of bibliometric databases reveals a systematic overlook in the data (i.e., scientific publications classified by SDGs) of the most disadvantaged categories of individuals, the poorest countries, and underrepresented topics that SDG targets explicitly focus on. Conversely, an unsolicited hegemonic role played by economic superpowers and Global North is identified.

Keywords: Sustainable Development Goals, SDG Classification, Bibliometric Databases, Large Language Models, OpenAlex, Web of Science, Scopus, Information Processing.

*Corresponding author, email: ottaviani@dzhw.eu

1 Introduction

Bibliometric databases play a critical role as digital infrastructures that enable bibliometric analyses and impact assessments within the scientific community. However, it is essential to acknowledge that these databases are not impartial; instead, they have a performative nature, as they are constructed based on specific understandings of the science system and value attributions (Whitley, 2000; Vinkler, 1988). Recently, there has been significant attention given to the contribution of the science system and its entities to the United Nations' Sustainable Development Goals (SDGs) in the bibliometric impact debate (Mishra et al., 2023; Meschede, 2020). The SDGs provide a comprehensive framework for addressing global challenges and promoting sustainable development in various domains. The latter is a global framework that includes monitoring mechanisms and indicators. European countries have adapted their national sustainability indicator systems to align with the UN Agenda 2030. (Lepenies et al., 2023) explores the political processes and struggles of implementing these goals in national contexts, classifying national indicator systems based on dimensions such as selection, appraisal landscape, participatory nature, and political communication. Their findings suggest that variations in these systems correspond to different national interpretations of sustainability. In the context of bibliometrics, SDG classifications are promoted to assess the societal relevance and impact of scientific research (Armitage et al., 2020). Bibliometric databases play a crucial role in the policy-making agency (and decision-making processes in general) as they serve as direct or indirect sources for informing decisions both at national and international levels, public and private. Policymakers (or whoever intermediate figure) might benefit of experts who, in turns, formulate their advises relying on information extracted from bibliometric databases. Major bibliometric databases, including Web of Science, Scopus, and OpenAlex, have introduced bibliometric classifications aligning publications with specific SDGs to facilitate the measurement of scientific contributions towards the SDGs. Armitage et al. (2020) carry out a bibliometric study aimed at comparing the Bergen and Elsevier' approaches to finding scholarly publications related to the United Nations' SDGs. They show that the overlap in publications retrieved by the latter two approaches is particularly small. Different search terms, combinations, and query structures significantly impact the retrieved publications, affecting the country rankings. The latter inconsistencies are not due to technical issues but rather different interpretations of SDGs. Understanding the reasons behind these differences is crucial for comprehending the performative aspects of bibliometric classifications and their impact on scientific outputs.

Information processing in digital infrastructure is susceptible to state-of-the-art methodologies and new technologies at large. In particular, in the last few years a variety of societal sectors have witnessed widespread attempts of introducing in their practices the emerging technology of generative artificial intelligence (AI). Industries and society at large seem to be increasingly undergoing a radical transformation due to generative AI. It is already in use in fields like education, entertainment, healthcare, marketing and research to produce scalable and customised content, automate processes, brainstorm ideas, and "increase productivity" (Lorenz et al., 2023). However, significant policy and societal issues related to the generative AI must be acknowledged, including employment changes, copyright ambiguities, the risk of maintaining societal biases, discrimination, and the possibility of misuse in the production of misinformation and manipulated content. Large language models (LLMs), i.e. that branch of generative AI specifically

focused on language processing, are pre-trained models utilizing deep learning techniques to generate human-like responses based on given prompts (Radford et al., 2019). LLMs are trained on vast amounts of text data, and they have shown remarkable language generation capabilities yet not producing (new) "knowledge". The content they generate strictly depends on the training data. Assuming the highest quality standard of the latter, when accuracy is strictly required (e.g., answer a question on history), in the best case scenario they reproduce same semantic structures; however, their semantic associations might also produce incorrect and misleading outcomes (i.e. misinformation), still showing a convincing language formulation. This potential misinformation source can be controlled and minimized - LLMs can be calibrated to "stick to the facts" (i.e. the training data). Different story is when the training data embeds biases responsible for ethically deplorable outcomes. In this case, the LLM would relentlessly reflect - or even intensify - these biases; only case-specific human-feedback supervision can mitigate them (and it takes place only *a posteriori*). Unfortunately, it has been well documented that such a phenomenon is widespread and affects both renown commercial and open-source multipurpose LLMs (e.g., ChatGPT, Llama, Gemini, Cloude) and field-specific ones, thereby reproducing systemic discrimination against marginalized groups, including those marginalized by race, gender, or other social factors (Sheng et al., 2019; Nadeem et al., 2020; Caliskan et al., 2017; Costa-juss and Casas, 2019; Abid et al., 2021; Lucy and Bamman, 2021; Tamkin et al., 2023).

In the last few years, many research papers have been dealing with the possible implications of generative AI usage in various fields of application(Lorenz et al., 2023; Capraro et al., 2024), including the science system (Wieczorek et al., 2023). In line with this research trend, with this work we propose to explore the effect of introducing generative AI in the operational research practice and consultancy. In particular, we narrow our analysis on the case study of SDGs, prominent international driver of large investments, employment, research directions, public attention, etc. at several interrelated levels of the society. We aim at running a conceptual exercise whose results can have general validity; specifically, we focus on the macro effects on the representation of SDG-related research in bibliometric databases, originating from introducing a generic LLM-based tool. As to the aim of generalizing the LLM-based tool, we propose to use the open-source LLM DistilGPT2, a lighter variant of the renown architecture GPT-2 which is particularly fitting our purposes (Radford et al., 2019; Sanh et al., 2019). The choice of this LLM is due to its great compromise between embedding no prior knowledge about SDGs (and related content) and serving basic LLM functions. Even though the latest versions of either proprietary (e.g. ChatGPT, Llama) or open-source LLMs (e.g., Falcon, GPTX-Neo) would produce better crafted discourse outcomes, they all would show prior knowledge about SDGs, ruling out the opportunity to discern clearly the data injection of our choice from semantic embedding previously defined by the initial training process. On the contrary, DistilGPT-2, having been trained on a small dataset, does incorporate a significantly lower structural data bias compared to other better renown LLMs.

In line with the categorization of SDGs according to human needs operated by Wu et al. (2018) (See Fig. 1), economic, social, and environment are considered the three dimensions of impact related to the 17 SDGs. We build the sample of SDGs to explore by choosing two subgroups of the first two: [SDG 4, SDG 5, SDG 10] relates to *equality* within the social dimension; [SDG 8 and SDG 9] relates to *economic and technological development*. Our research design involves three main steps: data collection and analysis, fine-tuning the LLM for each bibliometric database and each SDG and text generation,

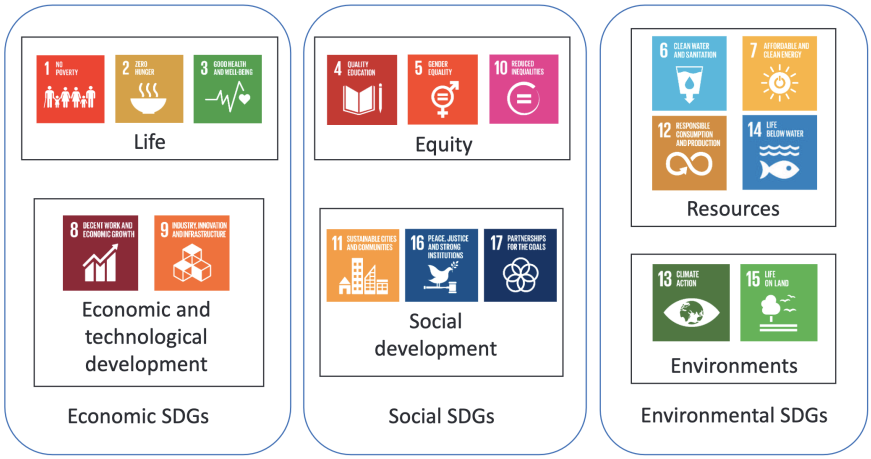

Figure 1: Categories and subgroups to classify the 17 SDGs according to human needs (Wu et al., 2018).

and text analysis (i.e. noun phrases extraction and human feedback) to explore the biases and variations in the generated responses. We identify a *jointly indexed publication* dataset of Web of Science, OpenAlex, and Scopus, counting 15,471,336 publications from 2015 to July 2023, which serves as the common ground for this research to identify the impact of the SDG classifications irrespective of the varying coverage of the underlying databases. From this dataset, we collect the varying publications attributed to the 5 SDGs mentioned above by each databases' SDG classification, creating distinct publication subsets from the common ground set for the fine-tuning process. For each SDG, three fine-tuned LLMs are then administered the same collection of prompts, allowing us to compare and analyse the generated responses. For each SDG, a unique set of prompts is drawn up (on the average 100 prompts each SDG). It is strictly tailored on the official targets released by UN. For each target, ten different prompts are generated, each of them focusing on different aspects of the target, then stimulating thoroughly the LLM about the latter. In doing so, we set a *norm* (or *benchmark* or *ground truth*) against which measuring compliance with the purposes of SDGs and data biases. In order to account for the variance due to parameter setting made upstream, we perform the latter process three times; i.e. for three different decoding strategies.

We identify four different categories to classify noun phrases (namely: *locations*, *actors*, *focuses*, *data/metrics*) in order to improve the interpretation. For each target, we match noun phrases and double check them "by hand" to assess which category of each target is addressed, what not, and eventual leftovers when something is not directly related to targets.

Our main outcome is the detection of a general, active neglect of vulnerable groups of people, such as those who face discrimination due to their origin, religion, race, ethnicity, or disability. The poorest countries, the most disadvantaged and discriminated actors, the most inclusive standards (such as WTO agreements and the ILO's Global Jobs Pact), and the most delicate and ethically sensitive topics (such as slavery, forced labour, human trafficking, access to essential services, human rights, sexual exploitation, forced marriage, and genital mutilation) are specifically left out. On the contrary, a direct support to economic superpowers and their instruments is systematic w.r.t. SDGs and categories.

Our findings are not isolated cases, yet in line with the wide literature that reports "artificial intelligence" outcomes echoing and perpetuating systemic discrimination, when

employing latest technologies for societal purposes. Moreover, the generality of our setup is the presumption that these discriminatory effects are allegedly taking place in the information processing of bibliometric databases.

2 Literature Review

Bibliometric databases serve as vital components within the scholarly communication ecosystem, granting researchers access to an extensive collection of academic publications and citation data. These databases, including Web of Science, OpenAlex, and Scopus, have become indispensable tools for conducting bibliometric analyses and evaluating research impact (Bornmann, 2014). However, it's essential to recognize that these databases are more than mere repositories; they function as digital infrastructures embodying specific values, assumptions, and practices (Vinkler, 1988). They are constructed based on particular understandings of the scientific system and value attribution, ultimately influencing the visibility and assessment of scientific outputs Whitley (2000).

The United Nations' Sustainable Development Goals (SDGs) have emerged as a prominent framework for addressing global challenges and fostering sustainable development worldwide. In the realm of bibliometrics, the SDGs provide a valuable framework to observe the societal relevance and impact of scientific research (Mishra et al., 2023; Meschede, 2020). Acknowledging the significance of measuring scientific contributions towards the SDGs, major bibliometric databases have introduced classifications aligning publications with specific goals. Nevertheless, discrepancies have been observed among the SDG classifications provided by different databases (Armitage et al., 2020), prompting a need to investigate the underlying reasons for these variations. Research has been mapped to the Sustainable Development Goals (SDGs) of the United Nations (UN) using a variety of published methods (Armitage et al., 2020; Bordignon, 2021; Confraria et al., 2024; Jayabalasingham et al., 2019; LaFleur, 2019). These methods differ in terms of the publishing database that is utilised, the process for retrieving papers, and the framework for defining inclusion and exclusion criteria. For instance, when defining inclusion and exclusion criteria, a more liberal approach could be taken to include any papers that advance knowledge on the subject matter, or a more conservative approach could be used to limit publications to those that detail efforts taken to meet the SDG targets. Publication sets for a certain SDG may be retrieved using solely Boolean methods or in addition to machine learning algorithms. This is dependent on the methodology used. The methodology may bring diversity in the publications it is applied to, as there are numerous data sources available that can be either subscription-based, open access, or a combination of both.

2.1 Labeling and Classifying SDGs

Research mapping to the SDGs lacks a widely accepted methodology as of yet, and the approaches that are in use have wildly divergent outcomes(Armitage et al., 2020). Using Boolean search expressions is a popular method for finding relevant research on a subject. The Boolean method retrieves only those articles that contain the defined search expressions. It does this by applying conditional functions to specific text sections (title, abstracts, journal sources, keywords, etc.) of scientific publications. Keywords can be used alone or in combination. In an effort to lessen the impact of issues raised on the Boolean technique, which led to a more restrictive publication set, the authors of

(Armitage et al., 2020) applied the Boolean method and limited their SDG publication sets to publications that directly contributed to targets and/or indicators. By restricting keywords from Elsevier 2020 queries(Jayabalasingham et al., 2019) to pertinent subject areas using the All-Science Journal Classification (ASJC), Bordignon's technique (Bordignon, 2021) attempted to reduce the polysemy of phrases. CorTexT, a text-mining technology, was subsequently employed to enhance those chosen publications. Using keyword combinations, Boolean operators, and proximity operators, the Aurora European Universities Alliance (Schmidt and Vanderfeesten, 2021) created and published their 169 target-level SDG queries (Vanderfeesten et al., 2020). Informed by the academics in their network, the University of Auckland (Wang et al., 2023) created queries that led to a localised version that includes additional publications that are unique to study themes in Australia and New Zealand. The authors of (Confraria et al., 2024) use a two-step process in which they construct SDG-specific terms from a variety of sources (policy reports, publications, forums, etc.), select the terms, and use the terms to find communities of publications based on citations. According to Armitage et al. (2020), there are difficulties with applying a keyword-based approach, including interpreting the themes and concepts of the SDGs, choosing which publications to attribute as a "contribution" to the selected interpretation of the SDG, and translating concepts into a search query that will correctly identify publications.

