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**Exploring the Usefulness of ChatGPT in Understanding
and Promoting the Concepts of Sustainability:
A Comparative Study**

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Abstract

This study explores the potential benefits of using the ChatGPT artificial intelligence chatbot, an advanced natural language processing model, to structure information, improve clarity and understanding, and promote the concepts of sustainability and carbon footprint. While ChatGPT was released to the public in November 2020, the scientific community, and not only, is already exploring its potential, limitations, capabilities, biases, copyright issues, and implications for legislation or EU regulation of the technology in various articles, books, and studies. This study compares ChatGPT responses to questions on sustainability, sustainable development, sustainability measurement, and economic viability with randomly selected responses from researchers on the Research Gate platform. It also compares its responses to findings from several studies. The aim is to determine in which situations ChatGPT can be more efficient than traditional research to understand the concepts of sustainability and carbon footprint, considering its known limitations. The research methodology is qualitative analysis where the results from ChatGPT were validated by cross-referencing with reliable sources, a critical step to ensure the reliability and validity of the findings. The conclusions of this study validate the potential of using ChatGPT to help enhance environmental awareness and sustainability efforts. Its capacity to provide quick, understandable, and accurate responses to various questions related to sustainability or carbon footprint offers a novel and accessible method to be utilised for educating the public and promoting eco-friendly practices. The purpose of the paper is to present the innovative application of ChatGPT and provide insights into the benefits of using AI-driven tools that could potentially transform the way we approach today's complex environmental challenges.

Keywords: ChatGPT (Chat Generative Pre-Trained Transformer), sustainability, Carbon footprint, environmental awareness.

JEL Classification: Q01, C8.

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1. Introduction

Understanding sustainability has become increasingly critical in today's context of climate change and environmental degradation. Sustainability represents a complex concept, including not only environmental protection, but also economic viability and social equality.

While traditional methods of disseminating knowledge on these topics involve education, media, and expert discussions, the emergence of artificial intelligence offers a new channel for learning and understanding such complex concepts. In particular, ChatGPT, developed by OpenAI, has shown promise in generating human-like text based on provided prompts.

The objective of this study is to evaluate the utility of ChatGPT in understanding and promoting sustainability concepts. We aim to compare the accuracy of the answers provided by ChatGPT with those given by researchers or established scientific studies.

2. Problem Statement

The entire media is talking about the ChatGPT Tool and the exams it passed especially in law (University of Minnesota) (Business Insider, 2023), Google coding interview for the level three engineer (Dreibelbis, 2023), or business management course (Wharton School of the University of Pennsylvania). The documented studies in academic environment started to appear and some literature examples related the possible domains where applicable will be listed below.

The Case Study of ChatGPT presented by Alshater (2022) has a significant potential to enhance academic performance research, economics, and finance in particular. The areas identified were assisting “researchers in data analysis and interpretation, scenario generation, and communication of findings” with the limitations the chatbots have: generalisability, dependence on data quality and diversity, lack of domain expertise, and limited ability to generate original insights.

In her study Fostikov (2023) is presenting very compact the application fields of ChatGPT with different examples and their sources from “humanoid interactive conversation” or universal language translator”, admission of tests, deliver code in different programming languages, to the impact this technology can have on future jobs, the risk of misuse inclusively in research, negative impact in political conflicts, risk of disinformation or unemployment. McGee (2023) was investigating the political impact of the answers provided by ChatGPT, concluding that it “was heavily biased in favour of liberal politicians”.

There are voices mentioning that the layoffs big Technology companies announced starting November 2022 are connected with the ChatGPT presence as presented in the Fortune article (The Fortune, 2023).

The questions raised by Hand and Khan (2020) related to the validation and verification of an AI are nowadays more actual than ever: “(1) Has the objective been properly formulated? (2) Is the AI system free of software bugs? (3) Is the AI

system based on properly representative data? (4) Can the AI system cope with anomalies and inevitable data glitches? (5) Is the AI system sufficiently accurate?"

Another artificial intelligence tool (Chrome Extension: Waldo – see the appendix) was used to identify the relevant literature in this case. Direct search was also performed on platforms like Academia and Research Gate to assure that the search results of AI Tool are correct.

