

Article

Unveiling Understandings of the Rio Declaration's Sustainability Principles: A Case of Alternative Concepts, Misaligned (Dis)Connections, and Terminological Evolution

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Abstract: The myriad and contested meanings of ‘sustainability’ and ‘sustainable development’ lead many to refer to both concepts as meaningless, oxymoronic, and paradoxical. Yet breaking down such terms to their key principles allows for introducing core concepts, constituent meanings, and associated practices that should enable greater understanding. Despite this, understandings of the interconnected nature of sustainability and sustainable development lack a holistic perspective among students. Exploring this area further, this paper presents findings from a 6-year longitudinal survey at Southern Connecticut State University which asked sustainability studies students ($n = 150$) for their perspectives on the Rio Declaration’s principles of sustainability. Findings from this study elucidate the many disconnections students form predicated on limited real-world global awareness of sustainability projects alongside breaking down broad concepts to those accommodated by contemporary socio-environmental discourse. Conversely, sustainability students consider alternative concepts such as responsibility, cooperation, accountability, intersectionality, and new economic pathways to be of value and necessity as opposed to the sustainability principles encompassed in the Rio Declaration. Summarising the alternative concepts that are preferable to sustainability students, and exploring the principles and implications of related disconnections and terminological evolution, this article argues for increasing engagement from sustainability academics to explore this departure from some of the discipline’s core foundations.

Keywords: Rio Declaration; principles; sustainability; students; terminology



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1. Introduction

The terms ‘sustainable development’ and ‘sustainability’ are frequently overused, misunderstood, and contested [1,2]. Indeed, the term ‘sustainable development’ combines two often contesting principles of endless economic growth and the sustainable use of natural resources [3]. Open to interpretation through different positionalities, philosophies, and political views, it is unsurprising that sustainable development and sustainability more broadly are open to interpretation. Referred to as “a paradoxical compound policy slogan” [4] the idea of sustainable development and its underpinning principles have been criticised on various grounds, with the term thus becoming an oxymoron [5]. Defining sustainability or sustainable development is challenging given that these are complex concepts, open to interpretation, and variable depending on socio-cultural context [6]. Sustainable development issues, by their nature, are complicated due to their interconnectedness and interactions between biophysical and socio-economic systems [7].

The emergence of sustainability principles following the publication of Our Common Future by the United Nations’ World Commission on Environment and Development (1987) [8] has continued to lead organisations and enterprises to develop myriad principles of their own [9]. While many of these principles have created dialogue and supported organisations in the direction of sustainability, their practical effectiveness remains uncertain [9,10]. These principles often frame sustainability as a journey, rather than a destination,

and offer broad, abstract ideals which act as a guide on the journey towards a sustainable future. Shrivastava and Berger [9] state that many principles of sustainability have regard for both short- and long-term impacts as well as local and global consequences, addressing the interdependence and interconnectedness of systems. Often, principles of sustainability are designed to take a holistic perspective on addressing sustainable development and encapsulate the diversity of socio-economic and environmental sub-systems and the interactions among them [1]. Importantly, considerations of the needs of current and future generations are well embedded in many sustainability principles, a property that coincides with fluctuations in ecosystems and natural resource usage [1,9].

The academic literature exploring student perspectives on sustainability principles is surprisingly sparse. What studies exist have investigated the attitudes students hold towards sustainability and sustainable development as concepts, what elements are overlooked, and the role of education for sustainable development (ESD) in facilitating critical thinking and subject-specific skills [3,6,11–13]. Few studies explore sustainability principles, their applicability, and place in the higher education curriculum. While there are exceptions [1], there is little evidence of what sustainability students consider to be the relative importance of the Rio Declaration's principles of sustainability. This is surprising given that the Rio Declaration on Environment and Development is, arguably, a founding document outlining a foundation for sustainability principles. To address this under-researched area of investigation, this study presents findings from a longitudinal survey of 6 years of sustainability studies students' perspectives on the Rio Declaration's principles of sustainability and their importance in implementing sustainable development.

The purpose of this article is, therefore, to identify how undergraduate sustainability students value the importance of principles within sustainability and whether alternative concepts should be integrated instead of core principles as outlined in the Rio Declaration. Sustainable development will continue to be a matter of substantial international concern and interest [14], yet identifying how sustainability principles underpin evolutionary sustainability frameworks warrants further study [15]. This article addresses this call for further research in this area. In doing so, it presents findings from a longitudinal questionnaire conducted with 150 sustainability studies students undertaking a 'Principles of sustainability' course at Southern Connecticut State University. This article is structured as follows. Section 2 summarises a review of the literature on sustainability principles and the disciplinary challenges sustainability studies currently face, particularly outlining the issues surrounding the interconnectedness of sustainability dilemmas. Section 3 outlines the methodological approach taken in this study and outlines the longitudinal quantitative approach to ascertain the importance of sustainability principles within sustainability studies. Section 4 presents the main findings from the survey, indicating the distinctive ways U.S. higher education students believe principles should be integrated within sustainability implementation and what alternative concepts could be applied instead. Section 5 synthesises the main findings from this study and concludes with implications arising and what future studies may wish to explore to widen the scope of research in this under-researched topic.

2. Literature Review

2.1. *The Contested Meanings of Sustainable Development and Principles of Sustainability*

Human development exceeds six of nine of the planetary boundaries, indicating that Earth is now well outside of the safe operating space for humanity [16]. Some of the root causes of this problem lie in excessive natural resource extraction and over-consumption, particularly in wealthier nations with higher carbon-intensive emission profiles [17]. Central to much of the debate around addressing environmental challenges such as climate change is the consensus that changes to human actions, global economics, policymaking, and systems of provision must change. The transition to a sustainable future and society demands innovative solutions to mitigate the impacts of, and adapt to the consequences of, interconnected and complex global environmental challenges. While there have been successive international meetings to facilitate widespread adoption and implementation

of sustainable practices across many systems, these have failed to galvanise meaningful action leading to further consequences associated with the climate crisis [18,19]. Given that there are competing ideologies and approaches to tackle complex global environmental challenges, it is unsurprising that little progress has been made. Alongside this, there is much scepticism, denialism, and a proliferation of delaying tactics that prevent meaningful action [20].

Arguably, the concepts central to understanding the complexities of environmental issues and how to solve them are lacking in both formal and public education [13], such that their translation into discourse and practice are contested and they become meaningless [3,5]. Yet while the concept of sustainable development is contested, understanding its constituent meanings and how it can be effectively implemented can provide meaningful opportunities for learning and elaboration [1]. Consequently, integrating introductory concepts, constituent meanings, and implemented practices within foundational courses in sustainability-related disciplines within higher education can lead to deeper understanding of the interconnected nature, tensions, inconsistencies, and idiosyncrasies of sustainable development [1,21,22]. The academic literature investigating student perspectives of sustainable development has indicated how many students (and teachers) hold many misconceptions and do not hold a holistic view of the concept [12,22]. Indeed, there has been little research on how sustainability-related degrees and their curriculums are comprised and the topics included within them.