Using machine learning to map research papers to SDGs in two ways—in an unsupervised way for clustering, or in a supervised way for classification—is an alternate or supplementary approach to query-based approaches. In order to get a tagged dataset for model training, supervised approaches generally use the same SDG queries (E.g., the South African SDG Hub, Zhang et al. (2020)). Paper text representations or citation graphs are commonly used for clustering, and the resulting clusters are then mapped to the SDGs directly or through intermediary clusters like "topics" (Wastl et al., 2020). For a summary of further techniques for categorising texts into SDGs, see Pukelis et al. (2020). They all have to deal with the same issues, though, as mentioned above, and machine learning adds another layer of difficulty when it comes to the interpretability of the clusters or model predictions.

Elsevier has been working to map research to the Sustainable Development Goals (SDGs) since 2018. To promote repeatability and transparency, the company has made its queries publicly available (Jayabalasingham et al., 2019). It is worth it to briefly outline their methodology. Basically, they have enhanced earlier attempts to map research to the SDGs while considering feedback, leading to the development of a more comprehensive query set with sub-queries addressing targets and indicators as well as the use of a machine learning model to boost recall.

This methodology, called "Elsevier 2021 SDG mapping" (Rivest et al., 2021), maintains precision levels above 80% while capturing, on average, twice as many articles as the 2020 version. As a component of its Social Impact rankings, Times Higher Education (THE) uses Elsevier SDG mapping. The most recent, simplified version of the queries and machine learning model is called "Elsevier 2023 SDG mapping" (Bedard-Vallee et al., 2023). It differs from the 2021 version in that it pertains to Covid-related improvements to SDG 3 inquiries and queries created for SDG 17 "Partnerships for the goals."

OpenAlex has built its own SDG Classifier on the Aurora SDG queries (Vanderfeesten et al., 2020), and the mBERT machine learning model built by the Aurora Universities Network (Jaworeck, 2022). The classifier assigns labels to works based on their alignment with specific goals, providing a score within the range $[0, 1]$. The score indicates

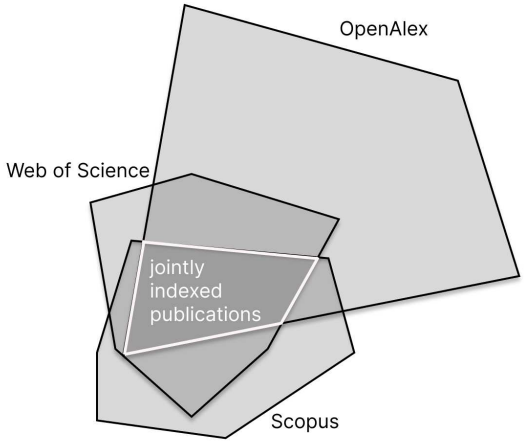

Figure 2: The jointly indexed publication dataset of Web of Science, OpenAlex and Scopus, counts 15 471 336 publications. It is obtained on an exact DOI match, when publications (*article* or *review* in *journal*) are published between 2015 and July 2023, and where the DOI is unique.

the model's forecasted likelihood of the work's pertinence to a specific objective. A publication with prediction score greater than 0.4 is considered classified for a given SDG.

Clarivate maps each SDG to sets of specific in-house "Micro Citation Topics" (according to the CWTS-Leiden classification). Selected Micro Citation Topics and their associated publications were assigned to one or more of 16 SDGs (17th SDG is not considered, i.e., the one related to the partnerships for the goals). The last updating of Citation Topics clustering together with the mapping of SDGs dates April 2023 (Clarivate InCites, 2023).

To date, few studies have been conducted to compare various SDG mapping strategies using datasets that have been manually tagged.

In Wulff et al. (2023) the authors examine the extent to which SDG searches result in false positives by labelling non-SDG-related content with SDG labels. Additionally, they look into the bias in SDG labelling systems, which is defined as the normalised difference between the number of SDG labels that are observed and predicted—that is, assigned by human experts.

Kashnitsky et al. (2024) explore the problem of recall assessment for keyword queries connecting research papers to Sustainable Development Goals, quantitative assessment of current collections of these keyword queries using multiple validation datasets.

The paper by Yao et al. (2024) focuses on SDG 4, which encourages education for sustainable development by 2030, and tackles the difficulty of incorporating the SDGs into Open Educational Resources (OERs). In order to address problems with multiple labelling and category imbalance, the authors suggest a unique labelling system that uses the AutoGluon machine learning framework to automatically assign several SDGs to OERs. Compared to current approaches, their evaluation, which included 900 lecture videos from SDG Academy, demonstrates better precision, recall, and transferability, providing a substantial opportunity for improving SDG-focused educational content.

3 Data Collection

The data collection process for this study entails gathering publications from three data providers: Web of Science, OpenAlex and Scopus. All the data was obtained from the German Kompetenznetzwerk Bibliometrie. The WoS and Scopus data are snapshots taken in July 2023 while the OpenAlex database is the version that was made available in December 2023. As sketched in Fig.2, we have created a *jointly indexed publication* subset with records common to all three datasets based on an exact DOI match, which have been published between 2015 and July 2023, and where the DOI is unique to the record in all three databases. This allows for a comparison among OpenAlex, WoS, and Scopus controlling for the varying coverage. The publication time window has been chosen as follows. The lower bound of the data set time is due to when the UN Sustainable Development Summit in New York approved the 2030 Agenda for Sustainable Development. Regarding the upper bound, the reason depends on our current resources' availability (i.e., the limitation due to classified publications provided by WoS, updated to July 2023). Overall, we include those publications classified by Web of Science as either *article* or *review* in *journal*, and provided of an abstract (pivotal to pursue our analysis). According to the settings above, the jointly indexed publications dataset - independently of any SDG classification - of WoS, OpenAlex and Scopus, counts 15 471 336 items.

For each bibliometric database, the classified publications have been collected as follows: Clarivate directly delivered to us the WoS unique identifiers and the related SDG classifications. The OpenAlex snapshot present in our infrastructure is given of SDG labels associated with a score between 0 and 1; in line with their guidelines, a publication with a score above 0.4 is considered classified with respect to the SDG in question. Regarding Scopus, Elsevier provides long lists of search queries (coded in SciVal's language) to classify publications, involving fields like: author + keywords, abstracts, journal sources, etc. We translated them into SQL and retrieved those publications by means of our infrastructure.

For each bibliometric DB, we have gathered the publications classified under the following SDGs:

SDG 4 Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

SDG 5 Achieve gender equality and empower all women and girls.

SDG 8 Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all.

SDG 9 Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation.

SDG 10 Reduce inequality within and among countries.

In line with the aim of the UN General Assembly in New York in 2015, the 17 SDGs can be roughly classified into 3 major dimensions: social, economic, and environmental sustainable development. We decide to focus on the first two. As shown in Fig.1, the latter can be grouped further. Within the social dimension, we choose SDG 4, SDG 5, and SDG 10 as they identify those ones related to *equality*. Regarding the economic dimension, we choose SDG 8 and SDG 9 as to their common focus on economic and technological development (Wu et al., 2018).

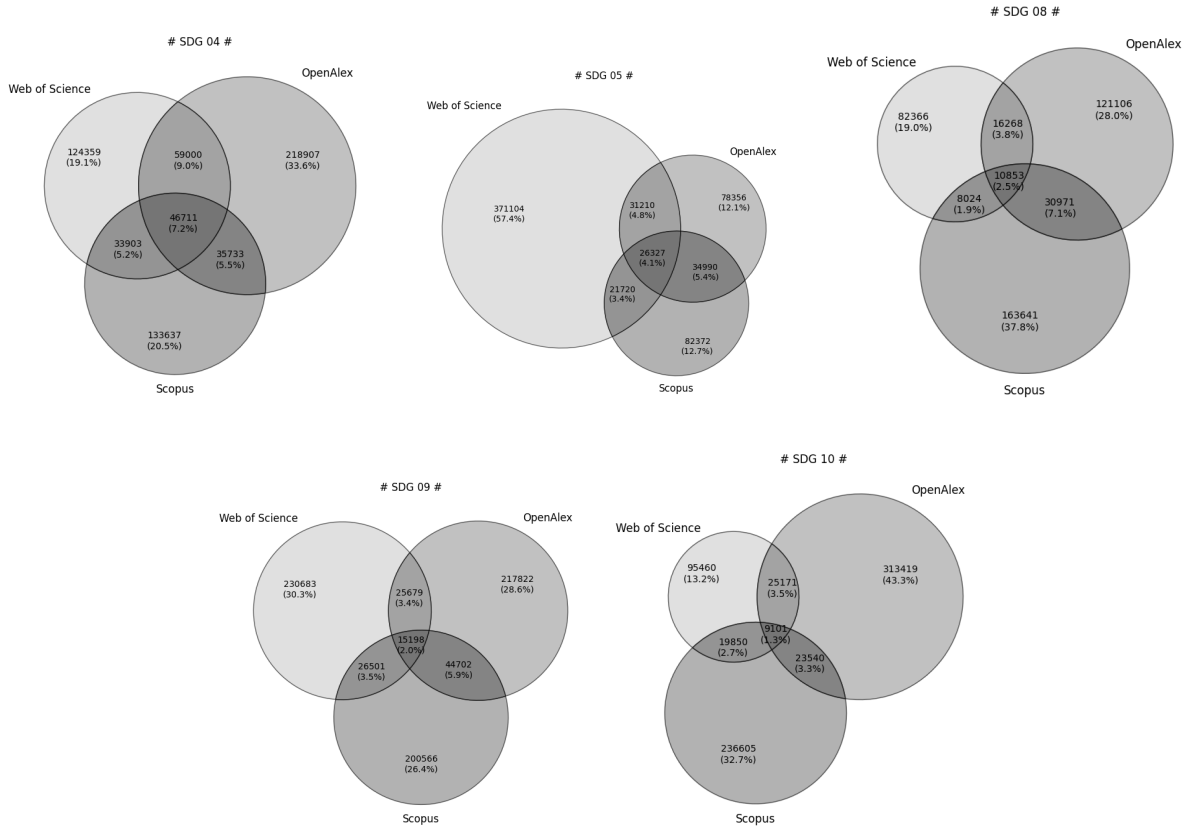

Figure 3: Venn Diagrams of SDGs 4, 5, 8, 9, and 10, for Web of Science, OpenAlex, and Scopus.

	SDG 4	**SDG 5**	**SDG 8**	**SDG 9**	**SDG 10**
Web of Science	263,973	450,361	117,511	298,061	149,582
OpenAlex	360,351	170,883	179,198	303,401	371,231
Scopus	249,984	165,409	213,489	286,967	289,096

Table 1: Number of SDG classified publications according to the three different databases.

In Fig.3 we show Venn diagrams to quantify the eventual overlap of the diverse SDG classifications, reporting number of publications and percentage with respect to the total number of classified publications for each SDG. Less than 8% of publications are uniformly assigned to a SDG, confirming former observations of highly disagreeing classifications.

4 Methods

The aim of this work is to employ the new emerging technology of LLM as data magnifying tool to explore the SDG-related research classified by those digital infrastructures as bibliometric databases. By processing research publications, the latter provide indicators and metrics that are benchmark for a wide audience, ranging from researchers to governments and international organizations, and passing through intermediate entities that inform policy-making. The information processing within digital infrastructures usually undergoes cutting-edge technologies; for this reason, it is reasonable to compare our anal-

ysis' outcomes with aggregate effects produced in the real world from the adoption of the LLM (within constraints and limitations of our setup). For this reason, we conceptualize an experiment as generalizable as possible. From another perspective, we aim at simulating the functioning of the "LLM engine" inside a generic AI-based tool used as support for research practices such as literature review, summarization, state-of-the-art assessment, etc.

The methodology employed in this research consists of three main steps: collecting research paper abstracts classified under the five SDGs we selected by Web of Science, OpenAlex, and Scopus; fine-tuning the DistilGPT-2 language model for each data provider and each SDG with SDG-related research production; and utilizing text analysis techniques to measure discrepancies among the data providers' responses to the same prompts. The data collection has been described in the previous section.

DistilGPT-2 is an open-source, English speaking, faster, and lighter variant of the open-source GPT-2; the aim of its development was to provide researchers with a playground to better understand larger generative language models (Hugging Face, 2020). And for that reason, it had been trained on a very limited dataset to embed the least possible prior knowledge in either content or instructions. It means that the structural data-bias of DistilGPT-2 is reduced to the minimum, letting us measure what comes from the different classifications. For each SDG classification and each bibliometric DB, a blank copy of the DistilGPT-2 model is fine-tuned by the abstracts of those publications classified under that given SDG. This exposure allows the model to familiarize itself with the language and concepts present in the dataset, enabling it to generate responses that reflect the inherent perspectives within the data.

As outlined in Fig.4, for each SDG the same set of prompts is administered to the three fine-tuned LLM models. In particular, for each SDG, a set of prompts has been produced by relying on the list of the official UN SDG targets (see Appendix A). In particular, for each target, 10 prompts have been generated, exploring it thoroughly by rephrasing it alongside varying the focus asked. The latter methodology has been chosen because OpenAI ChatGPT 4o can be well instructed in formulating prompts suited for a GPT2 architecture fine-tuned on paper abstracts in an efficacious way. The construction of these stimuli relying on the official targets (released by UN) lets us set a benchmark, thanks to which we can then assess *compliance* with the SDG and characterize data biases within the databases.

The models generate responses based on these prompts, which serve as the input for the subsequent text analysis. In order to ensuring decoding parameter exploration and, then, reducing uncertainty in the responses, three diverse decoding strategies are employed, bringing to three different responses each prompt. The latter are: *top-k*, *nucleus*, and *contrastive search*; in literature and practical applications, the first two are usually favoured by automatic evaluation while the third one by human evaluation (Su and Xu, 2022; Su and Collier, 2022). We analyse the responses through noun phrases analysis and topic modelling (i.e., LDA). The former resulted to be more informative and interpretable than the latter, especially when complemented by human (i.e., ours) direct checking. Therefore, we extract noun phrases for each fine-tuned LLM. Once we obtain for each LLM a set of noun phrases alongside their occurrence, we proceed as follows:

1 For each bibliometric DB (and for each SDG), we aggregate the noun phrases of the 3 subsets corresponding to the different decoding strategies. For each strategy, the noun phrases with a frequency higher than 2% are selected. The outcome is a set of noun phrases for a given SDG classified by a given bibliometric DB.