Kuhlman and Farrington (2010) are presenting the history of the concept, the Triple Bottom Line concept together with the well-being concept.

Georgescu-Roegen's Bioeconomics as discussed in the article of Gowdy and Mesner (1998), served as an initial introduction to the concepts necessary for comprehending sustainability measurement indicators.

3. Research Questions / Aims of the Research

Research Question 1: What is the accuracy level of the answers provided by ChatGPT compared to researchers and scientific studies?

Research Question 2: To what extent can ChatGPT contribute to the dissemination of knowledge about sustainability and carbon footprint?

Research Question 3: What are the potential advantages and limitations of using ChatGPT in the context of sustainability and carbon footprint?

The objectives of this research are guided by two key hypotheses:

Hypothesis 1: The answers provided by ChatGPT are comparable in accuracy to those provided by researchers and scientific studies.

Hypothesis 2: ChatGPT can significantly contribute to the dissemination of knowledge about sustainability.

4. Research Methods

The article is an experiment, without intending to make a complete analysis of all the questions. It will only exemplify 3 of the key questions (Biswas, 2017) "What is sustainability? How can we make sustainable development a reality? How can sustainability be measured?") and will present some ChatGPT answers to exemplify the synthesising power the tool has.

The research methodology of analysing the answers for the selected questions from different perspective (AI tool, Researchers as users in Research Gate platform or scientific studies) and compare and analyse the output it's a mixed-methods, which involves a qualitative component of selecting the questions, a semi "crowd researched" method as an aleatory fraction of the researcher answers will be documented and a cross-validation of the results obtain from the AI tool with the ones extracted from studies and researcher.

5. Findings

Biswas (2017) asked the Questions "What is sustainability? How can we make sustainable development a reality? How can sustainability be measured?"

For the first 3 questions there were 5009 answers provided by a great diversity of researcher. Just two pages (1, 39) out of 51 containing their answers were selected to be analysed.

All, the AI technology, research studies, and the researchers are identifying in the definition of sustainability the importance of the three pillars: environmental, social, and economic, they are mentioning the Triple Bottom Line (TBL) framework.

The studies are presenting the historical evolution of sustainability concept and the 3P (People, Planet, Profit).

The answers provided by the ChatGPT Tool were clear structured and short, identifying the consequences and the actors that are expected to take action. It identified ways to be followed by everybody, provided facts-based actions and listed indicators to be applicable to entire society (Ecological Footprint, Life Cycle Assessment (LCA), Social Impact Assessment (SIA), Triple Bottom Line (TBL), Sustainability Reporting).

The researchers were becoming emotional, were identifying particular cases which are supposed to be considered and were looking for solutions involving moral, behaviour-control, and self-responsibility. Finally, they are identifying the need of getting certain indicators (e.g. energy return on energy investment – ERoEI and Triple Bottom Line –TBL) and considered biological-physical factors (water, soil, biodiversity, atmospheric composition, sea level, availability, and cycle of nutrients, etc.) and human triggering factors (demographics, socio-political context, science, technology, education, culture, etc.) They were more precise in identifying the education as an important change factor to measure the sustainability of biophysical or human-triggered factors.

It is essential to mention that while the ChatGPT tool's speed in answering a large number of questions has significant potential, it must be used with caution and any hallucination must be identified and eliminated. This is because artificial intelligence tools can provide erroneous information or make false assumptions. It is also important to consider the sources of data which is analysed. Therefore, it is required to apply a rigorous approach to validate the accuracy of the ChatGPT's responses, ensuring that the study establishes a solid foundation for future efforts to promote sustainable practices.

Figure 1. ChatGPT Answer to the Question: What is sustainability?

What is sustainability?

Sustainability refers to the ability of a system or process to maintain its productivity or viability over time without depleting the natural resources or causing harm to the environment, social or economic systems.

Sustainability encompasses three main pillars: environmental, social, and economic. Environmental sustainability focuses on reducing the negative impact of human activities on the natural environment and preserving natural resources for future generations. Social sustainability refers to the promotion of equity, justice, and human rights, while economic sustainability seeks to promote economic growth while considering the long-term impacts of such growth.

Sustainability is an essential concept in addressing the challenges facing the planet, including climate change, loss of biodiversity, social inequality, and economic instability. To achieve sustainability, individuals, businesses, organizations, and governments must adopt practices and policies that balance environmental, social, and economic needs.