Introducing students to the topic of sustainable development and sustainability takes many forms. For example, textbooks exploring the basic foundations of sustainability do not approach the topic from the same positionality. Dresner [23] sets out to address questions of creating a sustainable society, the methods of achieving it, and ways of bringing about profound change in how things are organised, e.g., large-scale systems. Robertson (2021) presents detailed examinations of the state of various environmental issues, e.g., water, ecosystems, and energy, and how individuals, education, and organisations can become agents of change. Both Dresner [23] and Robertson [24] contextualise current issues within the history and evolution of sustainable development, particularly situating this within international conferences and the growth of various objectives, e.g., Millennium Development Goals (MDGs) and Sustainable Development Goals (SDGs). Contextualised within contradictions between growth and the integrity of systems that feed the growth, Jacques [2] discusses the challenges confronting implementing sustainability in practice, how sustainability is measured, the ethical and political dimensions of sustainable development, and case studies of civilisation collapse. With many texts introducing distinctive components of environmental issues, the historical development of sustainability, and the applications of sustainable development, core conceptual understandings of the topic will be inevitably uneven and generally not aligned within one disciplinary framework. Given the breadth of sustainability scholarship, this may not be possible. As Jacques [2] (p. 1) notes, to “attempt a brief introduction that allows for only limited and basic exploration of the complex, contested, and uncompromising set of ideas bound in the notion of sustainability is truly a fool’s errand”.

Identifying what comprises key principles and foundational aspects of sustainable development is a challenge. Principles are a popular way of expressing commitment to specific ideals and offer a starting point for individuals, communities, organisations, and states for addressing sustainability [9]. Principles of sustainability emerged from a socio-historical context of environmental abuses and anxiety over proliferation of nuclear weapons in the 1960s alongside evolving public awareness of environmental issues [9]. Such principles are designed to be general high-level ideas, occupying a high moral ground that can apply broadly to many organisational situations. For example, Buclet and Lazarevic [25] identify three principles to be adopted in favour of the emergence of a new conventional regime towards the objectives of sustainable development: proximity, increase in individual and collective capabilities, and participative democracy. In specific circumstances, the application of underlying principles is precisely targeted towards addressing individual

issues. Muttitt and Kartha [26] identify five principles for equitably curbing fossil fuel extraction, including enabling a just transition for workers and communities, curbing extraction consistent with environmental justice, and doing so where transition costs are shared fairly and have the least social costs. With respect to developing a sustainable circular economy, Velenturf and Purnell [27] present ten principles that aim to redefine the relationship between nature and society, transforming production, co-creating social value with consumers, citizens, and communities, and governance of progress towards sustainable circularity. Introducing students initially to the concept of sustainable development, Fuller [1], initially presented by Mitchell et al. [28] and later by Palmer et al. [29], includes four principles of sustainability: futurity, participation, equity, and environment. Fuller [1] reasons that the model is a useful one as it is simple yet conveys the essence of sustainability-related issues and their interaction. Sustainability principles broadly agreed upon and adopted by nation states include the Rio Declaration on Environment and Development that presents 27 principles on equity, consumption, participation, environmental legislation, and environmental protection.

2.2. Rio Declaration's Principles of Sustainability and the Disciplinary Challenges of Sustainability Studies

The Rio Declaration on Environment and Development was the result of months of negotiation, defining the concept of sustainable development in 27 principles. Applying these principles in an effective combination provides a meaningful approach to achieving a more sustainable global society, environment, and economy [30]. The Rio Declaration, in this sense, is complementary to other methods, clarifying sustainable development and providing the ideal—and internationally agreed upon and supported—perspective [30]. Though the Rio Declaration is not the 'Earth Charter' the secretary-general of the Conference, Maurice Strong, had hoped for, the Rio principles present paradigmatic descriptions, definitions, ethical interpretations, guidelines, and action frameworks for the concept of sustainable development [23,30,31]. Despite the Rio Declaration not being the stronger 'Earth Charter'—designed to be taught in schools, hung in homes, memorised and recited [31]—it was originally intended to be, it remains an important foundation in the global interpretation of sustainable development [30].

The core component of the Rio Declaration are 27 principles, which were arrived at after much arduous negotiation, with the final text being a political compromise [32]. Essentially, the Rio Declaration defines sustainable development through the principles outlined, providing the ideal perspective on how it can be achieved [30]. These 27 principles include the need to eradicate poverty (Principle 5), the need to reduce unsustainable production and consumption (Principle 8), and a commitment to enact effective environmental legislation (Principle 11). The Rio Declaration's principles of sustainability are illustrated in depth in Table 1. While these principles appear to be bold statements of intention to act on specific issues, their translation into law is challenging given that they contain insufficient content to be properly described as 'principles' in a legal sense [32]. Such examples include the vital role of women in environmental development (Principle 20) and the creativity of young people to be mobilised for sustainable development (Principle 21). Indeed, many of the principles are too general to be of real practical help. Dresner [23] outlines that the political compromise reached between developed and developing nations underscores the vagueness of Rio Declaration's principles, e.g., the right to development (Principle 3), and their wider utility in shaping alternative models of (sustainable) development. It is, therefore, unsurprising that the nuances of the contextual evolution underpinning core concepts of sustainable development are frequently disregarded when educating future sustainability scientists [22]. This has implications for wider understanding of contextual and current issues that continue to be barriers to sustainable practices [13], e.g., climate change [16], offshore wind development [33], and sustainable use of marine resources [34].

Table 1. The Rio Declaration’s Principles of Sustainability [35].

Principle 1	Human beings entitled to healthy and productive life in harmony with nature
Principle 2	Sovereign right of states to exploit their own resources pursuant to own policies
Principle 3	Right to development fulfilled to equitably meet needs of present and future generations
Principle 4	Environmental protection shall constitute an integral part of the development process and not in isolation from it
Principle 5	All people shall cooperate in eradicating poverty as a requirement for sustainable development
Principle 6	Needs of developing countries, the least developed, and most environmentally vulnerable shall be given special priority
Principle 7	Cooperation of partnership to conserve, protect, and restore the health and integrity of ecosystems recognising differentiated responsibilities
Principle 8	Reduction and elimination of unsustainable patterns of production and consumption and promotion of appropriate demographic policies
Principle 9	Strengthen capacity-building for sustainability by improving exchanges in science and technology
Principle 10	Issues are best addressed with participation of all concerned citizens at the relevant level
Principle 11	Enact environmental legislation, e.g., standards and management objectives
Principle 12	Cooperate to promote a supportive and open international economic system leading to economic growth and sustainable development in all countries
Principle 13	Develop national law regarding liability and compensation for victims of pollution and environmental damage
Principle 14	Effectively cooperate to discourage or prevent relocation and transfer any activities that cause severe environmental degradation
Principle 15	The precautionary approach be widely applied; lack of scientific certainty should not be used as a reason for postponing cost-effective measures
Principle 16	Endeavour to promote that the polluter should, in principle, bear the cost of pollution
Principle 17	Environmental impact assessment shall be undertaken for proposed activities
Principle 18	Immediately inform other states of any natural disasters that are likely to produce harmful effects on them
Principle 19	Provide prior and timely notification and relevant information on activities that may have adverse transboundary effects
Principle 20	Women have a vital role in environmental management and development—their participation is essential to sustainable development
Principle 21	Creativity, ideas, and courage of the youth of the world should be mobilised to achieve sustainable development
Principle 22	Indigenous people and their communities have a vital role to play in environmental management
Principle 23	Natural resources of people under oppression, domination, and occupation shall be protected
Principle 24	Warfare is destructive to sustainable development. Respect international law by providing protection for the environment in times of armed conflict
Principle 25	Peace, development, and environmental protection are interdependent and indivisible
Principle 26	Resolve all environmental disputes peacefully and by appropriate means
Principle 27	People should cooperate in good faith and in a spirit of partnership

However, this is not to say that the Rio Declaration’s principles are not without merit or use. Importantly, the Rio Declaration encourages global nations to be guided by a new ethic in a collective search for progress and development. The need to sustainably develop in the context of global environmental change is even more pressing now than what it was in 1992, when the Declaration was published. The integration of these broad principles into core concepts, e.g., public participation, precautionary principle, and polluter pays approaches has, over time, been essential to the success of many sustainability initiatives and to holding large-scale organisations to account for environmental degradation [36,37].