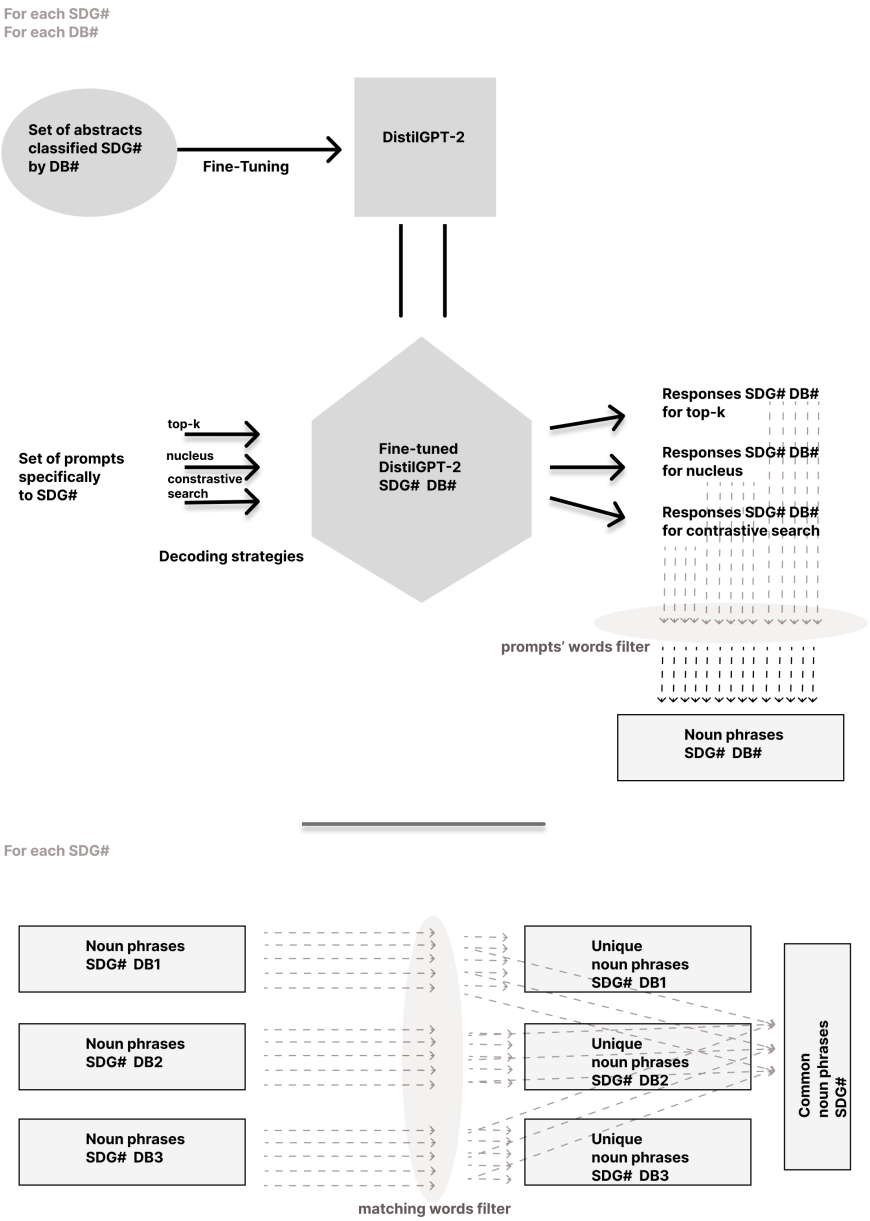

Figure 4: Schematic illustration of the research design followed in this paper. We fine-tune a blank large language model based on the architecture DistilGPT-2 to the subset of publication abstracts classified to a given SDG by a given bibliometric DB. Once obtained the fine-tuned LLM, we administrate to it a set of prompts (tailored on the SDG) through three different decoding strategies. Then, we collect into the same set the noun phrases extracted from the three response sets according to a minimum threshold. For each SDG, once obtained the latter sets for all the DBs involved, we filter out the *common* words, gathering them into another set.

2 For each SDG, we compare the three sets of noun phrases belonging to Web of Science, OpenAlex and Scopus. We issue a *common* subset, where we collect those noun phrases common to the three bibliometric DB's, which cannot differentiate between databases. After this filtering process, what is left is a subset of noun phrases *unique* to one or any two DBs.

3 For each target, we assess whether or not it has been addressed by the bibliometrics, by matching with the noun phrases of the four sets (one common and three unique sets) sided by double checking directly "by hand" the LLM responses. For better visualization and interpretation, we produce a table for each SDG, listing terms split among the following four categories: location, data/metrics, actors, focuses. Some noun phrases are not directly related to targets and then listed aside as "bias". Moreover, the category data/metrics is mainly coming from the LLM responses. Anyhow, the extracted noun phrases work as a main screening. A direct searching through the LLM responses is also deployed, in order not to mistake the absence of certain terms. In other words, if one term seems not to be addressed according to the noun phrases, we double check this absence searching through the LLM responses directly.

5 Results

Overall, we fine-tune 15 LLMs to specific collections of abstracts. Each of them undergoes a specific set of prompts (with respect to each SDG) through three decoding strategies. We explore the LLM responses by means of noun phrase analysis. In Fig.4, the process is systematized, showing how one of the 15 fine-tuned LLMs generates its corresponding set of noun phrases and how the results from WoS, OpenAlex, and Scopus are compared for each SDG. A noun phrase is considered valid if its frequency (i.e., its occurrence among the responses) within a given strategy is greater than 2%. For each SDG, we ultimately obtain a set of noun phrases found in common among the bibliometric databases and three sets of noun phrases uniquely belonging to each bibliometric database, respectively assigned to any two of the three databases. Issuing "unique" and "common" sets is particularly helpful toward the final aim of this work, i.e., assessing compliance/completeness and data biases of diverse bibliometric databases in classifying SDGs. However, the relevant result is not from the comparison with each other, but rather altogether with respect to what SDG are supposed to serve for.

As mentioned above, for each SDG, we issue a specific set of prompts (see Appendix A). The prompts aim to trigger the corresponding fine-tuned LLM under equal conditions concerning each SDG target. In other words, a set of 10 prompts is issued for each SDG target to explore it thoroughly. The number of targets varies from a minimum of 8 in SDG 9 (80 prompts) to a maximum of 12 in SDG 8 (120 prompts).

5.1 Compliance with SDG Targets and Biases

Given the nature of the LLM architecture (i.e., DistilGPT2) and the fine-tuning data (i.e., abstracts from scientific papers), we expect the LLM output to resemble a summary, similar to an abstract, related to the given prompt. More specifically, to generate a response, the interrelationships among tokens/words from the prompt (and their connections) are retrieved from the network of embedded words (formed through fine-tuning)

and laid out in text form. Hence, if the LLM does not respond adequately to a certain prompt, it indicates that a semantic network around that prompt has not been sufficiently formed. In other words, the information required by the prompt is missing or not well defined. This phenomenon allows us to define a metric to evaluate each fine-tuned LLM; i.e., how responsive each LLM is. In particular, since our stimuli (i.e., the prompts) mirror the SDG targets by construction, we can set the latter as the "ground truth" (or benchmark) and assess which targets the LLM covers or not. To do this, we match the extracted noun phrases against the SDG targets to identify which targets the bibliometric databases address. Determining whether a noun phrase refers to a target is not always straightforward; in such cases, we manually review the LLM responses. Additionally, we record other noun phrases that cannot be directly associated with any target.

After an initial screening of noun phrases and targets, we identify four main categories within which noun phrases and targets might be grouped:

Locations : Targets from four out of the five SDGs explored refer to political and geographical areas (e.g., least developed countries, African countries). Moreover, the LLM responses frequently reference locations for every SDG, either in the same form as mentioned in the targets or by specifying countries where a particular study was conducted (e.g., United States, South Africa, China).

Actors : Targets from all the SDGs analyzed refer to actors at different levels, from individuals to organizations and institutions. For instance, they may include persons with disabilities, workers, migrant women, households, and small and medium industries. The LLM responses exhibit similar behavior.

Focuses : Each SDG has its own focal themes mentioned throughout its targets. This category is the largest, as it essentially grows proportionally to the number of targets. The LLMs reference many focuses that may be identical to, synonymous with, or related to those found in the targets.

Data/Methods : This category primarily pertains to LLM responses. Here, we collect references to databases used as sources for studies (e.g., demographic health survey), specific research methodologies (e.g., thematic analysis, ethnographic study), indicators (e.g., Gini coefficient, GDP), and references to models and research concepts (e.g., two-country model, DSGE).

For each SDG, we analyze targets one by one, breaking down each of them into the aforementioned categories, matching the extracted noun phrases, and directly double-checking LLM responses in case of doubt. Finally, we determine to what extent each target is addressed by LLMs and also collect remaining data biases from the LLMs (e.g., when not required by targets). In what follows, we provide a comprehensive analysis of each SDG, discussing in detail all the considerations behind our classifications. Moreover, for better clarity, we describe the specific surveys, indicators, and models that emerged when relevant. For a stylized representation of the results, we present them in tabular form in Appendix B.

SDG 4: Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

The first target of SDG 4 aims to ensure complete, free, equitable, and quality primary and secondary education, leading to effective learning outcomes. While the specific

phrasing "all girls and boys" is not explicitly mentioned in LLM responses, terms such as "youth" and "children" broadly align with this objective. The focus of the target is generally addressed, though the concepts of gratuity and equity in education are not directly reflected. However, terms like "access" and "inequality" partially cover these aspects.

The second target, which emphasizes providing access to quality early childhood development, care, and pre-primary education for all girls and boys before primary school, is partially satisfied. While the LLM responses do not explicitly mention "care" or "pre-primary education," the broader focus on early childhood development is evident.

The third target calls for ensuring equal access for all women and men to affordable and quality technical, vocational, and tertiary education, including university. Although the specific phrasing "all women and men" is absent, terms like "gender" and "m-age" indirectly address this. "Equal access" is not directly mentioned but may be inferred from discussions on "inequality." However, references to technical, vocational, and tertiary education are notably missing.

The fourth target focuses on equipping youth with vocational and technical skills for employment, decent jobs, and entrepreneurship. While "youth" is mentioned in LLM responses, the target as a whole is not adequately addressed. References to vocational and technical skills, employment, and entrepreneurship are absent, though the term "career" might be loosely related.

The fifth target aims to eliminate gender disparities in education and ensure equal access to all levels of education and vocational training for disadvantaged groups, including persons with disabilities, indigenous peoples, and children in vulnerable situations. While gender disparities are indirectly addressed through terms like "inequality," specific references to vulnerable populations are missing.

The sixth target, which focuses on achieving literacy and numeracy for all youth and a substantial proportion of adults, is fully reflected in LLM responses.

The seventh target emphasizes equipping all learners with the knowledge and skills needed to promote sustainable development, including sustainable lifestyles, human rights, peace, non-violence, global citizenship, and cultural diversity. While "knowledge" related to sustainable development is mentioned, "skills" and the broader thematic elements are absent.

Target "a" highlights the need for safe, non-violent, inclusive, and effective learning environments for all, including persons with disabilities. While "effective learning environments" are mentioned, the specific connotations of "safe," "non-violent," and "inclusive" are missing. Additionally, references to persons with disabilities are overlooked, though "child" is detected.

Target "b" explicitly mentions developing countries, least developed countries, small island states, and African countries. LLM responses fail to address these regions, except for incidental mentions of South Africa and China. Furthermore, vocational and technical education remains unaddressed.

Target "c" reiterates the need for international cooperation in teacher training, particularly in developing countries, least developed countries, and small island developing states. While the LLM responses address teacher training, the geographic focus is not explicitly mentioned.

Beyond the explicit alignment with SDG 4 targets, additional insights emerge from the noun phrases in the LLM responses. For instance, while the targets emphasize least developed countries, developing countries, and small island states, the LLM responses

focus on regions such as South Africa (common to everyone), United States (WOS and OAL), Australia (WOS and OAL), Hong Kong (OAL), China (WOS).

A notable indicator mentioned across databases is the Programme for International Student Assessment (PISA), conducted by the Organisation for Economic Co-operation and Development (OECD). PISA measures the ability of 15-year-olds to apply reading, mathematics, and science knowledge and skills. Additionally, Scopus references Socioeconomic Status (SES), a comprehensive measure encompassing income, education level, job prestige, and perceptions of social standing. SES serves as a reliable indicator of various psychological outcomes and quality of life.

In terms of statistical tools, both OpenAlex and Scopus mention the mean and standard deviation of age within population samples, indicating consistency in data retrieval. Regarding data analytics, OpenAlex references thematic analysis, a qualitative method used in social sciences to identify recurring patterns and themes in data.

SDG5: Achieve gender equality and empower all women and girls.

The first target calls for ending all forms of discrimination against women and girls everywhere. This target can be considered fulfilled, as the terms "discrimination," "women," and "girls" (in the context of youth) are present in the LLM responses.

The second target focuses on eliminating all forms of violence in both public and private spheres. The term "violence" is common across all three databases (DBs), with Web of Science (WOS) and OpenAlex (OAL) explicitly referencing gender-based violence. Additionally, OAL mentions "domestic violence," which aligns with the private sphere. While the public domain is not explicitly mentioned, it can be inferred from related terms. However, the target specifically references sexual exploitation and trafficking, which are absent in all three DBs.

The third target aims to eliminate harmful practices, particularly child, early, and forced marriage, as well as female genital mutilation. These specific practices are not explicitly mentioned in the LLM responses. However, references to Demographic Health Surveys (DHS) indirectly relate to marriage age, providing a tangential connection.

The fourth target emphasizes recognizing and valuing unpaid care and domestic work through public services, infrastructure, and social protection policies. These elements are not explicitly found in the LLM responses. However, the target also promotes shared responsibility within households and families, which is partially addressed through terms like "work-life balance."

The fifth target, which focuses on ensuring women's full and effective participation and equal opportunities for leadership in political, economic, and public life, is adequately covered in the DBs.

The sixth target is partially addressed. While access to reproductive health is explicitly mentioned, sexual health and reproductive rights are not. Additionally, the DBs do not reference the Programme of Action of the International Conference on Population and Development or the Beijing Platform for Action.