Source: Openai, ChatGPT; <https://chat.openai.com/chat>.

Figure 2. ChatGPT Answer to the Question: How can we make sustainability environment a reality?

How can we make sustainability environment a reality?

There are several ways in which we can make sustainability a reality and ensure that we protect the environment for future generations. Here are some examples:

1. Reduce energy consumption: One of the most significant contributors to carbon emissions is energy consumption. We can make sustainability a reality by reducing our energy consumption through measures such as using energy-efficient appliances, turning off lights and electronics when not in use, and using public transportation or cycling instead of driving.
2. Use renewable energy sources: Investing in renewable energy sources such as solar, wind, and hydro power can help to reduce our reliance on non-renewable sources of energy such as fossil fuels, which contribute significantly to climate change.
3. Adopt sustainable agriculture: Sustainable agriculture practices such as crop rotation, organic farming, and reduced use of pesticides can help to reduce the impact of agriculture on the environment, improve soil health, and promote biodiversity.
4. Reduce waste: We can make sustainability a reality by reducing our waste through measures such as recycling, composting, and reducing our consumption of single-use plastics.
5. Support sustainable businesses: By supporting businesses that adopt sustainable practices such as using renewable energy sources, reducing waste, and promoting fair labor practices, we can help to drive the adoption of sustainable practices across industries.
6. Advocate for policies that support sustainability: By advocating for policies that support sustainability, such as regulations on carbon emissions, incentives for renewable energy adoption, and measures to reduce waste, we can help to create a more sustainable future for all.

These are just a few examples of the many ways in which we can make sustainability a reality. By working together and adopting sustainable practices, we can protect the environment and promote a sustainable future for generations to come.

Source: Openai, ChatGPT; <https://chat.openai.com/chat>.

Figure 3. ChatGPT Answer to the Question: How sustainability can be measured?

How sustainability can be measured?

Measuring sustainability involves assessing the impact of human activities on the environment, social systems, and economic systems, and evaluating whether those activities can be maintained over time without depleting natural resources or causing harm to the environment, social or economic systems. There are several ways to measure sustainability, including:

1. Ecological Footprint: The Ecological Footprint is a tool used to measure the impact of human activities on the environment. It measures the amount of land, water, and other resources required to produce the goods and services consumed by a population. It also takes into account the waste produced by those activities.
2. Life Cycle Assessment (LCA): LCA is a methodology used to evaluate the environmental impact of a product, process, or service over its entire life cycle, from raw material extraction to disposal. It assesses the environmental impact of each stage of the life cycle and provides a holistic view of the product's impact on the environment.
3. Social Impact Assessment (SIA): SIA is a tool used to assess the social impact of a project, policy, or program. It evaluates the potential impact on the community, including changes in employment, income, health, and well-being.
4. Triple Bottom Line (TBL): TBL is a framework that evaluates the sustainability of an activity or organization based on three pillars: environmental, social, and economic. It assesses the impact of the activity on each of these three pillars and provides a balanced view of its sustainability.
5. Sustainability Reporting: Sustainability reporting involves disclosing information about an organization's sustainability performance. It provides stakeholders with information about an organization's environmental, social, and economic impact and enables them to make informed decisions about its sustainability.

These are just a few examples of the many ways in which sustainability can be measured. By using these tools and methodologies, we can better understand the impact of human activities on the environment, social systems, and economic systems and take action to promote sustainability.

Source: Openai, ChatGPT; <https://chat.openai.com/chat>.

The usage of the ChatGPT tool and its advantage of speed in answering a large number of questions have made it possible to utilise the chat method to generate the table below. This table provides a structured overview and lists the sources where the identified tools can be found.