Such principles, if embedded in practice, could lead to greater equity and justice arising from the consequences of unsustainable, and the benefits of sustainable, development [38]. The fact that the Rio Declaration is a political compromise does not detract from its significance [32]. Certainly, applying how each of the Rio Declaration's principles may apply to improve interrelated socio-economic and environmental challenges through systems thinking perspectives supports understanding of the dynamics between complex elements of organisations and processes [3,21,39]. However, many studies in sustainability have progressed beyond forensically evaluating principles of sustainability, and rightly so, having transitioned to solutions-oriented and applied research [27,40]. One potential drawback of having done so is that there are few reflections on what core curriculum is being taught to future sustainability scientists.

Much research has focused on the contestability of 'sustainable development' and 'sustainability' as core concepts. Indeed, the definition of sustainable development in Our Common Future [8] is both vague and broad, which can be viewed as both a strength and weakness [23,41]. For example, the needs of present and future generations are likely to be variable and not predicated on the same resources or methods of extraction currently used. Critics of the concept of sustainable development point to the incongruence of environmental and economic merging to effectively reduce environmental pressures, noting that development is viewed as the antithesis of sustainability [1]. Yet, development is not the same as economic growth as it, too, is a multi-dimensional process and embraces multiple concepts (not too dissimilar to sustainability) such as political freedom and social justice [1]. The ambiguity of multi-dimensional concepts and processes is often poorly understood by students. For example, Fuller [1] (p. 15) notes that comments from their students included "I never realised that sustainability involved equity". This suggests that separating concepts as opposed to demonstrating their interconnectedness leads to deficient understandings of sustainability [13]. While the concepts of sustainable development and sustainability remain contested—as they may remain for some time—they are nonetheless useful for introducing critical analyses of multifaceted socio-economic, governance, and environmental challenges that need to be urgently addressed [1].

The Rio Declaration's sustainability principles have been instrumental in the evolution and development of other benchmark standards and objectives, e.g., the Sustainable Development Goals (SDGs) [42,43]. A core example of this is Rio Principle 10 relating to the environmental issues being best addressed with the participation of all citizens. Principle 10 is the embodiment of the effort to create a more informed and empowered public and established the fundamental elements of good environmental governance through access to information, public participation, and access to justice [43]. Such access rights are embedded within the SDGs and are essential to their implementation, e.g., SDG13 Climate Action [42]. Indeed, many of the Rio Declaration's sustainability principles have evolved into subsequent objectives or underlying implementation mechanisms in the Millennium Development Goals (MDGs) and Sustainable Development Goals [42,43]. For example, Principle 4 on environmental protection has evolved into Goal 7 on environmental sustainability in the MDGs, which has since been broadened into Goals 6, 7, and 11 through 15 of the SDGs [42].

Research shows that neither teachers nor students hold a holistic view of the concept of sustainable development or sustainability, particularly where issues of economics and governance lie [11,12,22]. However, the economy is often given priority in national and international policymaking [44]. This is often due to many teachers' shallow and oversimplified understandings of sustainability-related issues and misconceptions of sustainable development generally [45,46]. Frequently, teaching of sustainable development issues often leads to individual analyses of environment, society, and economy leading to a narrow techno-scientific approach which inhibits systems thinking and holistic solutions-oriented approaches to be developed [1,44]. This has been suggested to be the result of how sustainability is presented—at the intersection of environmental, social, and economic pillars rather than situating the economy within social and larger environmental boundaries [22].

While the role of education for sustainable development (ESD) has attempted to bridge gaps in knowledge deficits, misconceptions about SD and how sustainability challenges should be adequately addressed remain [3,6]. Fuller [1] argues that many higher education students are so exposed to the linguistic devaluation of sustainability that they also appear to have accepted the vagueness of the term and are on their way to becoming the next generation of misusers.

It appears that many studies exploring how students frame their perspectives towards what they learn in their degrees and the implications this has for developing subject-specific skills is often consigned to specific education-related journals, e.g., *Journal of Geography in Higher Education* [47,48] and *Environmental Education Research* [13,22]. However, it should be acknowledged that the implications for what and how students learn, the (perceived) importance of core concepts, and the implications this has for teaching, the discipline at large, and how the subject is practiced is of substantial importance to academics, students, and practitioners. This is particularly important for sustainability science and sustainability studies given the wicked problems and challenges that require effective solutions to prevent irreversible global environmental changes [16].

3. Methodology

The aims of this study were to investigate undergraduate students' perspectives on the Rio Declaration's principles of sustainability and their perceived importance in the implementation of sustainable development projects. In doing so, this paper addresses an important gap in sustainability studies research about the importance of foundational sustainability courses taught to undergraduate students and whether the historical context and evolution of sustainability (from the Rio Declaration to the UN SDGs) are valuable and, indeed, necessary. To undertake this study, a short questionnaire was developed with the primary aim of ascertaining student perspectives on the importance of sustainability principles and their application to implementing sustainable development. The objective of survey research is to acquire information about the characteristics, attitudes, and behaviours of a population by administering a uniform questionnaire to a sample of individuals [49,50]. Survey research is useful for eliciting perspectives and attitudes about socio-economic, governance, and environmental issues; it is also valuable for investigating complex social interactions and behaviours [49,51].

Undergraduate students studying the course 'Principles of sustainability' at Southern Connecticut State University were surveyed in the Fall semester of 2018 through 2023, resulting in six consecutive years of data collection. This course is structured in three sections. The first section presents 'The story of sustainability', explaining the progression of sustainable development, its core concepts, and introducing the Rio Declaration's principles. This section draws heavily on the work of Dresner [23] to explain the socio-historical evolution of sustainable development. The second section presents 'Key principles' and how they may be implemented in practice. Taking issues of development, climate change, consumerism, and energy resources as exemplar issues, specific principles are related to case studies of tailored sustainability implementation. Finally, the third section corresponds to 'Applying the principles' in everyday circumstances and specifically critiques sustainability and sustainable development as a concept with respect to impact, scalability, and limitations. Consequently, the breadth and depth of this course lends itself well to evaluating sustainability studies students' perspectives on the importance of sustainability principles.

In total, 150 students completed the self-administered questionnaire over this time-frame, with the main socio-demographic characteristics of respondents presented in Table 2. The survey sample was, however, predominately comprised of white (70%), part-time employed (67%), typically politically left-leaning (45%), female (61%) students aged between 18 and 21 (61%). The questionnaire comprised closed-ended, Likert-scale, and open-ended questions to ascertain student understandings of the Rio Declaration's principles of sustainability and their importance with respect to the implementation of sustainable development projects. The questionnaire was completed online using Qualtrics and conducted after the

first section of the course had been completed. Specifically, the questionnaire comprised 15 questions: the first three related to those principles respondents considered to be the most and least important, the next two related to awareness of sustainability projects and their inclusion of sustainability principles, the following three questions ascertained ranked importance of individual principles, while questions nine and ten questioned whether sustainable development projects should be measured by, and concerned with, other things rather than ‘principles’, and the final five questions corresponded to socio-demographic characteristics of the respondents.

Table 2. Socio-demographic characteristics of respondents.