Target 5.a, which calls for reforms to grant women equal rights to economic resources, including access to ownership and control over land, property, and financial services, is not covered by the DBs. However, the generic term "wealth" might loosely relate to this target.

Targets 5.b and 5.c are well-covered. These targets focus on enhancing the use of technology for women's empowerment and adopting policies and legislation to promote

gender equality and the empowerment of women and girls.

None of the SDG 5 targets explicitly reference specific locations. However, since LLMs are trained on scientific reports that include field studies, geographical mentions are expected. South Africa is consistently mentioned across all three DBs. Additionally, WOS references Australia, the U.S., and New Zealand; OAL mentions Tanzania, India, and the United Kingdom; and Scopus (SCP) includes India and Ghana. Furthermore, Scopus references "urban/rural residence" and "region."

The dimension of data and metrics is particularly noteworthy. Methodologically, the three DBs exhibit distinct approaches. WOS emphasizes quantitative and theoretical methods, mentioning cross-sectional studies, theory, and models. It also references the National Transfer Accounts (NTA) project, which measures how individuals at different life stages obtain and allocate economic resources to meet immediate needs, share with others, and prepare for the future. WOS also mentions generic online surveys and the National Longitudinal Surveys (NLSs), sponsored by the Bureau of Labor Statistics of the U.S. Department of Labor, that collect data on labor market experiences and other significant life events, with information gathered at multiple points in participants' lives. Each NLS sample includes several thousand individuals, many of whom have been followed for several decades.

In contrast, OpenAlex and Scopus adopt more qualitative approaches. OpenAlex highlights thematic analysis (also mentioned in SDG 4), while Scopus references ethnographic studies. Both DBs mention the Demographic Health Surveys (DHS), nationally representative household surveys that collect data on population, health, and nutrition. DHS provides a wide range of monitoring indicators but often excludes specific impact evaluation measures, such as mortality rates, fertility, marriage, family planning, reproductive health, child health, nutrition, and HIV/AIDS. OpenAlex also references the World Values Survey (WVS), a global initiative examining values, beliefs, and their social and political implications through nationally representative surveys in nearly 100 countries since 1981. Additionally, Scopus mentions generic online surveys.

A final observation is the term "empowerment," which is frequently mentioned in OpenAlex and Scopus but absent in WOS.

SDG10: Reduce Inequality within and among countries

The first target, which focuses on achieving and sustaining income growth, is fully covered. The second target aims to empower and promote social ("social justice"), economic ("financial inclusion"), and political inclusion for all, explicitly highlighting potential discriminating variables. Some of these variables are addressed, such as age and sex (assumed to align with "gender"), while others—like disability, ethnicity, race, origin, and religion—are not.

The third target, which emphasizes ensuring equal opportunities, reducing inequalities of outcome, eliminating discriminatory laws and practices, and promoting appropriate measures, is partially covered. While "integration" and "inclusion" might indirectly address discriminatory laws, these are not explicitly mentioned.

The fourth target is fully covered. It calls for adopting policies to achieve greater equality through fiscal measures ("tax"), wage policies ("income," "financial inclusion," "welfare"), and social protection policies.

The fifth target, which focuses on regulating and monitoring global financial markets and their implementation, is fully addressed.

The sixth target, which advocates for the representation of developing countries in decision-making within global economic and financial institutions to ensure effective, credible, accountable, and legitimate institutions, is only partially covered. The terms "developing countries" and "decision-making" are present, but the broader context is missing.

The seventh target, which addresses facilitating orderly, safe, regular, and responsible migration and implementing well-managed migration policies, is not covered. Only "migration policies" is retrievable from the LLM responses.

Target 10.a, which calls for implementing special and differential treatment for developing countries in accordance with World Trade Organization agreements, is not met.

Target 10.b is partially addressed. "Foreign direct investment" is explicitly mentioned by Scopus, and African countries are referenced in the LLM responses. However, least developed countries, landlocked developing countries, and small island developing states are not mentioned.

Target 10.c, which focuses on reducing transaction costs for migrant remittances, is fully covered.

Regarding the geographical dimension, unlike the outcomes for SDG 4, explicit references to developing countries and examples of African countries are present. However, despite prompting, the LLMs do not mention small island or landlocked developing countries. Additionally, unprompted references to the United States, Australia, and the UAE appear.

This SDG explicitly references financial and economic institutions. All three DBs mention the World Bank, while OpenAlex (OAL) also references the Organisation for Economic Co-operation and Development (OECD). Additionally, OAL mentions the World Benchmarking Alliance (WBA), a non-profit organization that evaluates 2,000 of the world's most influential companies, holding them accountable for their contributions to the SDGs. The WBA publishes freely accessible benchmarks to assess and track corporate performance Alliance (2025). Both OAL and Scopus (SCP) also reference households as an actor.

In terms of data and metrics, all three DBs share terms like "model," "panel," and "survey." Panel data are commonly used in microeconomic applications. Methodologically, Web of Science (WOS) suggests exploring various branches of economics, including modeling, econometrics, causal inference, policy evaluation, and macroeconomic and market dynamics. Specific terms like "theory," "likelihood," "endogeneity," "long run," "short run," and "risk-taking" are mentioned. OAL adopts a slightly more empirical approach, with terms like "hypothesis." Scopus (SCP) emphasizes empirical economic research ("empirical evidence"), international trade ("trade"), causal inference ("endogeneity"), and measuring inequality ("Gini coefficient"), the latter being particularly relevant to SDG 10.

Regarding datasets, SCP mentions the World Values Survey, previously referenced by OAL in SDG 5.

Broadly, from a frequency perspective, WOS focuses more on financial markets, OAL on financial and social inclusion, and SCP on trade and economic development.

A final observation: SCP explicitly mentions foreign direct investment (FDI), a tool that has been critiqued for its potential ties to colonial legacies (Glaister et al., 2020).

SDG8: Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all.

The first target, which focuses on sustaining per capita economic growth and achieving at least 7 percent GDP growth per annum in the least developed countries, is covered by the LLM responses.

The second target is also fully covered. It aims to achieve higher levels of economic productivity through technological upgrading, innovation, and diversification (implied by "variety"), with a focus on high-value-added sectors ("human capital") and labor-intensive industries.

The third target is partially covered. It promotes development-oriented policies across various fields, including productive activities, job creation, innovation, and firm growth, all of which are addressed by the LLMs. However, entrepreneurship, creativity, formalization of firms, and access to financial services are not mentioned. Additionally, while the target specifically references micro-, small-, and medium-sized enterprises, the LLM responses do not account for firm size.

The fourth target has two components: (1) improving global resource efficiency in consumption and production, and (2) decoupling economic growth from environmental degradation in line with the 10-Year Framework of Programmes on Sustainable Consumption and Production. The first component is covered, but the second is not.

The fifth target is minimally covered. It aims to achieve full and productive employment and decent work for all women and men, including youth and persons with disabilities, and to ensure equal pay for work of equal value. While "youth employment" is frequently mentioned (most prominently in OAL and moderately in SCP), there is no reference to persons with disabilities. "Wage inequality" (SCP) might indirectly address equal pay.

The sixth target, which focuses on reducing the proportion of youth not in employment, education, or training, is fully covered.

The seventh target is not addressed. It calls for immediate and effective measures to eradicate forced labor, modern slavery, human trafficking, and the worst forms of child labor, including the use of child soldiers, with the goal of ending child labor in all forms by 2025.

The eighth target, which aims to protect labor rights and promote safe and secure working environments for all workers, including migrant workers (particularly women migrants) and those in precarious employment, is not covered at all.

The ninth target, which promotes sustainable tourism to create jobs and support local culture and products, is widely covered. While "culture" is not explicitly mentioned, the other keywords are shared across all three DBs.

The tenth target, which seeks to strengthen the capacity of domestic financial institutions to expand access to banking, insurance, and financial services for all, is not covered.

Target 8.a, which aims to increase Aid for Trade support for developing countries (particularly least developed countries) through initiatives like the Enhanced Integrated Framework for Trade-related Technical Assistance, is broadly covered. However, explicit references to the Framework are missing. The World Trade Organization (WTO) initiated Aid for Trade, a policy concept designed to help developing countries build trade capacity and infrastructure.

The final target (8.b) focuses on developing and operationalizing a global strategy for

youth employment and implementing the Global Jobs Pact of the International Labour Organization (ILO). While "youth employment" is widely mentioned, the ILO Pact is not referenced.

Geographically, China is a shared focus across all three DBs. WOS does not mention other locations, while OAL references the U.S., UK (relevant to Target 8.4, which mentions developed countries), Sub-Saharan Africa, and South Africa. SCP mentions Sub-Saharan Africa, South Africa, and Latin America, with references to developing and least developed countries throughout the targets.

In terms of data and metrics, panel data and endogeneity are commonly mentioned. Endogeneity is associated with econometric time series analysis, while panel data is used in econometric analysis. WOS specifically mentions the dynamic general equilibrium model, a neoclassical macroeconomic tool for policy analysis, and the two-country model, which examines interactions between two economies, particularly in international trade and monetary policy. WOS also references the dynamic panel data model, which includes time-lagged variables, unlike the static panel data model.

OAL highlights Data Envelopment Analysis (DEA), a nonparametric method used in operations research and economics to estimate production frontiers. DEA has been applied in various fields, including international banking, economic sustainability, and machine learning. SCP also mentions DEA, along with the U-shaped relationship, often used in performance evaluation. Other terms like "performance," "likelihood," "regression," and "long run" suggest a focus on optimizing econometric analyses.

Common themes across the DBs include "human capital." Specifically, WOS frequently mentions "welfare" and less frequently "investment" and "gender." OAL references "wage," "labor market," "liberalization," and "gender," albeit with low frequency. SCP shows high frequency for "investment" and moderate frequency for "wage inequality."

A final observation: "technology" is the most cited noun phrase in WOS and SCP, while OAL most frequently cites "youth unemployment."

SDG9: Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation

The first target focuses on developing quality, reliable, sustainable, and resilient infrastructure—including regional and transborder infrastructure—to support economic development and human well-being, with an emphasis on affordable and equitable access for all. This target is partially covered. While references to sustainability and infrastructure are present, reliability, resilience, human well-being, and equitable access are not addressed.

The second target aims to promote inclusive and sustainable industrialization, increase industry's share of employment and GDP, and double its share in least developed countries. Although "inclusive" is not explicitly mentioned, the target can be considered covered, given the reference to Ghana (a least developed country) in WOS.

The third target focuses on providing small-scale industrial and other enterprises, particularly in developing countries, with access to financial services, including affordable credit, and integrating them into value chains and markets. The LLM responses only partially address this target, mentioning actors, locations (China, South Africa), and markets.

The fourth target, which involves upgrading infrastructure and retrofitting industries

to make them sustainable by increasing resource-use efficiency and adopting clean and environmentally sound technologies, is fully covered. Key terms like "green innovation," "infrastructure," "resource-use efficiency," and "industrial processes" are present.

The fifth target emphasizes enhancing scientific research, upgrading the technological capabilities of industrial sectors (especially in developing countries), and increasing the number of research and development workers per 1 million people, as well as public and private R&D spending. The first part of this target is covered, but the latter aspects are not addressed.

Target 9.a aims to facilitate sustainable and resilient infrastructure development in developing countries through enhanced financial, technological, and technical support, particularly for African countries, least developed countries, landlocked developing countries, and small island developing states. While some elements are covered, references to financial support and the latter two categories of countries are missing.

Target 9.b focuses on supporting domestic technology development, research, and innovation in developing countries by creating a conducive policy environment for industrial diversification and value addition to commodities. However, "industrial diversification" and "value addition to commodities" are not retrieved from the LLM responses.

Target 9.c seeks to increase access to information and communications technology and provide universal and affordable internet access in least developed countries. While the first part is covered, the second is not.

Geographically, China is a common focus across all three DBs. WOS also mentions the World, the U.S., and Ghana, while OAL and SCP both reference South Africa.

In terms of data and metrics, the DBs share terms like "survey," "U-shaped relationship," and "Data Envelopment Analysis (DEA)." WOS additionally mentions GDP, "long run," and Green Total Factor Productivity (GTFP), a methodology that measures productivity by considering inputs like capital, energy, and labor, alongside desired outputs (economic benefits) and undesirable outputs (environmental damage). WOS also references both "theoretical framework" and "empirical evidence."

OAL mentions "endogeneity," "empirical analysis," and "firm performance," while SCP references "empirical evidence" and "long run."

A common actor across the DBs is the manufacturing industry. WOS specifically mentions firms and small- to medium-sized enterprises (SMEs), OAL mentions firms, and SCP references SMEs.

Shared focuses across the DBs include productivity and construction. WOS also highlights knowledge, patents, and competition. OAL mentions A-shares, which represent stocks of mainland China-based companies traded on Chinese stock exchanges, as well as green infrastructure, green innovation, foreign direct investment (FDI), technological progress, production, financing, and the World Bank Enterprise Survey (WBES). The WBES is a firm-level survey conducted since 2005, providing insights into the business environment, firm characteristics, and performance metrics across economies worldwide.

6 Discussion of the results

The aim of this work is identifying data biases within the SDG classification operated by bibliometric databases through the emerging technology of large language modeling. This approach is pretty promising as of LLM capabilities, and the increasing usage in research practice and society at large lets us figuring these data biases definitely relevant to assess.

The first direct assessment of our contribution relates to identifying the publications each bibliometric database classified as a given SDG. We examine 5 SDGs. After having built a jointly indexed publication set to provide even conditions for the comparison, we have collected the publications and quantified the overlapping of the diverse classifications.

As shown in Fig.3, for each SDG, the overlaps of classified publications might be extremely small, ranging from a minimum of 1.3% (SDG 10) to a maximum of 7.2% (SDG 4) when considering the simultaneous overlap of all three DBs. Even considering additionally the pairwise overlapping, the uncovered publications (i.e., those ones classified by only one DB) are at least 73% of the total in the "most agreeing classification" (SDG 4), and around 90% in the most misaligned case (i.e. SDG 10). Such a wide difference in the publication subsets is fairly expected to produce significantly diverse outcomes among the three bibliometric DBs and highlights the performativity of the SDG classification.