Table 1. Are there any tools the state can use? Put the information in a table: Ways, Description, Tools, Website of the tool.

| Ways | Description | Global Tools | Global Website |
|------------------------------------|--|--|--|
| Develop sustainability policies | Develop policies that promote sustainability, such as regulations on carbon emissions, incentives for the adoption of renewable energy, and measures to reduce waste. | Sustainability policy frameworks | United Nations Sustainable Development Goals |
| Implement regulatory frameworks | Implement regulatory frameworks that ensure that businesses comply with sustainability standards. This can include regulations on environmental impact, labour practices, and human rights. | Regulatory frameworks for sustainability | Global Reporting Initiative (GRI) |
| Encourage sustainability reporting | Encourage businesses to report on their sustainability performance. This can provide transparency and allow the state to monitor and assess the sustainability and cost-effectiveness of businesses. | Sustainability reporting guidelines | Sustainability Accounting Standards Board (SASB) |
| Evaluate life cycle assessments | Evaluate life cycle assessments (LCAs) to assess the environmental impact of businesses. This can help identify areas for improvement and promote sustainable practices. | Life cycle assessment tools | Life Cycle Assessment (LCA) software - SimaPro |
| Use cost-benefit analysis | Use cost-benefit analysis to evaluate the cost-effectiveness of businesses. This can help to determine whether businesses are operating in a sustainable and cost-effective manner. | Cost-benefit analysis tools | Cost-Benefit Analysis Toolkit - World Bank |
| Use certification schemes | Use certification schemes such as Fairtrade, Rainforest Alliance, and Forest Stewardship Council, to ensure that businesses operate in a sustainable and socially responsible manner. | Sustainability certification schemes | Fairtrade International, Rainforest Alliance, Forest Stewardship Council (FSC) |

| Ways | Description | Global Tools | Global Website |
|--------------------------------|--|---|---|
| Monitor and report on progress | Monitor and report on progress towards sustainability goals. This can provide transparency and accountability and allow the state to identify areas for improvement. | Sustainability monitoring and reporting tools | Global Reporting Initiative (GRI), United Nations Global Compact, Carbon Disclosure Project (CDP) |

Source: Based on Openai, ChatGPT downloaded Table; <https://chat.openai.com/chat>.

6. Conclusions

Regarding the accuracy level of the answers provided by ChatGPT compared to researchers and scientific studies, the conclusion is that AI provides structured and objective answers that can serve as a starting point for further research. However, for detailed work and fine-tuning of the results, the skills of researchers are essential. Human input tends to focus on specific aspects of a problem, often representing ethical and moral considerations. However, despite this narrower perspective, I believe that the human role in reviewing AI results and making decisions based on the corrected outcomes will remain crucial in the future.

In terms of the role ChatGPT can play in disseminating knowledge about sustainability, it can be seen as a valuable tool for rephrasing findings and presenting them in a way that aligns with the knowledge level of the intended audience. By leveraging the AI's capabilities, it can bring clarity to individuals who may find it challenging to comprehend the concepts of sustainability and its measurement.

Regarding the question about the advantages and limitations of using ChatGPT within the context of sustainability, advantages are rather generic ones like accessibility and availability of the answers, possibility to handle multiple queries simultaneously and rapidly with no risk of fatigue, contribute to interactive learning experience by responding to user queries in real-time, offers tailored information customised on user's level of knowledge or interest, able to democratise knowledge. Limitations are the dependence of training data, lack of contextual understanding, difficulty with ambiguity (hallucinations), risk of oversimplification, dependence on electricity, ethical and privacy consideration.

Further research can help to better understand these aspects and develop strategies to maximise the benefits while mitigating the limitations.

The first hypothesis that ChatGPT's responses could mirror the accuracy of researchers and scientific studies is somewhat confirmed. While the AI can provide comprehensive details based on existing information and can propose objective KPIs for assessing sustainability, it does not yet have the capacity to generate novel ideas or innovation within this field.

The second hypothesis saying that ChatGPT can significantly contribute to the dissemination of knowledge about sustainability, especially when it comes to differentiated messages based on qualification level of the audience, is validated. Undoubtedly, researchers possess specialised knowledge in this domain, and their input provides a higher level of detail. However, the question remains whether this

level of detail can effectively reach regular citizens, and it is in this context that the valuable capabilities of ChatGPT come into play.

An interesting experiment could involve publishing the answers provided by ChatGPT to the questions posed by Biswas (2017) on ResearchGate and observing the response of researchers to them.

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Appendix

Links to used Tools:

ChatGPT Version 3.5: Carbon Footprint Q&A. (openai.com).

Waldo Extension for Chrome: <https://www.waldo.fyi/>.