Year Group	Responses	Age Profile	Gender Profile	Ethnicity Profile	Political Affiliation	Employment Status
2018	<i>n</i> = 32	18–21: <i>n</i> = 21 22–25: <i>n</i> = 9 26–30: <i>n</i> = 0 31+ : <i>n</i> = 2	Female: <i>n</i> = 18 Male: <i>n</i> = 12 Other: <i>n</i> = 2	White: <i>n</i> = 23 Black: <i>n</i> = 3 Hispanic: <i>n</i> = 3 Mixed: <i>n</i> = 1 Other: <i>n</i> = 2	Democrat: <i>n</i> = 17 Republican: <i>n</i> = 3 Other: <i>n</i> = 10 None: <i>n</i> = 2	Employed PT: <i>n</i> = 25 Unemployed: <i>n</i> = 7
2019	<i>n</i> = 38	18–21: <i>n</i> = 23 22–25: <i>n</i> = 7 26–30: <i>n</i> = 5 31+ : <i>n</i> = 3	Female: <i>n</i> = 23 Male: <i>n</i> = 14 Other: <i>n</i> = 1	White: <i>n</i> = 27 Black: <i>n</i> = 3 Hispanic: <i>n</i> = 4 Mixed: <i>n</i> = 1 Other: <i>n</i> = 3	Democrat: <i>n</i> = 15 Republican: <i>n</i> = 6 Other: <i>n</i> = 14 None: <i>n</i> = 3	Employed PT: <i>n</i> = 28 Unemployed: <i>n</i> = 10
2020	<i>n</i> = 18	18–21: <i>n</i> = 15 22–25: <i>n</i> = 2 26–30: <i>n</i> = 0 31+ : <i>n</i> = 1	Female: <i>n</i> = 14 Male: <i>n</i> = 3 Other: <i>n</i> = 1	White: <i>n</i> = 10 Black: <i>n</i> = 3 Hispanic: <i>n</i> = 4 Mixed: <i>n</i> = 0 Other: <i>n</i> = 1	Democrat: <i>n</i> = 11 Republican: <i>n</i> = 0 Other: <i>n</i> = 6 None: <i>n</i> = 1	Employed PT: <i>n</i> = 9 Unemployed: <i>n</i> = 9
2021	<i>n</i> = 18	18–21: <i>n</i> = 9 22–25: <i>n</i> = 7 26–30: <i>n</i> = 2 31+ : <i>n</i> = 0	Female: <i>n</i> = 11 Male: <i>n</i> = 7 Other: <i>n</i> = 0	White: <i>n</i> = 12 Black: <i>n</i> = 0 Hispanic: <i>n</i> = 3 Mixed: <i>n</i> = 2 Other: <i>n</i> = 1	Democrat: <i>n</i> = 9 Republican: <i>n</i> = 0 Other: <i>n</i> = 9 None: <i>n</i> = 0	Employed PT: <i>n</i> = 12 Unemployed: <i>n</i> = 6
2022	<i>n</i> = 23	18–21: <i>n</i> = 11 22–25: <i>n</i> = 7 26–30: <i>n</i> = 1 31+ : <i>n</i> = 4	Female: <i>n</i> = 15 Male: <i>n</i> = 8 Other: <i>n</i> = 0	White: <i>n</i> = 18 Black: <i>n</i> = 2 Hispanic: <i>n</i> = 1 Mixed: <i>n</i> = 2 Other: <i>n</i> = 0	Democrat: <i>n</i> = 7 Republican: <i>n</i> = 3 Other: <i>n</i> = 13 None: <i>n</i> = 0	Employed PT: <i>n</i> = 14 Unemployed: <i>n</i> = 9
2023	<i>n</i> = 21	18–21: <i>n</i> = 12 22–25: <i>n</i> = 6 26–30: <i>n</i> = 1 31+ : <i>n</i> = 2	Female: <i>n</i> = 11 Male: <i>n</i> = 8 Other: <i>n</i> = 2	White: <i>n</i> = 16 Black: <i>n</i> = 0 Hispanic: <i>n</i> = 5 Mixed: <i>n</i> = 0 Other: <i>n</i> = 0	Democrat: <i>n</i> = 8 Republican: <i>n</i> = 2 Other: <i>n</i> = 11 None: <i>n</i> = 0	Employed PT: <i>n</i> = 13 Unemployed: <i>n</i> = 8
Total	<i>n</i> = 150	18–21: <i>n</i> = 91 22–25: <i>n</i> = 38 26–30: <i>n</i> = 9 31+ : <i>n</i> = 12	Female: <i>n</i> = 92 Male: <i>n</i> = 52 Other: <i>n</i> = 6	White: <i>n</i> = 106 Black: <i>n</i> = 11 Hispanic: <i>n</i> = 20 Mixed: <i>n</i> = 6 Other: <i>n</i> = 7	Democrat: <i>n</i> = 67 Republican: <i>n</i> = 14 Other: <i>n</i> = 63 None: <i>n</i> = 6	Employed PT: <i>n</i> = 101 Unemployed: <i>n</i> = 49

The survey sample of primarily sustainability students at a public university was chosen specifically to gather information over 6 years to obtain longitudinal data that would be broadly representative of undergraduate students specialising in sustainability studies. Ensuring that sufficient numbers of students completed the questionnaire required further years of student participation to ensure meaningful findings and that conclusions could be drawn. This sample of 150 respondents over 6 years does not look to evaluate the evolution of understanding of the topic of sustainability as little distinctions between

the years were identified. Rather, this sample was chosen as it illustrates a departure from sustainability principles and their importance in sustainability studies. Despite this, there are peculiarities with the study population that inevitably shape perspectives that could be framed as a limitation, notably that the sample comprised those who were broadly aware of, and literate in, the language of sustainability. Nevertheless, little research has been done in this area as other research has explored general principles of sustainability [1] but not the Rio Declaration's principles in their entirety. Following data collection, collation and coding, the principal tools used to analyse the data and produce descriptive statistics and thematic analysis were a combination of quantitative and qualitative techniques [52]. The benefit of using Qualtrics is that it allows for initial data analysis to be undertaken using its core features, yet the responses to open-ended questions were analysed following the six-stage method outlined by Braun and Clarke [52]. Rather than using NVivo, the thematic analysis was done 'by hand' to get a better 'feel' for the data. This is a well-applied analytical approach to analyse qualitative data thematically [52].

There is value in reflecting on the methodology applied in this study. Primarily, conducting a questionnaire allows for breadth of understanding of a particular topic [49]. This is particularly valuable where few studies have explored similar issues in related environments [50]. Given that few studies have been undertaken in this area, the findings generated as part of the thematic analysis illustrate distinctions in the ways that students view core sustainability principles. Applying a quantitative approach to understanding the importance of sustainability principles within sustainability studies over a longitudinal period has generated substantial data. As part of this study, many of the questions also allowed for open-ended comments to be provided, thus minimising the failings of a potentially 'reductionist' approach [50]. Additionally, a questionnaire may limit the justifications as to why students hold their opinions, instead restricting their responses to broad categories of agreement or disagreement [49]. There are, however, some important limitations of the methodological approach applied in this study that other studies may wish to refine, primarily that an explorative qualitative approach was not first undertaken to better define appropriate questions. Other limitations of the methodology applied in this study may align with a lack of triangulated results between methodologies. Conducting mixed-methods research approaches can provide both breadth and depth of understanding on a topic [50,51], and future studies may identify this as an appropriate next step in this research agenda. Departing from this methodology, and addressing its limitations, future studies may apply a qualitative approach to understanding the value and importance of sustainability principles applied in the teaching of sustainability studies to elucidate deeper understandings.