Once a LLM is fine-tuned on the classification of a given SDG by a certain DB, it is then questioned through a set of prompts tailored to the corresponding SDG.

The LLM responses mimic abstracts from scientific papers. Since we built our prompts on the targets for each SDG, we are allowed to benchmark the SDG targets themselves. In other words, we set as standard the compliance of LLM responses with the SDG targets to assess data biases. In order to explore widely any corner of the word embedding network built by fine-tuning, we perform three different decoding strategies and account all the responses. For each SDG, we assess whether the targets are addressed or not and to what extent through noun phrases analysis, a successful method to condense results, together with "by hand" double checking directly through the responses, in case of ambiguity or lack of clarity from the former. We successfully distinguish when targets are addressed or not. Moreover, we collect some "leftover bias"; i.e., signal from the LLMs not explicitly related to the targets.

We have established 4 main categories to classify noun phrases and support the analysis and the interpretation of the results. These categories come from considerations about the nature of SDG targets and, accordingly, the noun phrases extracted from the LLM responses, together with the nature of data we train the LLMs on (i.e., publication abstracts). After having analyzed each SDG singularly, these categories help us reading the outcomes transversally, and characterizing that aggregate effect we are after (research question). One category is the location. Each SDG except one (i.e., SDG 5) makes explicit geographical references (in more than two targets). In most cases, each SDG mentions developing countries, African countries, least developed countries; only in one case (i.e., SDG8), developed countries are mentioned in the targets. All the LLMs mention several locations (SDG 5 included). Anyhow, on the contrary than what the targets (and then the prompts) ask for, we report a prime focus towards the economic superpowers United States (present in all of the SDGs) and China (four SDGs) and the highly developing country South Africa (present in all of the SDGs). It is worth to mention that SDG 4 refers to an equitable and decent education for everyone, actually mentioning only African and least developed countries; in this case we find a paradoxical result, as the only countries mentioned are highly developed and developing ones (US, Australia, China, South Africa, UK, Hong Kong). Another interesting result is that the only SDG where China is missing is the one committed to gender equality. Moreover, even though the latter target does not request any specific location, a diversified portfolio of countries come out, mentioning, in addition to the highly developed US, UK, Australia and New Zeland, the developing Tanzania, India, Ghana (and the frequent South Africa). Representing African and least developed countries are Sub-Saharan Africa for reducing

inequalities (SDG 10) and economic growth and decent work (SDG 8), and Ghana for industry, innovation and infrastructure (SDG 9). Australia is present only in the three SDGs which focus on the social features of equality. Another category regards the actors emerging from targets and LLM responses. This category includes individuals, institutions, organizations, companies. Targets from SDG 4, 5, and 10, explicitly mention diverse categories of disadvantaged people - all the three databases overlook almost all of them. In SDG 4 the bibliometric DBs fail to mention the vulnerable, persons with disabilities, indigenous peoples, children in vulnerable situations. In SDG 10: individuals discriminated against on the bases of Disability, Race, Ethnicity, Origin, Religion. In SDG 8: persons with disabilities, migrant workers, women migrants, those in precarious employment. On the contrary, other actors mentioned in the prompts are successfully matched. Moreover, some specific actors directly requested in the targets emerge. For example, SDG 10 asks for financial and economic institutions and the LLMs mention World Bank and OECD. Moreover, in SDG10, LLMs mention the World Benchmarking Alliance, a multi-stakeholder who does benchmarking and consulting to businesses to align with the SDGs. No targets ask for such a private organization with this function. The manufacturing industry is mentioned by LLMs both the economic SDGs; in addition, the battery industry comes up in SDG 8. A third category is meant to collect data, metrics, indicators, benchmarks and research methodologies. By construction, this category mostly belongs to the LLM responses, as they are trained on scientific abstracts and then reporting methodologies and related. Anyhow, a few indicators or benchmarks are mentioned also in the targets. Depending on the specific SDG we have diverse findings for this category. Several data sources are mentioned by the LLMs all over the SDGs; they issue indicators through their own metrics (e.g., survey, framework, tests), collect data and then provide measures meant to policymakers. SDG 5 stands out for the amount of data sources mentioned. We found online surveys, the Demographic Health Survey (that collect data on population, health, and nutrition from household surveys), the World Values Survey (a global initiative examining values, beliefs, and their social and political implications), the National Longitudinal Survey (from US - that collect data on labor market experiences and other significant life events, with information gathered at multiple points in participants' lives), and the National Transfer Accounts (which measures how individuals at different life stages obtain and allocate economic resources to meet immediate needs, share with others, and prepare for the future). Another notable data source is PISA (issued by OECD), mentioned in SDG 4; it measures the ability of 15-year-olds to apply reading, mathematics, and science knowledge and skills. Furthermore, in SDG 10 we find again World Value Survey. In SDG 8 and 9, we find also panel data in addition to generic survey. In addition, we find the World Bank Enterprise Survey in SDG 9. No specific research methodologies are mentioned in the targets. Anyhow, as to the nature of the training data, it is not surprising that the LLMs are plenty of them. For example, the thematic analysis (qualitative) is found in SDG 4 and 5. In addition, the latter SDG shows ethnographic (qualitative) and cross-sectional (quantitative) studies. In SDG 10, 8, and 9, we find research terms related to economic analysis, referring to econometrics, market dynamics, causal inference (strictly related to policy analysis), generally macro and micro economics, international trade, etc. The concept of endogeneity is recurrent. Also, references to theoretical models (DSGE, two country model) are present in all three SDGs. Moreover, a specific method used for estimation of production efficiency (i.e., Data Envelope Analysis) is found in both SDG 8 and SDG 9. Several benchmarks are mentioned in the targets and it is asked to align with them.

Apart for Aid from Trade, the LLMs always fail to mention them. They are: WTO agreements, Global Jobs Pact of the ILO, The Programme of Action of the International Conference on Population and Development, The Bejing Platform for Action, 10-Year Framework of Programmes on Sustainable Consumption and Production. Moreover, the LLMs mention the Socioeconomic Status in SDG4, the inequality measure Gini coefficient in SDG 10, the Green Total Factor Productivity in SDG 9. They are pertinent to the according SDG. In the last category we collect all the focuses that targets and/or LLMs mention. First occurrence that comes to eyes is that LLMs happen to be systematically overlooking those sensitive topics implicitly related to the most vulnerable categories of individuals, then validating the thesis that all the fine-tuned LLMs are actively overlooking most disadvantaged categories of people. In that respect, it is illustrative the absence of mentions for human rights, cultural diversity, and global citizenship in SDG 4. As of the nature of SDG 5 (i.e., gender inequality), all the focuses are related to different categories of disadvantaged individuals, implicit from the requests. We find no mention to trafficking, sexual and other forms of exploitation, forced marriage, genital mutilation, infrastructure and social protection policies, and in general legal actions to safeguard respect for principles of equality. Regarding SDG 10, LLMs fail to report discriminatory laws and responsible, orderly, planned and well-managed migration; both of them clearly refer to disadvantaged individuals. In SDG 8, the one related to decent work, LLMs don't mention forced labour, modern slavery and human trafficking, labour rights, equality for accessing insurance and financial services. They clearly refer to disadvantaged people. Finally, in SDG 9 we find no mention for inclusive industrialization, human well-being, equitable access to to financial services and credit, equitable access to the Internet. It is worth to highlight the missing mentions about non violence and peace, asked to focus on in education, in SDG 4. The missed focuses above are the almost totality of all the missing focuses all over the SDGs. On the contrary, those that have been addressed are several, diverse and more numerous than the latter for each SDG (we invite the reader to explore it themselves in the tables in Appendix B. The latter validates further the thesis that LLMs are overlooking disadvantaged categories of people in a systematic fashion. Some remarkable biases (i.e. not directly matching with targets) found in the LLMs are the following. In SDG 4 LLMs widely consider teaching English language is something which to invest on; this might be controversial. Liberalization is an economic policy intervention proposed by LLMs in both SDG 10 and SDG 8. The foreign direct investment is found in the LLMs both in SDG 8 (where asked in the targets) and in SDG 9. In SDG 9, LLMs pay attention on A-shares, which represent stocks of mainland China-based companies traded on Chinese stock exchanges; it is the only form of stock mentioned all over the LLMs.

7 Conclusions

The SDG classifications of WoS, OpenAlex, and Scopus each provide a different perspective on what constitutes an SDG. Bibliometric classifications, while striving to offer objective measures, seem to present a specific focus that is crucial in attributing social relevance through SDG classifications. Depending on the applied classification, scientists and institutions working in the aforementioned fields might, or might not, be able to empirically demonstrate their impact to policymakers. As a matter of fact, the emerging technology of LLMs is expected to radically transform information-intensive domains such as digital

platforms. We aim to evaluate the potential macro effects of their information-processing takeover, from the SDG classification of research to informing decision-makers at large. At the same time, by its very nature, the LLM acts as a detector of data biases within bibliometric databases. LLMs have been instrumental in unearthing and understanding the different perspectives of the bibliometric databases mentioned above. However, the main findings of this work do not arise from comparisons among the databases themselves but from their aggregation against the official SDG targets. Specifically, the research design we conceived allows us to define a benchmark for evaluating the compliance of the LLM with the SDGs themselves. Our primary result is the assessment of an active overall overlooking of vulnerable categories of individuals, such as those discriminated against on the basis of disability, race, ethnicity, or religion. In particular, the following are overlooked: the poorest countries; the most discriminated and disadvantaged actors; the most inclusive standards (e.g., WTO agreements, the Global Jobs Pact of the ILO); and the most sensitive and ethically challenging topics (e.g., slavery, forced labour, human trafficking, access to basic services, human rights, sexual exploitation, forced marriage, and genital mutilation). Conversely, direct support for economic superpowers and their instruments is systematic with respect to the SDGs and their categories. Although never asked about, either directly or indirectly, the United States is omnipresent, mentioned throughout the SDGs, and plays a hegemonic role. For instance, a data source strictly from the U.S. emerges (i.e., the National Longitudinal Survey); the World Bank appears as both a financial institution and a provider of benchmarks; investment in teaching the English language is widely supported as policy implementation. Another economic superpower widely mentioned is China, with attention paid to its stock market. Within the constraints and limitations of our setup, we can affirm that LLM technology is perpetuating systemic discrimination due to biases present in the selection of the SDG-classified corpus operated by the bibliometric databases. This result aligns with a broad research trend showing that LLMs (and generative AI tools in general) tend to reproduce systemic discrimination in various ways due to their training datasets. The validity of our results might be considered fairly general, and several relevant strengths support this conclusion. One undisputed strong point is the LLM architecture choice (i.e., the pretrained DistilGPT2); the fine-tuned LLMs have nearly no contamination or interference from other training-data sources. Moreover, the renowned high sensitivity of LLMs to parameter settings is mitigated by employing three diverse decoding strategies. Finally, our results are invariant across different bibliometric databases, making them systemic effects. Ethical concerns mostly converge around the accountability of these discriminatory effects. As per LLM functioning, the research production classified under SDGs (i.e., training data) embeds such discriminatory biases. The way of classifying or labeling research does not seem to be what should be held accountable for these results. As shown in Section 3, different bibliometric databases, deploying different SDG classifications, identify research productions that vary considerably; these discriminatory effects do not depend on them. Hence, the jointly indexed publication subset (which corresponds to the vast majority of research provided by Web of Science and Scopus) is responsible for these effects. However, it is worth remarking that three-fourths of the OpenAlex database is excluded from the jointly indexed publication subset—allegedly the most diverse research production for which OpenAlex is renowned and considered innovative. It does not seem unrealistic that the research production stored in bibliometric databases might inherently embed an overall Global North perspective. It is reasonable to suppose that their ownership, being American and English, has been correlated with funding schemes that have prioritized

research questions related to the well-being of Western countries. The main limitation of our work lies in one of the latter remarks. The actual potential of OpenAlex—namely, non-English and/or diverse research production—has not been leveraged due to the construction of a "shared corpus" of publications (i.e., the jointly indexed publication subset) among the three bibliometric databases at hand. We aim to address this limitation in future work. Finally, future work will refine the process of retrieving information from the LLM. For example, a possible extension might include the prompt-engineering technique few-shot learning, which involves writing prompts using information derived from an initial round of responses.

Funding Acknowledgments

Data for WoS, OpenAlex, and Scopus in this study were obtained from the German Kompetenznetzwerk Bibliometrie (https://bibliometrie.info/), funded by the German Federal Ministry for Education and Research (BMBF) with grant number 16WIK2101A. The study is funded by the German Federal Ministry for Education and Research (BMBF) with grant number 01PH20006B.

Open science practices

Most of the data involved in our analysis is copyrighted and can't be shared due to the restricted licence terms. This is unavoidable due to the nature of our research questions. Anyhow, we have included in our analysis the open database OpenAlex, and the comparison with the proprietary databases contributes to the discourse on open science practices. Moreover, all the procedures to process data are clearly explained, and the code will be shared upon request. Furthermore, open source software has been applied predominately, from the choice of the large language model to the use of python and its libraries for the analysis. All of the code written in python (through a jupyter notebook sheet), used for training the open-source DistilGPT2, is available.

Author contributions

Matteo Ottaviani: Conceptualization, Data curation, Analysis, Writing – original draft, Writing – review and editing.
Stephan Stahlschmidt: Conceptualization, Writing – review and editing.

Competing interests

The authors have no competing interests.

References

Abid, A., M. Farooqi, and J. Zou (2021). Persistent anti-muslim bias in large language models. In *Proceedings of the 2021 AAAI/ACM Conference on AI, Ethics, and Society*, pp. 298–306.

Alliance, W. B. (2025). World benchmarking alliance (wba). https://www.worldbenchmarkingalliance.org. Accessed: 2025-03-10.

Armitage, C. S., M. Lorenz, and S. Mikki (2020). Mapping scholarly publications related to the sustainable development goals: Do independent bibliometric approaches get the same results? *Quantitative Science Studies 1*(3), 1092–1108.

Bedard-Vallee, A., C. James, and G. Roberge (2023). Elsevier 2023 sustainable development goals (sdgs) mapping. *Elsevier Data Repository 1*.

Bordignon, F. (2021). Dataset of search queries to map scientific publications to the un sustainable development goals. *Data in Brief 34*, 106731.