4. Results and Discussion

4.1. *The (Un)Importance of Sustainability Principles*

Students were first asked about what the most and least important principles of sustainability were to them. Both questions were open-ended questions and received various responses from students ranging from specific principles from the Rio Declaration to expanded answers. Regarding the most important principles, only half of students identified principles that correspond to those in the Rio Declaration. Principles 1, 3, 4, 15, and 21 were commonly referenced from respondents who identified those from the Rio Declaration. Detailed responses indicated that a minority of students did have a nuanced perspective of the breadth of sustainable development. For example, R111 commented that "eradicating poverty, the precautionary principle, and recognising indigenous people's role in sustainability are the three most important principles of sustainability. I think that eradicating poverty will allow for people who have their basic needs met to advocate for other issues they are passionate about and put their time into other things that they enjoy that may directly benefit the environmental movement. I think the precautionary principle is also essential because I cannot count the amount of times growing up that I listened to commercials or news broadcasts about unintended consequences of a prod-

uct's use on people's health and the environment. Exercising caution can help prevent undoable damages to the environment and people. Finally, recognising indigenous people's knowledge of sustainability is important to me because in many cases they are the experts on their local environment. Their knowledge is indispensable when it comes to making environmental and sustainability decisions". This detailed quote, indeed, makes several interlinkages between various challenges that need addressing and identifies that the principles of sustainability have applicable value as a result. Where sustainability students are considering actual principles that are of importance, they are identifying the potential and actual interconnectedness between sustainable development dimensions [22].

However, the remaining half of respondents who did not identify actual sustainability principles rather identified practices including conservation, preservation, cooperation, equity, justice, equality, educated involvement, economic development, access to food and water, maintaining biodiversity, sustainable wildlife management, sustainable energy, and adaptation. There was little agreement in these responses as to what were the most important practices given the wide array of identified actions. Given that the questionnaire was administered after students had been introduced to the Rio Declaration in a course dedicated to the 'Principles of sustainability', it is somewhat surprising that only half of the sample population identified sustainability principles. Lord and Baviskar [53] note that university graduates do not develop enduring understandings of the subject matter they've learned in college, and when questioned can give little to no explanation or provide plausible but erroneous answers to questions concerning information they had previously learned in class. The distinction here, however, is that students currently taking the class could not provide an adequate answer to a question they were currently studying. This may have implications for sustainability overall if foundational concepts and values in sustainability science are easily forgotten or misconceived.

When asked to indicate which principles were less important, a similar finding occurred with less than half of respondents identifying those from the Rio Declaration. Those principles that were identified as being less important were Principles 2, 16, 19, 24, 25, 26, and 27. Most comments, however, did not correspond to principles but broad economic dimensions of sustainable development. Many responses to this open-ended question simply mentioned 'economics', 'the cost', 'fair taxation', 'equal distribution of wealth', 'economic activity', 'economic vitality', or 'economic development'. In justifying this position, detailed comments revolved around "economic growth is more important than environmental impacts because without money we can't save the planet" (R83). This reinforces long-held beliefs that economic growth and environmental protection are at odds with one another [1]. Some students reinforced their perspectives towards the economic dimensions of sustainability further, e.g., "polluter pays principle—they shouldn't have been polluting in the first place (I don't really know how to answer this question without sounding like an absolute a**hole)" (R143). Interpreting this comment and its reflection is challenging as it appears on the face of it to be an ardent support of carbon neutrality and a sentiment of strong anti-pollution activities. Yet, it may also be a sentiment of anti-capitalism and the role of disincentives to curb pollution.

Further expanded comments include those relating to developing countries and their socio-economic conditions, e.g., "special treatment of developing countries is least important because we should not be considering other countries' growth than our own as they are not as important as us, financially or socially" (R64). The undertones of this comment reinforce notions of a socio-political hierarchy and importance when compared to developing countries that have evolved in U.S. public discourse, e.g., 'America First' [54,55]. Indeed, comparison in development status is an important consideration in sustainability, primarily to eradicate poverty and the environmental stresses that result, yet the transactional and sovereigntist view of U.S. interactions in the global sustainability order as illustrated here may perpetuate hyper-competitiveness based on economic growth and societal development [55]. This is one example of the many disconnections that some sustainability students identify, underpinned by discourses of development and potential attitudes that

are anti-environmental legislation to reduce environmental impacts. What these perspectives do reinforce is that governance and economic dimensions of sustainable development are not holistically integrated [11,12,22].

Asked how important the principles of sustainability are to students personally, 95 students identified they were ‘very important’, 50 indicated they were ‘important’, and the remaining 5 stated they were ‘neither important nor unimportant’. No students chose the categories ‘somewhat important’ or ‘not important at all’. Despite overwhelmingly considering the principles to be personally important, it is nevertheless important to explain potential motivations for these answers, which may be misleading. Indeed, it is possible that a level of social desirability bias may exist, dictating that sustainability studies students *should* be pro-sustainability [56,57]. However, responses to later questions may indicate support for such highly positive levels of personal importance given to sustainability principles. This is because students align broader pro-social concepts and issues to sustainability, e.g., cooperation, responsibility, inequality, accessibility, prosperity, and equity. Rather than sustainability being an umbrella term, individual, yet related, concepts are viewed as paramount above specific principles rather than comprising a holistic view of sustainable development [12,22].

4.2. Importance of Rio Declaration’s Sustainability Principles

Students were asked to rate (from five being ‘very important’ to one being ‘not at all important’) the importance of each principle from the Rio Declaration. Table 3 presents the average, median, modal, high, and low scores for each principle based on all 150 students responding. The highest-rated principles were 4 (environmental protection), 7 (cooperation to conserve ecosystems), 1 (people living in harmony with nature), and 8 (sustainable production and consumption). Interestingly, Principle 7 did not receive any ratings below a three indicating that no student believed it to be unimportant. Conversely, Principles 2 (sovereign right of states to exploit own resources), 15 (the precautionary principle), and 6 (the needs of developing countries to be given special priority) were rated the lowest in terms of importance.

Table 3. Importance of Rio Declaration Sustainability Principles.

Principle	Average	Median	Mode	High	Low
1. Human beings entitled to healthy and productive life in harmony with nature	4.56	5	5	5	1
2. Sovereign right of states to exploit their own resources pursuant to own policies	2.9	3	3	5	1
3. Right to development fulfilled to equitably meet needs of present and future generations	4.43	5	5	5	1
4. Environmental protection shall constitute an integral part of the development process and not in isolation from it	4.63	5	5	5	1
5. All people shall cooperate in eradicating poverty as a requirement for sustainable development	4.25	5	5	5	1
6. Needs of developing countries, the least developed, and most environmentally vulnerable shall be given special priority	4.14	4	4	5	1
7. Cooperation of partnership to conserve, protect, and restore the health and integrity of ecosystems recognising differentiated responsibilities	4.62	5	5	5	3
8. Reduction and elimination of unsustainable patterns of production and consumption and promotion of appropriate demographic policies	4.52	5	5	5	2
9. Strengthen capacity-building for sustainability by improving exchanges in science and technology	4.28	4	5	5	2
10. Issues are best addressed with participation of all concerned citizens at the relevant level	4.20	4	5	5	1

Table 3. Cont.