Bornmann, L. (2014). Do altmetrics point to the broader impact of research? an overview of benefits and disadvantages of altmetrics. *Journal of informetrics 8*(4), 895–903.

Caliskan, A., J. J. Bryson, and A. Narayanan (2017). Semantics derived automatically from language corpora contain human-like biases. *Science 356*(6334), 183–186.

Capraro, V., A. Lentsch, D. Acemoglu, S. Akgun, A. Akhmedova, E. Bilancini, J.-F. Bonnefon, P. Brañas-Garza, L. Butera, K. M. Douglas, et al. (2024). The impact of generative artificial intelligence on socioeconomic inequalities and policy making. *PNAS nexus 3*(6), pgae191.

Clarivate InCites (2023). Research area schemas - un sustainable development goals. https://incites.help.clarivate.com/Content/Research-Areas/sustainable-development-goals.htm. Accessed: 13 April 2024.

Confraria, H., T. Ciarli, and E. Noyons (2024). Countries' research priorities in relation to the sustainable development goals. *Research Policy 53*(3), 104950.

Costa-juss, C. B. M. R. and N. Casas (2019). Evaluating the underlying gender bias in contextualized word embeddings. *GeBNLP 2019 33*.

Glaister, K. W., N. Driffield, and Y. Lin (2020). Foreign direct investment to africa: Is there a colonial legacy? *Management International Review 60*(3), 315–349.

Hugging Face (2020). Distilgpt-2 model card. https://huggingface.co/distilgpt2. Accessed: 21 April 2024.

Jaworeck, R. (2022). Sdg bert - multi-language multi-label bert model for classifying texts to sustainable development goals (sdgs) based on aurora sdg query model v5 (1.1). *Zenodo*.

Jayabalasingham, B., R. Boverhof, K. Agnew, and L. Klein (2019). Identifying research supporting the united nations sustainable development goals. *Elsevier Data Repository 1*.

Kashnitsky, Y., G. Roberge, J. Mu, K. Kang, W. Wang, M. Vanderfeesten, M. Rivest, S. Chamezopoulos, R. Jaworek, M. Vignes, et al. (2024). Evaluating approaches to identifying research supporting the united nations sustainable development goals. *Quantitative Science Studies*, 1–16.

LaFleur, M. (2019). Art is long, life is short: An sdg classification system for desa publications. *DESA Working Paper 159*.

Lepenies, R., L. Büttner, I. Bärlund, K. Jax, J. Lyytimäki, A. B. Pedersen, H. Ø. Nielsen, C. Mosoni, R. Mille, G. Payen, et al. (2023). The politics of national sdg indicator systems: A comparison of four european countries. *Ambio 52*(4), 743–756.

Lorenz, P., K. Perset, and J. Berryhill (2023). Initial policy considerations for generative artificial intelligence.

Lucy, L. and D. Bamman (2021). Gender and representation bias in gpt-3 generated stories. In *Proceedings of the third workshop on narrative understanding*, pp. 48–55.

Meschede, C. (2020). The sustainable development goals in scientific literature: A bibliometric overview at the meta-level. *Sustainability 12*(11), 4461.

Mishra, M., S. Desul, C. A. G. Santos, S. K. Mishra, A. H. M. Kamal, S. Goswami, A. M. Kalumba, R. Biswal, R. M. da Silva, C. A. C. Dos Santos, et al. (2023). A bibliometric analysis of sustainable development goals (sdgs): a review of progress, challenges, and opportunities. *Environment, Development and Sustainability*, 1–43.

Nadeem, M., A. Bethke, and S. Reddy (2020). Stereoset: Measuring stereotypical bias in pretrained language models. *arXiv preprint arXiv:2004.09456*.

Pukelis, L., N. B. Puig, M. Skrynik, and V. Stanciauskas (2020). Osdg–open-source approach to classify text data by un sustainable development goals (sdgs). *arXiv preprint arXiv:2005.14569*.

Radford, A., J. Wu, R. Child, D. Luan, D. Amodei, I. Sutskever, et al. (2019). Language models are unsupervised multitask learners. *OpenAI blog 1*(8), 9.

Rivest, M., Y. Kashnitsky, A. Bédard-Vallée, D. Campbell, P. Khayat, I. Labrosse, H. Pinheiro, S. Provençal, G. Roberge, and C. James (2021). Improving the scopus and aurora queries to identify research that supports the united nations sustainable development goals (sdgs) 2021. *Mendeley Data 2*.

Sanh, V., L. Debut, J. Chaumond, and T. Wolf (2019). Distilbert, a distilled version of bert: smaller, faster, cheaper and lighter. In *NeurIPS EMC² Workshop*.

Schmidt, F. and M. Vanderfeesten (2021). Evaluation on accuracy of mapping science to the united nations' sustainable development goals (sdgs) of the aurora sdg queries. *Zenodo*.

Sheng, E., K.-W. Chang, P. Natarajan, and N. Peng (2019). The woman worked as a babysitter: On biases in language generation. *arXiv preprint arXiv:1909.01326*.

Su, Y. and N. Collier (2022). Contrastive search is what you need for neural text generation. *arXiv preprint arXiv:2210.14140*.

Su, Y. and J. Xu (2022). An empirical study on contrastive search and contrastive decoding for open-ended text generation. *arXiv preprint arXiv:2211.10797*.

Tamkin, A., A. Askell, L. Lovitt, E. Durmus, N. Joseph, S. Kravec, K. Nguyen, J. Kaplan, and D. Ganguli (2023). Evaluating and mitigating discrimination in language model decisions. *arXiv preprint arXiv:2312.03689*.

Vanderfeesten, M., R. Otten, and E. Spielberg (2020). Search queries for "mapping research output to the sustainable development goals (sdgs)" v5. 0. *Zenodo*.

Vinkler, P. (1988). Bibliometric features of some scientific subfields and the scientometric consequences therefrom. *Scientometrics 14*(5-6), 453–474.

Wang, W., W. Kang, and J. Mu (2023). Mapping research to the sustainable development goals (sdgs). *Research Square preprint rs.3.rs-2544385/v2*.

Wastl, J., S. Porter, H. Draux, B. Fane, and D. Hook (2020). Contextualizing sustainable development research. *Digit. Sci*.

Whitley, R. (2000). *The intellectual and social organization of the sciences*. Oxford University Press, USA.

Wieczorek, O., I. Steinhardt, C. Schneijderberg, R. Schmidt, and S. Mauermeister (2023). The bot delusion. chatgpt and anticipated consequences for research communication.

Wu, J., S. Guo, H. Huang, W. Liu, and Y. Xiang (2018). Information and communications technologies for sustainable development goals: state-of-the-art, needs and perspectives. *IEEE Communications Surveys & Tutorials 20*(3), 2389–2406.

Wulff, D. U., D. S. Meier, and R. Mata (2023). Using novel data and ensemble models to improve automated labeling of sustainable development goals.

Yao, R., M. Tian, C.-U. Lei, and D. K. Chiu (2024). Assigning multiple labels of sustainable development goals to open educational resources for sustainability education. *Education and Information Technologies*, 1–23.

Zhang, R., M. Vignes, U. Steiner, and A. Zimek (2020). Matching research publications to the united nations' sustainable development goals by multi-label-learning with hierarchical categories. In *2020 IEEE 7th International Conference on Data Science and Advanced Analytics (DSAA)*, pp. 516–525. IEEE.

A SDG Prompts

SDG 4: Quality Education

Target 4.1

1. How can countries ensure that all girls and boys complete free, equitable and quality primary and secondary education by 2030?
2. What strategies can be implemented to provide quality primary and secondary education for all?
3. How can educational outcomes be improved to be relevant and effective?
4. What are the challenges in achieving free and equitable education for all?
5. How can countries measure and monitor the quality of primary and secondary education?
6. What role does government policy play in ensuring free and quality education?
7. How can international cooperation support education initiatives in developing countries?
8. What impact does quality education have on economic and social development?
9. How can community programs support access to primary and secondary education?
10. What measures can be taken to reduce dropout rates in schools?

Target 4.2

11. How can countries ensure access to quality early childhood development and pre-primary education by 2030?
12. What strategies can be implemented to support early childhood development?
13. Why is early childhood education important for primary education readiness?
14. How can public awareness campaigns promote the importance of early childhood education?
15. What role do caregivers and parents play in early childhood development?
16. How can government policies support access to pre-primary education?
17. What challenges do countries face in providing quality early childhood education?
18. How can international cooperation enhance early childhood education initiatives?
19. What impact does early childhood education have on long-term learning outcomes?
20. How can community programs support early childhood development and education?

Target 4.3

21. How can countries ensure equal access to affordable and quality technical, vocational, and tertiary education for all?
22. What measures can promote access to university education for women and men?
23. How can vocational education be made more accessible and affordable?
24. What role does government funding play in supporting higher education access?
25. How can scholarships and financial aid programs support tertiary education access?
26. What challenges do countries face in providing quality technical and vocational education?
27. How can international cooperation support access to higher education in developing countries?
28. What impact does equal access to higher education have on economic growth?
29. How can technology be leveraged to enhance access to quality education?
30. What policies can support lifelong learning opportunities for adults?

Target 4.4

31. What strategies can increase the number of youth and adults with relevant skills for employment by 2030?
32. How can technical and vocational skills be promoted among youth and adults?
33. What role do apprenticeships and internships play in skill development?
34. How can government policies support skill development for decent jobs?
35. What impact do technical skills have on employment and entrepreneurship?
36. How can international cooperation enhance skill development programs?
37. What challenges do countries face in providing relevant skills training?
38. How can businesses support skill development for their employees?
39. What measures can be taken to promote entrepreneurship through skill development?
40. How can community programs support youth and adult skill development?

Target 4.5

41. What measures can eliminate gender disparities in education by 2030?
42. How can equal access to education be ensured for vulnerable groups?
43. What strategies can support education for persons with disabilities?
44. How can indigenous peoples be included in educational opportunities?
45. What role do scholarships play in promoting equal access to education?
46. How can international cooperation support the elimination of education disparities?
47. What challenges do countries face in achieving equal access to education?
48. How can community programs promote education for vulnerable children?
49. What impact does eliminating education disparities have on social development?
50. What policies can support equal access to vocational training for all?

Target 4.6

51. How can countries ensure that all youth and a substantial proportion of adults achieve literacy and numeracy by 2030?
52. What strategies can promote adult literacy and numeracy programs?
53. How can education systems support youth literacy and numeracy development?
54. What role do community programs play in promoting literacy for adults?
55. How can international cooperation enhance literacy and numeracy initiatives?
56. What challenges do countries face in achieving literacy for all?
57. How can technology be leveraged to promote literacy and numeracy?
58. What impact does literacy have on economic and social development?
59. How can public awareness campaigns promote the importance of literacy?
60. What measures can support continuous learning opportunities for adults?

Target 4.7

61. How can countries ensure that all learners acquire knowledge and skills for sustainable development by 2030?
62. What strategies can promote education for sustainable development and sustainable lifestyles?
63. How can human rights and gender equality be integrated into education systems?

64. What role do schools play in promoting a culture of peace and non-violence?
65. How can global citizenship be encouraged through education?
66. What impact does education for sustainable development have on social development?
67. How can community programs support education for sustainable development?
68. What challenges do countries face in promoting education for sustainable development?
69. How can international cooperation enhance education for global citizenship?
70. What policies can support the integration of cultural diversity in education?

Target 4.a

71. How can education facilities be built and upgraded to be child, disability, and gender sensitive?
72. What measures can provide safe and inclusive learning environments for all?
73. How can non-violent learning environments be promoted in schools?
74. What role do infrastructure improvements play in enhancing education quality?
75. How can international cooperation support the upgrading of education facilities?
76. What challenges do countries face in providing inclusive learning environments?
77. How can community programs support the creation of safe learning spaces?
78. What impact does a safe and inclusive learning environment have on student outcomes?
79. How can technology be used to create effective learning environments?
80. What policies can support the development of child-friendly education facilities?

Target 4.b

81. How can the number of scholarships available to developing countries be expanded by 2020?
82. What role do scholarships play in promoting higher education access?
83. How can international cooperation support scholarship programs?
84. What challenges do least developed countries face in accessing higher education?
85. How can technology be integrated into scholarship programs for technical and engineering education?
86. What impact do scholarships have on education opportunities for students from developing countries?
87. How can businesses support scholarship programs for higher education?
88. What measures can ensure the sustainability of scholarship programs?
89. How can community programs promote awareness of scholarship opportunities?
90. What policies can support the expansion of scholarships for vocational training?

Target 4.c

91. How can the supply of qualified teachers be substantially increased by 2030?
92. What measures can support international cooperation for teacher training?
93. How can teacher training programs be enhanced in developing countries?
94. What role do incentives play in attracting qualified teachers?
95. How can technology be used to support teacher training and development?
96. What challenges do countries face in increasing the supply of qualified teachers?
97. How can community programs support teacher training initiatives?
98. What impact does the supply of qualified teachers have on education quality?
99. How can public awareness campaigns promote the importance of teacher training?
100. What policies can support the development of teacher training programs?

SDG 5: Gender Equality

Target 5.1

1. How can countries end all forms of discrimination against women and girls everywhere?
2. What strategies can be implemented to combat gender discrimination?
3. Why is it important to address discrimination against women and girls?
4. How can public awareness campaigns help end discrimination against women?
5. What role do legal frameworks play in combating gender discrimination?
6. How can education contribute to ending discrimination against women and girls?
7. What are the challenges in enforcing anti-discrimination laws?
8. How can international cooperation support the fight against gender discrimination?
9. What measures can be taken to ensure equal opportunities for women and girls?
10. How can businesses contribute to ending discrimination against women in the workplace?

Target 5.2

11. What measures can be taken to eliminate all forms of violence against women and girls?
12. How can public and private spheres be made safer for women and girls?
13. What strategies can combat trafficking and sexual exploitation of women and girls?
14. How can countries strengthen their legal frameworks to protect women from violence?
15. What role do social services play in supporting victims of violence?
16. How can community programs help eliminate violence against women and girls?
17. What impact does eliminating violence against women have on society?
18. How can international cooperation support the eradication of violence against women?
19. What are the challenges in eliminating domestic violence against women?
20. How can education and training programs prevent violence against women and girls?

Target 5.3

21. What measures can be taken to eliminate harmful practices such as child marriage?
22. How can countries combat early and forced marriage?
23. What strategies can eradicate female genital mutilation?
24. How can public awareness campaigns help eliminate harmful practices against women?
25. What role do legal frameworks play in preventing harmful practices?
26. How can education and community programs protect girls from harmful practices?
27. What impact does eliminating child marriage have on women's rights?
28. How can international cooperation support the fight against harmful practices?
29. What are the challenges in eradicating female genital mutilation in certain cultures?
30. How can social services support victims of harmful practices?

Target 5.4

31. How can unpaid care and domestic work be recognized and valued?
32. What role do public services play in supporting unpaid care work?
33. How can infrastructure and social protection policies promote shared responsibility?
34. What strategies can encourage shared responsibility within households?
35. How can countries measure and monitor unpaid care work?
36. What impact does recognizing unpaid care work have on gender equality?
37. How can businesses support employees with unpaid care responsibilities?
38. What challenges do countries face in valuing unpaid care and domestic work?
39. How can international cooperation promote shared responsibility in households?
40. What policies can support the recognition of unpaid care work?

Target 5.5

41. How can women's full and effective participation in decision-making be ensured?
42. What measures can promote equal opportunities for women in leadership?
43. How can countries increase women's participation in political life?
44. What strategies can support women's leadership in economic sectors?
45. How can public awareness campaigns promote women's participation in decision-making?
46. What role do mentorship programs play in supporting women leaders?
47. How can international cooperation enhance women's leadership opportunities?
48. What challenges do women face in achieving equal opportunities for leadership?
49. How can businesses promote women in leadership positions?
50. What impact does women's participation in decision-making have on society?

Target 5.6

51. How can universal access to sexual and reproductive health be ensured?
52. What measures can promote reproductive rights for all women?
53. How can countries implement the Programme of Action of the International Conference on Population and Development?
54. What role do healthcare services play in supporting reproductive health?
55. How can education programs promote reproductive rights?
56. What impact does ensuring reproductive rights have on women's health?
57. How can international cooperation support reproductive health initiatives?
58. What challenges do countries face in providing access to reproductive health services?
59. How can community programs support reproductive health and rights?
60. What policies can ensure reproductive rights for women and girls?

Target 5.a

61. What reforms can give women equal rights to economic resources?
62. How can countries ensure women's access to land and property ownership?
63. What strategies can promote women's access to financial services?
64. How can inheritance laws be reformed to support gender equality?
65. What role do legal frameworks play in giving women control over natural resources?
66. How can international cooperation support economic rights for women?
67. What impact does equal access to economic resources have on women's empowerment?
68. How can community programs support women's economic rights?
69. What challenges do women face in accessing economic resources?
70. How can businesses promote women's economic rights?

Target 5.b

71. How can enabling technology promote the empowerment of women?
72. What role does information and communications technology play in women's empowerment?
73. How can countries enhance women's access to technology?
74. What strategies can promote digital literacy among women and girls?
75. How can businesses support the use of technology for women's empowerment?
76. What impact does technology have on women's economic opportunities?
77. How can international cooperation support women's access to technology?
78. What challenges do women face in accessing enabling technology?
79. How can education programs promote the use of technology among women?
80. What policies can support the use of technology for women's empowerment?

Target 5.c

81. What policies can promote gender equality and the empowerment of women and girls?
82. How can countries adopt and strengthen enforceable legislation for gender equality?
83. What role do legal frameworks play in promoting gender equality?
84. How can public awareness campaigns support gender equality initiatives?
85. What impact does promoting gender equality have on economic development?
86. How can international cooperation enhance gender equality efforts?
87. What challenges do countries face in enforcing gender equality legislation?
88. How can community programs support the empowerment of women and girls?
89. What strategies can ensure the implementation of gender equality policies?
90. How can education programs promote gender equality and women's empowerment?

SDG 8: Decent Work and Economic Growth

Target 8.1

1. How can countries sustain per capita economic growth in accordance with national circumstances?
2. What strategies can be implemented to achieve at least 7 percent GDP growth per annum in least developed countries?
3. Why is sustaining per capita economic growth important for national development?
4. How can economic policies be tailored to fit national circumstances and drive growth?
5. What are the challenges in achieving sustained economic growth in least developed countries?
6. How can international cooperation support economic growth in least developed countries?
7. What role do technological advancements play in sustaining economic growth?

8. How can countries measure and monitor their economic growth effectively?
9. What impact does sustained economic growth have on poverty reduction?
10. How can economic diversification contribute to sustained per capita economic growth?

Target 8.2

11. What measures can be taken to achieve higher levels of economic productivity?
12. How can diversification help improve economic productivity?
13. What role does technological upgrading play in enhancing productivity?
14. How can innovation drive economic productivity in high-value added and labour-intensive sectors?
15. What are the benefits of focusing on high-value added sectors for economic growth?
16. How can labour-intensive sectors contribute to higher economic productivity?
17. What strategies can be used to promote technological upgrading in developing countries?
18. How can countries balance diversification and specialization to achieve economic growth?
19. What impact does innovation have on economic productivity?
20. How can international partnerships support technological upgrading and innovation?

Target 8.3

21. What policies can promote development-oriented productive activities?
22. How can decent job creation be supported through government policies?
23. What role does entrepreneurship play in economic development?
24. How can creativity and innovation be encouraged in the business sector?
25. What measures can support the formalization and growth of micro, small, and medium-sized enterprises?
26. How can access to financial services be improved for small enterprises?
27. What are the benefits of development-oriented policies for economic growth?
28. How can countries create an enabling environment for entrepreneurship?
29. What impact do development-oriented policies have on job creation?
30. How can international cooperation support the growth of small and medium-sized enterprises?

Target 8.4

31. How can global resource efficiency in consumption and production be improved progressively?
32. What strategies can decouple economic growth from environmental degradation?
33. How can the 10-Year Framework of Programmes on Sustainable Consumption and Production be implemented effectively?
34. What role do developed countries play in leading sustainable consumption and production?
35. How can countries measure and monitor resource efficiency improvements?
36. What impact does sustainable consumption and production have on economic growth?
37. How can international cooperation support sustainable resource use?
38. What are the challenges in achieving resource efficiency in developing countries?
39. How can public awareness campaigns promote sustainable consumption and production?
40. What policies can encourage businesses to adopt resource-efficient practices?

Target 8.5

41. What measures can achieve full and productive employment for all women and men by 2030?
42. How can decent work opportunities be created for young people and persons with disabilities?
43. What strategies can ensure equal pay for work of equal value?
44. How can employment policies be designed to be inclusive of all demographics?
45. What role does education and training play in achieving full employment?
46. How can countries monitor and evaluate progress towards full and productive employment?
47. What impact does decent work have on economic growth and development?
48. How can international cooperation support the achievement of full employment?
49. What challenges do countries face in creating decent work opportunities for all?
50. How can businesses contribute to achieving full and productive employment?

Target 8.6

51. What strategies can substantially reduce the proportion of youth not in employment, education, or training by 2020?
52. How can education systems be improved to support youth employment?
53. What role do vocational training programs play in reducing youth unemployment?
54. How can governments create job opportunities for young people?
55. What measures can support the transition from education to employment for youth?
56. How can international cooperation support youth employment initiatives?
57. What are the challenges in reducing youth unemployment in developing countries?
58. How can public-private partnerships enhance youth employment opportunities?
59. What impact does reducing youth unemployment have on economic growth?
60. How can youth entrepreneurship be encouraged as a solution to unemployment?

Target 8.7

61. What measures can be taken to eradicate forced labour and end modern slavery?
62. How can human trafficking be effectively combated on a global scale?
63. What strategies can secure the prohibition and elimination of the worst forms of child labour?
64. How can the recruitment and use of child soldiers be prevented?
65. What steps can be taken to end child labour in all its forms by 2025?
66. What role do international agreements play in combating forced labour and modern slavery?
67. How can public awareness campaigns support the eradication of forced labour?
68. What impact does ending modern slavery have on economic development?
69. How can countries strengthen their legal frameworks to combat human trafficking?
70. What are the challenges in eradicating child labour in developing countries?

Target 8.8

71. How can labour rights be protected for all workers, including migrant workers?
72. What measures can promote safe and secure working environments for all workers?
73. How can the rights of women migrants be protected in the workplace?
74. What strategies can support workers in precarious employment?
75. How can international cooperation enhance labour rights protections?
76. What role do labour unions play in promoting safe working environments?

77. How can businesses ensure the safety and security of their workers?
78. What impact does protecting labour rights have on economic productivity?
79. How can countries monitor and enforce labour rights protections?
80. What are the challenges in promoting safe working environments in developing countries?

Target 8.9

81. How can policies be devised to promote sustainable tourism by 2030?
82. What measures can create jobs through sustainable tourism?
83. How can sustainable tourism promote local culture and products?
84. What role does community involvement play in sustainable tourism development?
85. How can countries balance tourism growth with environmental sustainability?
86. What strategies can enhance the economic benefits of sustainable tourism?
87. How can international cooperation support sustainable tourism initiatives?
88. What challenges do countries face in promoting sustainable tourism?
89. How can technology be leveraged to promote sustainable tourism?
90. What impact does sustainable tourism have on local economies?

Target 8.10

91. How can the capacity of domestic financial institutions be strengthened?
92. What measures can encourage and expand access to banking services for all?
93. How can insurance services be made more accessible to the general population?
94. What role do financial literacy programs play in expanding access to financial services?
95. How can technology be used to improve access to financial services?
96. What impact does expanded access to banking have on economic development?
97. How can international cooperation support financial inclusion initiatives?
98. What challenges do developing countries face in expanding access to financial services?
99. How can regulatory frameworks support the growth of domestic financial institutions?
100. What are the benefits of expanding access to insurance services for economic stability?

Target 8.a

101. How can Aid for Trade support be increased for developing countries?
102. What role does the Enhanced Integrated Framework for Trade-related Technical Assistance play?
103. How can international cooperation enhance Aid for Trade initiatives?
104. What impact does Aid for Trade have on economic development in least developed countries?
105. How can developing countries effectively utilize Aid for Trade support?
106. What strategies can be implemented to strengthen Aid for Trade programs?
107. How can countries monitor and evaluate the effectiveness of Aid for Trade support?
108. What challenges do least developed countries face in accessing Aid for Trade?
109. How can private sector involvement enhance Aid for Trade initiatives?
110. What measures can ensure the sustainability of Aid for Trade support?

Target 8.b

111. How can a global strategy for youth employment be developed and operationalized by 2020?
112. What measures can implement the Global Jobs Pact of the International Labour Organization?
113. How can international cooperation support global youth employment strategies?
114. What role do education and training programs play in global youth employment?
115. How can countries create a conducive environment for youth employment?
116. What are the key components of an effective global strategy for youth employment?
117. How can countries measure and monitor progress towards youth employment goals?
118. What impact does the Global Jobs Pact have on youth employment and economic growth?
119. How can youth voices be included in the development of employment strategies?
120. What challenges do countries face in implementing global youth employment initiatives?

SDG 9: Industry, Innovation and Infrastructure

Target 9.1

1. How can countries develop quality, reliable, sustainable, and resilient infrastructure to support economic development?
2. What strategies can be implemented to create regional and transborder infrastructure?
3. Why is affordable and equitable access to infrastructure important for all?
4. How can infrastructure development contribute to human well-being?
5. What are the key components of sustainable infrastructure development?
6. How can developing countries improve their infrastructure to support economic growth?
7. What role does technology play in developing resilient infrastructure?
8. How can public-private partnerships be leveraged for infrastructure development?
9. What are the challenges in developing quality infrastructure in least developed countries?
10. How can infrastructure projects be made more inclusive?

Target 9.2

11. What measures can be taken to promote inclusive and sustainable industrialization?
12. How can the industry's share of employment and GDP be significantly raised by 2030?
13. What strategies can help double the industry's share in least developed countries?
14. How can national circumstances influence industrialization policies?
15. What are the benefits of sustainable industrialization for economic growth?
16. How can industrial policies be designed to be inclusive of all demographics?
17. What role does innovation play in promoting sustainable industrialization?
18. How can countries balance industrial growth with environmental sustainability?
19. What are the key indicators of successful industrialization?
20. How can international cooperation support inclusive industrialization?

Target 9.3

21. How can access to financial services be increased for small-scale industrial enterprises?
22. What are the benefits of affordable credit for small-scale enterprises in developing countries?
23. How can small enterprises be integrated into value chains and markets?
24. What role do financial institutions play in supporting small-scale enterprises?
25. How can government policies support the growth of small-scale industrial enterprises?
26. What challenges do small-scale enterprises face in accessing financial services?
27. How can technology be leveraged to support small-scale industrial enterprises?
28. What strategies can be used to promote the financial inclusion of small enterprises?
29. How can international partnerships enhance access to financial services for small enterprises?
30. What impact does financial access have on the growth of small-scale industrial enterprises?

Target 9.4

31. What measures can be taken to upgrade infrastructure to make it sustainable by 2030?
32. How can industries be retrofitted to increase resource-use efficiency?
33. What are the benefits of adopting clean and environmentally sound technologies in industries?
34. How can industrial processes be made more sustainable?
35. What role do national capabilities play in upgrading infrastructure and industries?
36. How can countries encourage the adoption of environmentally friendly industrial practices?
37. What are the key components of sustainable industrial infrastructure?
38. How can international support help countries upgrade their industries?
39. What challenges do countries face in retrofitting industries for sustainability?
40. How can public awareness campaigns promote sustainable industrial practices?

Target 9.5

41. How can scientific research be enhanced to upgrade technological capabilities in industrial sectors?
42. What strategies can be used to encourage innovation in developing countries?
43. How can the number of research and development workers be increased by 2030?
44. What role does public and private research and development spending play in industrial growth?
45. How can technological capabilities in industrial sectors be improved?
46. What are the benefits of increased scientific research for economic development?
47. How can international cooperation support technological advancements in developing countries?
48. What challenges do countries face in enhancing their scientific research capabilities?
49. How can education systems support the growth of research and development sectors?
50. What impact does innovation have on the competitiveness of industrial sectors?