Principle	Average	Median	Mode	High	Low
11. Enact environmental legislation, e.g., standards and management objectives	4.46	5	5	5	2
12. Cooperate to promote a supportive and open international economic system leading to economic growth and sustainable development in all countries	4.24	4	5	5	2
13. Develop national law regarding liability and compensation for victims of pollution and environmental damage	4.35	5	5	5	1
14. Effectively cooperate to discourage or prevent relocation and transfer any activities that cause severe environmental degradation	4.20	4	5	5	2
15. The precautionary approach be widely applied: lack of scientific certainty should not be used as a reason for postponing cost-effective measures	3.94	4	5	5	1
16. Endeavour to promote that the polluter should, in principle, bear the cost of pollution	4.36	5	5	5	2
17. Environmental impact assessment shall be undertaken for proposed activities	4.28	4	5	5	3
18. Immediately inform other states of any natural disasters that are likely to produce harmful effects on them	4.42	5	5	5	2
19. Provide prior and timely notification and relevant information on activities that may have adverse transboundary effects	4.20	4	5	5	2
20. Women have a vital role in environmental management and development—their participation is essential to sustainable development	4.46	5	5	5	1
21. Creativity, ideas, and courage of the youth of the world should be mobilised to achieve sustainable development	4.49	5	5	5	1
22. Indigenous people and their communities have a vital role to play in environmental management	4.46	5	5	5	1
23. Natural resources of people under oppression, domination, and occupation shall be protected	4.32	5	5	5	1
24. Warfare is destructive to sustainable development. Respect international law by providing protection for the environment in times of armed conflict	4.20	5	5	5	1
25. Peace, development, and environmental protection are interdependent and indivisible	4.24	4.5	5	5	1
26. Resolve all environmental disputes peacefully and by appropriate means	4.34	5	5	5	1
27. People should cooperate in good faith and in a spirit of partnership	4.43	5	5	5	1

The findings here are of particular interest in the context of responses to other questions in the survey. Perhaps most notable are the ratings of Principles 2 and 6 as the least important, and the potential reasons for their being considered unimportant. Responses to other questions consistently highlighted that special treatment to developing countries was not an essential consideration for sustainability given the perception that those states were not as important as developed countries both “financially and socially” (R64). Consequently, there is a substantial misaligned disconnection about one of the core tenets of sustainable development. Principally, to eradicate poverty and promote sustainable production and consumption of states’ own resources is one of the cornerstones of sustainable development [8,23]. Such attitudes fail to see the holistic view of the interconnectedness of sustainable development and constitute a failure to distinguish broader socio-environmental and developmental contexts of sustainability challenges [1]. This finding stands out particularly given that later responses to questions in the survey

highlighted aspects of justice. It is clear that these considerations are solely focussed on justice dilemmas in the United States, and not in developing nations. Conversely, the interrelationship of rating Principles 4, 7, 1, and 8 as most important places concern for ecosystem conservation and the protection of the biophysical environment as prevalent considerations for sustainability students that should be achieved through sustainable production and consumption. This global systems approach stands in contrast to those principles rated least important and provides distinctive perspectives and views towards the importance placed on environmental challenges and socio-economic issues.

4.3. Integrating Sustainability Principles in Sustainable Development

Though the importance of sustainability principles personally and more broadly were noted in very positive terms, there was a distinctive lack of awareness of existing sustainability projects and inclusion of any principles. Only 61 students (40.6%) were aware of any sustainability project. Of these responses, over 80% were aware of campus-level initiatives, e.g., solar panels, community garden, and food recovery programme led by the sustainability office, or a research project tied to individual staff members in specific areas, e.g., blue economy. This demonstrates that the minority of students who indicated that they were aware of a project were aware of immediately local projects that they had some level of interaction with. Interestingly, those who mentioned a research project coordinated by an academic staff member attempted to contextualise this with their own personal involvement when asked whether such projects incorporate any principles of sustainability and how these are achieved, e.g., “constantly having internal meetings to make sure we are abiding by our ethos” (R89). Those who did not mention an on-campus or staff research project were aware of broader projects in other states and countries, e.g., Babcock Ranch solar-powered town [58] and Surfers Against Sewage [59]. Again, however, awareness of these projects was due to personal involvement at some level, e.g., an international student aware of an ocean activist project in the UK or having family members at a solar-powered town in Florida. This finding is interesting as it demonstrates that while sustainability students are positive about conceptual issues, their awareness of real-world applications is minimal. This has implications for the state of sustainability studies more broadly. Contributing additional subjects to sustainability studies, e.g., geography are predisposed to the integration of case studies, could ensure that students are able to relate conceptual material to real-world examples [60]. In this case, very few students could identify a project beyond the university itself. This lack of broader awareness may underpin why there is a deficiency in developing a holistic view of sustainable development in practice [1].

Following this, when asked whether projects should incorporate sustainability principles, 66.6% of respondents ($n = 100$) indicated they ‘definitely’ should, with a further 26.6% ($n = 40$) indicating they ‘probably’ should. Only 10 students indicated ‘maybe’ in response to this question, with no respondents indicating they should not. This overwhelmingly positive response to incorporating sustainability principles further highlights the constructive value students place on these concepts. Students justified their responses with additional comments. Some suggested that projects must include at least one principle to be defined as effective, e.g., “successful sustainability projects will be based on at least one principle of sustainability otherwise would probably not be very effective” (R23) and “a standard of requirements/policies should be expected for sustainable initiatives” (R58). These responses exemplify that inclusion of principles is paramount as it provides validation and a set of guidelines that are foundational if projects are to be successful and effective. Constructing concepts of ‘success’ and ‘effectiveness’ is intriguing here, given that sustainability is predicated on robustness against shocks (to continue over time) and effectiveness (to thrive) [61]. Others framed similar responses as further questions around the classification of being ‘sustainable’ if principles were not included, e.g., “if a sustainability project does not follow its own principles, is it actually sustainable?” (R25) and “how could a sustainable project not include sustainability principles? That’s like having a bake sale without selling baked goods” (R55).

Further justification within the comments provides context as to why students consider sustainability principles to be useful, e.g., “I think it is necessary to follow the principles of sustainability if we expect to make any progress whatsoever. I strongly believe that the principles of sustainability make very valid points and are a good starting point, so they should be followed and incorporated” (R130). Here, R130 indicates the necessity of applying principles as a beginning for sustainable development to set a progressive trajectory. It is interesting that contextualised in this terminology, the concept of ‘progress’ is aligned to the notion of forward improvement. Justified in these terms, principles are viewed as an enabler of sustainable development [9], at least one part of the journey—the beginning. In slight contrast, some comments referred to the extent to which projects focussing on principles would detract from innovation, e.g., “the principles are helpful for organised thinking about sustainability, but they could be considered an arbitrary hindrance to progress when they distract from creative, effective solutions and ideas” (R41). Comments such as these reinforce the tailored nature of implementing sustainable development and that flexibility, adaptability, and inclusion are essential to the success of projects [62,63]. Heavy focus on guidelines may be restrictive, particularly where social sustainability projects are concerned. While most comments did focus on the relationship between sustainability principles and their applications, a minority of comments focussed on the immediate task of completing the questionnaire, e.g., “because that is what the course is about, should include the main topic” (R14). In this case, the respondent failed to look beyond the act of simply completing the questionnaire and tie the response to the course they were studying.

4.4. Alternative Concepts, Misaligned (Dis)Connections, and Terminological Evolution

Students were explicitly asked whether other concepts should be incorporated into sustainability projects aside from the principles outlined in the Rio Declaration. Most students ($n = 91$, 60.6%) indicated that they did not consider other concepts and believed that the Rio principles were sufficient. The remaining 59 students (39.4%), however, agreed that other concepts were more important. The response to this open-ended question is revealing as it highlights alternative concepts (as shown in Figure 1) in addition to misaligned sustainability (dis)connections and terminological evolution, principally around the following: responsibility and cooperation, legislative-enforced penalties, new economic models, ecosystem services, intersectionality, and longevity.