Target 9.a

51. How can sustainable infrastructure development be facilitated in developing countries?
52. What role does financial support play in developing resilient infrastructure?
53. How can technological support enhance infrastructure development in African countries?
54. What strategies can be used to support infrastructure development in least developed countries?
55. How can international cooperation help landlocked developing countries improve their infrastructure?
56. What are the challenges in developing infrastructure in small island developing states?
57. How can technical support be provided to enhance infrastructure development in developing countries?
58. What impact does resilient infrastructure have on economic growth in developing countries?
59. How can countries leverage international partnerships for infrastructure development?
60. What measures can be taken to ensure the sustainability of infrastructure projects?

Target 9.b

61. How can domestic technology development be supported in developing countries?
62. What role does research and innovation play in industrial diversification?
63. How can a conducive policy environment be created for technology development?
64. What strategies can be implemented to support value addition to commodities in developing countries?
65. How can international cooperation enhance domestic technology development?
66. What are the benefits of supporting research and innovation in developing countries?
67. How can government policies promote industrial diversification?
68. What challenges do developing countries face in fostering innovation?
69. How can private sector investments support technology development in developing countries?
70. What impact does technology development have on economic growth in developing countries?

Target 9.c

71. How can access to information and communications technology be significantly increased?
72. What strategies can be used to provide universal and affordable access to the Internet in least developed countries?
73. How can technology be leveraged to promote economic development in developing countries?
74. What role do international agreements play in increasing access to information technology?
75. What are the challenges in providing affordable access to the Internet in least developed countries?
76. How can public-private partnerships support the expansion of information and communications technology?
77. What measures can be taken to improve digital literacy in developing countries?
78. How can access to information technology enhance educational opportunities?
79. What impact does affordable Internet access have on economic growth?
80. How can international cooperation support the expansion of information and communications technology?

SDG 10: Reduced Inequalities

Target 10.1

1. How can countries ensure that the income growth of the bottom 40 percent surpasses the national average by 2030?
2. What strategies can be implemented to boost the income growth of the bottom 40 percent of the population?
3. Why is it important for the income of the bottom 40 percent to grow faster than the national average?
4. What measures can governments take to achieve sustained income growth for the bottom 40 percent?
5. How can income inequality be reduced by focusing on the bottom 40 percent of the population?
6. What are the challenges in ensuring higher income growth for the bottom 40 percent of the population?
7. How can fiscal policies be designed to support income growth for the bottom 40 percent?

8. What role does education play in achieving income growth for the bottom 40 percent of the population?
9. How can social protection programs be targeted to benefit the bottom 40 percent?
10. What impact does income growth of the bottom 40 percent have on overall economic stability?

Target 10.2

11. How can societies promote the social, economic, and political inclusion of all individuals?
12. What steps can be taken to empower marginalized groups by 2030?
13. Why is it important to promote inclusion irrespective of age, sex, disability, race, or other status?
14. How can economic policies be inclusive of all demographics?
15. What are the key indicators of social inclusion?
16. How can technology be used to promote inclusion for all?
17. What are the barriers to achieving social inclusion, and how can they be overcome?
18. How can political systems be reformed to ensure the inclusion of all groups?
19. What strategies can be implemented to empower women economically and politically?
20. How can we measure progress in social, economic, and political inclusion?

Target 10.3

21. What policies can ensure equal opportunity and reduce inequalities of outcome?
22. How can discriminatory laws and practices be identified and eliminated?
23. What is the impact of promoting appropriate legislation on reducing inequality?
24. How can businesses promote equal opportunities in the workplace?
25. What role does education play in reducing inequalities of outcome?
26. How can social policies be designed to ensure equal opportunity for all?
27. What are effective methods for monitoring and evaluating equality policies?
28. How can community programs support the reduction of inequalities?
29. What strategies can be used to promote equal access to healthcare?
30. How can public awareness campaigns contribute to reducing inequalities?

Target 10.4

31. How can fiscal policies be designed to achieve greater equality?
32. What role do wage policies play in reducing inequality?
33. How can social protection policies be improved to promote equality?
34. What are the benefits of adopting progressive taxation systems?
35. How can government spending be aligned with equality objectives?
36. What are the challenges in implementing effective wage policies?
37. How can international cooperation support the adoption of equitable policies?
38. What impact do social protection policies have on poverty reduction?
39. How can economic growth be made more inclusive through policy changes?
40. What strategies can be used to ensure fair distribution of resources?

Target 10.5

41. How can the regulation of global financial markets be improved?
42. What are the key components of effective financial market regulations?
43. How can the monitoring of financial institutions be strengthened?
44. What role do international organizations play in regulating financial markets?
45. How can transparency in global financial markets be increased?
46. What are the challenges in implementing global financial regulations?
47. How can financial market stability be maintained through regulation?
48. What strategies can be used to prevent financial crises?
49. How can developing countries improve their financial market regulations?
50. What impact does strong financial regulation have on economic development?

Target 10.6

51. How can developing countries gain a stronger voice in global economic decision-making?
52. What steps can be taken to enhance the representation of developing countries in international institutions?
53. Why is it important for developing countries to have a say in global financial institutions?
54. How can international economic and financial institutions be reformed to be more inclusive?
55. What are the benefits of increased representation for developing countries?
56. How can transparency and accountability be improved in global institutions?
57. What challenges do developing countries face in global decision-making processes?
58. How can partnerships between developed and developing countries be strengthened?
59. What role do regional organizations play in enhancing representation for developing countries?
60. How can capacity building support the participation of developing countries in global institutions?

Target 10.7

61. What policies can facilitate orderly and safe migration?
62. How can migration policies be designed to be well-managed and responsible?
63. What are the benefits of regular and safe migration?
64. How can countries balance national security with the facilitation of migration?
65. What role do international agreements play in managing migration?
66. How can migrants be protected from exploitation and abuse?
67. What strategies can be used to integrate migrants into host societies?
68. How can remittances be maximized to benefit both migrants and their home countries?
69. What are the economic impacts of migration on host and home countries?
70. How can data on migration be improved to inform policy decisions?

Target 10.a

71. How can the principle of special and differential treatment for developing countries be implemented?
72. What are the benefits of differential treatment for least developed countries?
73. How can World Trade Organization agreements support developing countries?
74. What challenges do developing countries face in the global trading system?
75. How can trade policies be designed to benefit developing countries?
76. What role does foreign aid play in supporting differential treatment for developing countries?

77. How can international cooperation be strengthened to support least developed countries?
78. What are the key components of successful differential treatment policies?
79. How can developing countries be supported in accessing global markets?
80. What impact does differential treatment have on economic development in developing countries?

Target 10.b

81. How can official development assistance be increased to states where the need is greatest?
82. What role does foreign direct investment play in supporting least developed countries?
83. How can financial flows be directed to benefit African countries and small island developing states?
84. What are the challenges in encouraging financial flows to developing countries?
85. How can national plans and programs be aligned with international financial assistance?
86. What strategies can be used to attract foreign direct investment to landlocked developing countries?
87. How can development assistance be made more effective?
88. What are the benefits of increased financial flows to least developed countries?
89. How can donor countries be encouraged to meet their development assistance commitments?
90. What role do private sector investments play in supporting development goals?

Target 10.c

91. How can the cost of migrant remittances be reduced to less than 3 percent?
92. What are the challenges in eliminating remittance corridors with high costs?
93. How can technology be used to reduce the cost of remittances?
94. What role do financial institutions play in lowering remittance costs?
95. How can regulatory frameworks be improved to support cheaper remittance transfers?
96. What are the benefits of reducing remittance costs for migrants and their families?
97. How can international cooperation support the reduction of remittance costs?
98. What strategies can be used to make remittance transfers more efficient?
99. How can awareness be raised about the importance of reducing remittance costs?
100. What impact does the cost of remittances have on the economic well-being of migrant families?

B Compliance with Targets and Data Biases

***** SDG 4: Quality Education *****

	Biases	Addressed Targets	Not Addressed Targets
Locations	U.S., Australia	South Africa, China, Hong Kong	African Countries*, Developing Countries*, Least Developed Countries, Small Island Developing States
Actors	Classroom, Family, Government	Children, Teachers, Youth	The Vulnerable, Persons With Disabilities, Indigenous Peoples, Children In Vulnerable Situations
Focuses	Engagement, Performance, Understanding, Reading, Career, English Language, Curriculum	Quality Primary And Secondary Education, Effective Learning, Quality Early Childhood Development, University, Gender, Literacy, Numeracy, Knowledge, Effective Learning Environments, International Cooperation For Teacher Training, All Levels Of Education, Access, Information Technology, Scientific Programmes	Free Education, Access to Care, Skills, Technical Education/Skills/Programmes, Vocational Education/Training/Skills; Employment, Decent Jobs, Entrepreneurship, Scholarships, Engineering Programmes, Safety, Inclusiveness, Sustainable Lifestyles, Human Rights, Peace, Non-Violence, Global Citizenship, Cultural Diversity
Data/Metrics	Survey, Program For International Student Assessment (PISA), Thematic Analysis, Mean and Standard Deviation (Age), Income, Socioeconomic Status (SES)		

SDG 5: Gender Equality

	Biases	Addressed Targets	Not Addressed Targets
Locations	South Africa, U.S., Australia, New Zealand, Tanzania, India, United Kingdom, Ghana, Urban And Rural Residences		
Actors	Society, Community	Women, Girls ('youth'), Household, Family, Child	
Focuses	Employment, Prevention, Economic Development, Income, Ability, Work-Life Balance	Discrimination Against Women and Girls, Gender-Based Violence, Private Sphere, Care, The Promotion Of Shared Responsibility, Participation, Leadership in Decision-Making in Society, Wealth, Law, Market, Use of technology, Empowerment of Women, Policy and Law for gender equality and empowerment of women and girls	Trafficking, Sexual And Other Types Of Exploitation, Forced Marriage, Female Genital Mutilation, Public Services, Infrastructure, Social Protection Policies, Economic resources, ownership of lands, other forms of property, financial services, Inheritance and natural resources
Data/Metrics	Survey, Cross-Sectional Study, Online Survey, Demographic Health Survey, World Value Survey, National Longitudinal Survey, National Transfer Accounts, Thematic Analysis, Ethnographic Study		The Programme of Action of the International Conference On Population And Development, The Beijing Platform For Action

SDG 10: Reduced Inequalities

	Biases	Addressed Targets	Not Addressed Targets
Locations	U.S., Australia, China	African countries ('Sub-Saharan Africa', 'South Africa'), Developing Countries (United Arab Emirates, South Africa)	Least Developed Countries, Small Island and Landlocked Developing States
Actors	World Benchmarking Alliance, Household	Financial and Economic Institutions (World Bank, OECD), Discriminated individuals (age, gender)	Discriminated individuals (Disability, Race, Ethnicity, Origin, Religion)
Focuses	Efficiency, Integration, Liberalization, Social Justice, Health	Income Growth, Social and Financial Inclusion (Age, Gender), Policies and Practices, Financial And Social Inclusion, Integration, Fiscal ('tax') policy, Social Protection Policy, Wage Protection ('welfare'), Regulation of Financial Markets, Effective Econ and Fin Institutions, Implementation Of Financial Regulation, Migration policies, Foreign Direct Investment, Cost of Migrant Remittance	Discriminatory Laws, Responsible, Orderly, Regular, Safe Migration, planned and well-managed migration
Data/Metrics	econometrics, causal inference/policy evaluation ('endogeneity'), 'long-run', 'short-run', market dynamics, empirical economic research, international trade, inequality measure ('Gini Coefficient'), World Values Surveys		World Trade Organization Agreements

SDG 8: Decent Work and Economic Growth

	Biases	Addressed Targets	Not Addressed Targets
Locations	China	Developed countries (U.S., U.K.), Least developed countries (Sub-Saharan Africa), Developing countries (South Africa)	
Actors	Manufacturing Industry, Battery Industry,	Firm, Youth	micro-, small- and medium-sized enterprises, persons with disabilities, migrant workers, women migrants, those in precarious employment, domestic financial institutions
Focuses	Human Capital, Liberalization, Gender	Sustain per capita economic growth, sustain GDP growth, higher levels of economic productivity (by means of technological upgrading, innovation, high-value added, labour-intensive sectors), development-oriented policies to support productive activities, job creation, innovation, growth of firms, resource efficiency in consumption and production, youth employment, wage inequality, reducing the proportion of youth not in employment, education or training, policies for sustainable tourism that creates jobs	support entrepreneurship, creativity, formalization of micro- and SMES, Access to financial services, environmental degradation, decent work, eradicate forced labour, end modern slavery and human trafficking, protecting labour rights, promote safe and secure working environments; access to banking, insurance and financial services for all

Data/Metrics	Panel data, Survey, dynamic general equilibrium model, Two-country model, Dynamic Panel, Data Envelopment Analysis (DEA), U-shape, Performance, Regression, Likelihood, Long run	Aid for Trade, GDP	10-Year Framework of Programmes on Sustainable Consumption and Production, Global Jobs Pact of the ILO

SDG 9: Industry, Innovation, and Infrastructure

	Biases	**Addressed Targets**	**Not Addressed Targets**
Locations	China, World, United States, Ghana, South Africa	Least developed countries (Ghana) , Developing countries (South Africa, China), African countries (Ghana, South Africa)	landlocked developing countries, small island developing States.
Actors	Manufacturing Industry, Firm, Small- to Medium-sized Enterprises ('SMEs')	Small industrial and other enterprises	

	Biases	Addressed Targets	Not Addressed Targets
Focuses	Construction, A-shares, green infrastructure, green innovation, technological progress, Foreign Direct Investment (FDI), ICT	quality and sustainable infrastructure, sustainable industrialization, markets, regional infrastructure, resource-use efficiency, adoption of clean and environmentally sound technologies (green innovation and infrast) and industrial processes, scientific research, technological capabilities of industrial sectors, sustainable, infrastructure development, technological support, support economic development, access to information and communications technology	inclusive industrialization, reliability and resilience infrastructure, human well-being, equitable access, financial services, affordable credit, value chains, increasing the number of research and development workers per 1 million people, public and private research, financial support, industrial diversification, value addiction in commodities, domestic technology development, research and innovation, access to the Internet

Data/Metrics	Survey, Data Envelopment Analysis, Green Total Factor Productivity, Theoretical framework, Endogeneity, Empirical Analysis, Firm Performance, Long Run, World Bank Enterprise Survey	GDP	