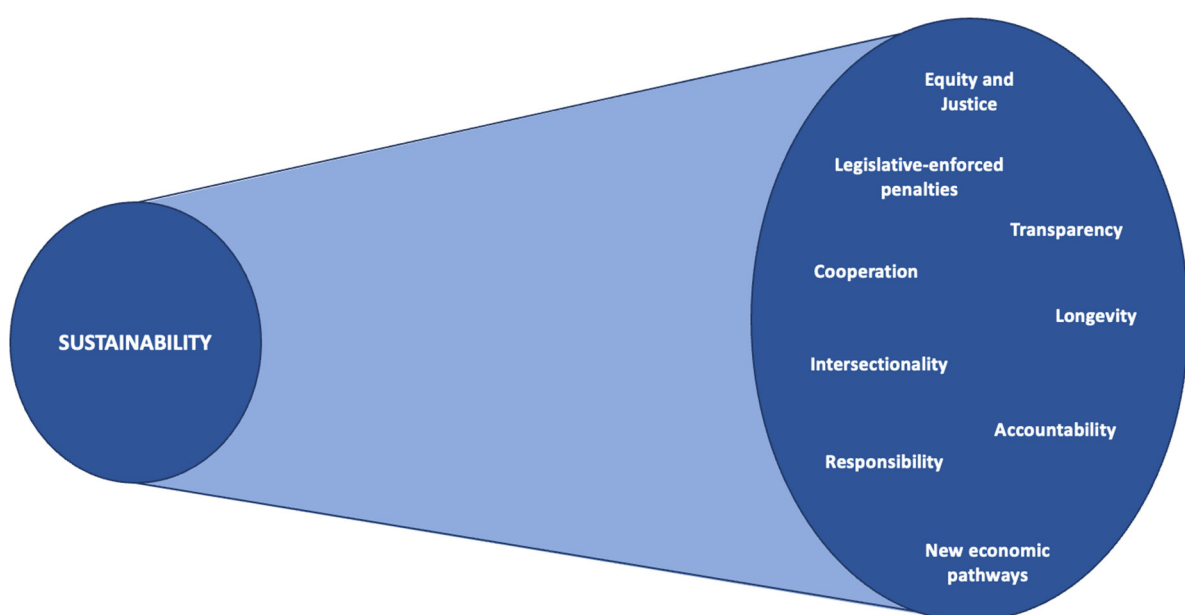


Figure 1. Alternative Concepts to Sustainability.

The theme of ‘responsibility and cooperation’ was highlighted by respondents to indicate that actors, particularly governments at various levels, should prioritise sustainable action, e.g., “many of these concepts referred to a group of people, however I would include the concept that it’s a global effort” (R9) and “cooperation from all corners of the globe, sustainable action should not be a choice because we will all benefit” (R50). The framing of collective action towards shared sustainable objectives is also contextualised as having multiple benefits and therefore unsustainable activities should be prohibited. Some comments specifically called for the proportionate participation of developed nations to engage with sustainable development, e.g., “I think there needs to [be] a concept about required participation by developed countries or at least the idea about equity not just presented by Principle 3” (R42). Here, comments noting equity call for equitable participation in action as opposed to equity within or between generations. Other students mentioned that responsibility should also encompass accountability, e.g., “I think that the state itself, with the local government, should follow up with the project so the local government can hold the project accountable like what we see with the Paris Agreement” (R81) and “The principles could focus more on accountability, manufacturing practices and consumption limits. Wealth inequality also plays a massive role in the problems we are facing today around the world. That leads back to the corporate and government level lack of accountability and leadership” (R132). It is interesting that concepts of responsibility and cooperation are present given that Principles 5, 7, 9, 12, 14, and 27 make explicit reference to cooperation, while Principle 11 refers to the enactment of effective environmental legislation. However, actively ensuring visible accountability and transparency for actors who fail to participate in sustainable activities [36,37] is the crux of this terminological evolution.

Related, is the concept of ‘legislative-enforced penalties’ and ‘new economic models’ as methods of ensuring sustainable action. Students suggested that appropriate enforcement and repercussions were needed if actors did not follow the Rio principles, e.g., “financial responsibility and repercussions about not following principles to the best of ability” (R35) and “legislative actions penalties/fines for enforcement” (R39). Responses such as these may arise as some indicated that “fossil fuel companies get away with literally killing and burning our planet and they still continue to make profits but if I burnt down a home or forest I’d be arrested” (R102). This comparison between large polluting companies and individual acts of destruction may appear to be extreme yet it illustrates the extent to which penalties for climate-related hazards are enforced or not. Going further than Principle 16, comments such as these explain that expanding the role of legislation should consider the damage accrued by large-revenue, polluting companies and enact penalties accordingly [64]. Expressions of support for legislative-enforced penalties align with the notion of restorative justice [64]. Concepts such as restorative or climate justice were not mentioned as overarching frameworks or mechanisms for ensuring fossil fuels companies are held accountable for disproportionate carbon emission pollution [26], instead focusing on judicial approaches alone. Given that the university has a broad social justice mission [65] and was the first in the United States to declare a climate emergency, a fact which is well advertised to students [66], it is surprising that concepts of energy or climate justice were not mentioned. Despite this, respondents aligned penalties and legislation to be incorporated within ‘new economic models’, e.g., “I think that there should be circular economy incorporated into a more sustainable systems thinking” (R123). The neoliberal economic regime that the global society currently remains in exacerbates resource over-extraction and material consumption [67], yet alternative economic models as proposed by Raworth [68] may provide avenues for sustainable economics, establishing dynamic systems, and regenerative and distributive environments.

One key area of terminological evolution departing from the Rio principles is that of ‘intersectionality’ and its broader considerations of those disproportionately impacted by sustainability challenges. Many responses focussed on this concept for inclusion, e.g., “sustainability should include special protection of the current youth” (R20), “I think that in addition to the principles regarding youth, women, and Indigenous people, there

should be a principle about intersectionality that includes more minorities, such as those in economic classes who are disproportionately affected by climate change" (R79), and "the accommodations of the disabled and the mentally and physically ill should be taken into consideration to make sure the projects will not cause them harm" (R80). These comments demonstrate that sustainability students consider prevalent socio-cultural dimensions of sustainable development, specifically where Indigenous communities, age, gender, race, and economic class are concerned. These components, framed within the context of climate change, refer to the concepts of environmental and climate justice [69]. Though climate justice was not explicitly mentioned, it is unsurprising that this cohort of students would inherently frame social justice issues to environmental dilemmas given that this is a priority of the institution [65].

Some respondents indicated that 'ecosystem services' and how the biophysical environment is managed should be more a priority of sustainability projects than broad principles. Themes of fragility and prosperity underlie this framing of ecosystem services with respondents noting, e.g., "concepts of ensuring the continued prosperity of other species and their habitats" (R103), "some sort of principle regarding a certain amount of land conservation would be ideal. Biden's 30by30 plan comes to mind. Conserving and or preserving physical land is in the long-term interest of all peoples" (R111), and "I think greater focus should be placed on the importance of the interconnectedness and fragility of the ecosystem, including all living beings, not just humans. Prioritising ourselves and not recognising this critical balance is the driver of the environmental problems we now face" (R113). A focus on environmental management as the basis of sustainability shares part of the focus of Principle 4, corresponding with environmental protection. Yet, these comments indicate that aspects of longevity should be conceptualised in the interest of all living beings. Conceptualising in this way, students may align with similarities from Aldo Leopold's Land Ethic, a distinctive environmental ethical framework [69,70]. Again, this is an example of terminological evolution where underlying issues of fragility, prosperity, and management expand upon the Rio Declaration's sustainability principles.

Contrary to responses to earlier questions, when asked whether sustainable development projects should be more concerned with other elements aside from principles, a majority of students (56.6%, $n = 85$) agreed with the statement. Justifying this position, students noted that principles should be the foundation that builds into meaningful action for sustainability projects, e.g., "they're the foundation and while some projects may choose to focus on that, others are ready to build on that" (R5), "real, possible and concrete ideas on how to incorporate cost-effective and sustainable actions" (R37), and "it should be focussed on actions taken to support the principles, not the principles themselves" (R62). It is interesting that students took this opportunity to indicate that principles should be a supporting guide, and not the focus, for action. These are sound observations as this aligns well with the value of sustainability principles overall—that they provide an ideal perspective on how it can be achieved [9,30].

Some respondents expanded on this, noting that sustainability initiatives should be more concerned with specific outcomes irrespective of whether they are successful or result in failure, e.g., "implementing the principles, acting to achieve either success or failure and then moving forward having learned from the success or failure" (R41) and "I think the primary concern should be the outcome. At the end of the day, sustainable communities could be built without ever referencing the principles of sustainability. Most things, like equity, equality, youth and female involvement etc. are just normal things for a community to include" (R132). Curiously, some students indicated that concepts and practices such as equity, youth participation, and female empowerment are not required to be principles as they are more generic than sustainability initiatives—going so far as to label them 'normal'. Sustainability projects are, by nature, tailored to the particularities of implementation in various contexts [27], while some projects do not always encompass elements of equity and equality [71,72]. Such concepts corresponding to justice are often taken for granted and often assumed to be integrated yet are commonly overlooked [73]. This disconnection

between core concepts and applicability may stem from a lack of awareness of real-world examples of initiatives beyond immediate locations as demonstrated from responses in earlier comments. Furthermore, rather than providing genuine reflection on the specific contexts of implementation of broad concepts, it may appear that such comments reflect little more than accommodation to contemporary and popular socio-environmental consciousness promoted frequently through social media channels.

Other comments suggested a broader approach to sustainability projects beyond principles, e.g., “people, people, environment, then people again with a sprinkle of economy” (R56) and “sustainability projects should be concerned with the qualities of values that are being added into these projects. People need to value the process that they are involved with instead of just moving along without caring” (R75). Put simply, preferences to focus on the social components of sustainable development are at the core of the Rio Declaration, notably Principle 1. Additionally, references to ‘valuing the process’ relate to the notion that sustainability is a journey [9] and the values and lessons that these may impart along the way. Inevitably, diverse sustainability-related approaches require experimentation and innovation that are often tailored to diverse environmental and socio-cultural contexts [27,74]. In this way, pursuing various solutions and pathways can mitigate risks in case a solution does not deliver the anticipated benefits. References to ‘moving along without caring’ may indicate that deeper public engagement with sustainability is required for meaningful sustainable development and broader social and transformational change [75].

5. Concluding Discussion

Sustainability science requires a fundamental shift in how coupled socio-economic and environmental problems are addressed, which necessitates specialists to expand beyond their disciplinary perspectives to collaboratively cooperate if systemic challenges underscoring unsustainability are to be effectively, meaningfully, and successfully managed. These challenges are myriad, requiring tailored solutions underpinned by foundational principles central to sustainability [9,30,74]. This shift, however, demands a corresponding shift in education to equip sustainability students with the theoretical concepts, skills, and methods they need to address these contemporary challenges [21]. Within the context of the findings presented in this article, however, this is a key point. The concepts of ‘sustainable development’ and ‘sustainability’ are not static, but rather fluid and dynamic [3,6]. Indeed, the concepts comprising sustainability are just as contested and not well understood, while others that are entrenched in public discourse are frequently mentioned as mere lip-service to contemporary socio-environmental consciousness.

Applying a questionnaire methodological approach, this study examined undergraduate students’ perspectives on sustainability principles—specifically those incorporated as part of the Rio Declaration—and their perceived importance in the implementation of sustainable development. The findings from this longitudinal survey of 150 sustainability students over 6 years provide some clarification for, and reasons why, various misaligned (dis)connections and terminological evolution occur. There are many notable outcomes from this study. Firstly, there were many disconnections between core sustainability values and principles with reference to the special treatment for developing countries, particularly where eradicating poverty is concerned. Contextualised within the notion that developing countries are not comparable to the United States in societal or financial terms, this disconnection reinforces domestic debates about the socio-political hierarchy that places developed nations firmly at the top of global power dynamic [54,55]. Secondly, throughout the questionnaire (which was specifically about sustainability principles) there were many times when students referred to broader concepts of environmental management or social justice. This indicates an important terminological evolution and departure from sustainability as a broad umbrella concept that incorporates many of the concepts that students mentioned, e.g., equity and justice. Such a departure may have implications for addressing interconnected challenges if ‘sustainability’ only refers to environmental issues

while ‘sustainable development’ suggests socio-economic dilemmas thus contributing to the contested meanings of both concepts [2,13].

Thirdly, while sustainability principles were viewed positively and considered useful as a guide for projects to embed, students were not aware of many examples of initiatives beyond their local campus. This marks a disconnection between knowledge of conceptual ideas and awareness of real-world applications. Consequently, this may explain broader deficiencies in why sustainable development is not viewed holistically [1]. Finally, students discussed alternative concepts and practices which they considered to be more applicable to sustainability projects than the Rio principles and noted: responsibility and cooperation, legislative-enforced penalties, new economic models, ecosystem services, intersectionality, and longevity. Intriguingly, these concepts and practices, though seemingly disconnected, in parts seek to enhance components of sustainability across its various pillars, e.g., accountability for environmental pollution and transparency for sustainable activities [36,37], penalties enforced through legislation taking into account the damage accrued by large-revenue, polluting companies [64], and enhancing the protections of marginalised and disproportionately impacted communities as a result of environmental challenges [76]. Taken together, these findings demonstrate a juncture in sustainability principles, education, and potentially future application. While many studies have sought to define key principles in various arenas [25–27], and their value for consolidating ideal perspectives are well noted [9], these findings illustrate that future sustainability scientists are expanding and reframing their own ideal perspectives in ways they find valuable and necessary.

This, however, remains within the spirit of the Rio Declaration and sustainability overall, as future generations may, indeed, face different challenges that require their own distinctive implementation approaches. The findings from this study have implications for how sustainability is taught to undergraduate university students—not just in the U.S. but in other countries also—its value for educating future sustainability scientists, and whether teaching students the history and evolution of sustainability is worthwhile. These issues need to be explored in further depth. Our current understanding of what and how sustainability is taught, the lessons learned, and how it is shaping sustainability as a discipline is being determined beyond sustainability academia. Consequently, sustainability scientists and academics should engage more actively with these current interdisciplinary dialogues on how sustainability is taught along with how sustainability principles are framed, their relative importance, and application.

While the focus of this article centres on the Rio Declaration’s sustainability principles, subsequent adoption of these evolved principles has been integrated within the SDGs [42,43]. Irrespective of which principles or objectives are integrated into core sustainability studies courses at undergraduate (or even postgraduate) education level, there appear to be similar limitations with respect to their interconnectedness and implementation [22]. From a critical perspective, the SDGs continue an optimistic vision of sustainable development, i.e., that environmental protection is compatible with economic growth [1,3]. This optimism is unwarranted as economic growth is not compatible with sustainability [66]. The SDGs suffer similar inherent weaknesses to the Rio Declaration’s sustainability principles in terms of implementation, which remains voluntary [77]. This, therefore, lends itself aptly to consider a future research agenda which explores the value and integration of sustainability principles within sustainability studies. This study only focused on one higher education institution in the U.S. and therefore the findings are limited to one undergraduate educational context. Future studies may wish to conduct research in multiple universities across various educational contexts (e.g., public and private universities) and in different countries (in the Global North and Global South). Identifying the application of sustainability principles in different educational contexts and countries would provide cross-cultural understandings and perspectives to be outlined. Comparative analyses would be well applied to this research agenda. Furthermore, an identification of what objectives or principles are incorporated into foundational higher education course, if even included, would also indicate the international value of such frameworks.

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