Evidence Based Library and Information Practice

Are Academic Libraries Doing Enough to Support the Sustainable Development Goals (SDGs)? A Mixed-Methods Review

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Article abstract

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Methods – A mixed-methods review was conducted to address the research question: How do academic libraries contribute to the attainment of SDGs? The methodology included literature searches conducted in Scopus, Web of Science Core Collection, EBSCO's Library, Information Science & Technology Abstracts (LISTA), and hand-searching. The selected timeframe, 2017-2024, encompasses the introduction of the SDGs and extends to the present body of evidence.

Results – The study found 25 relevant articles with data from 164 academic libraries worldwide. The evidence base indicates limited awareness and examples of sustainability literacy, suggesting the need for new initiatives. Instances of "SDG washing" were identified where librarians exaggerated the impact of their SDG-related programs, mislabeled routine activities as SDG contributions, or used SDG terminology superficially without meaningful action. This study suggests that SDG attainment is influenced by leadership, organizational culture, personal initiatives, and partnerships.

Conclusions – Academic libraries simultaneously address multiple SDG targets, indicating a comprehensive sustainability approach. Positive correlations between specific targets imply synergies that libraries can exploit to strengthen their sustainable development roles. Future research should investigate the impact of institutional factors on SDG implementation in academic libraries and identify strategies to overcome the common challenges in SDG initiatives. Specific SDG targets and indicators should guide context-specific recommendations. It is also advised to develop standardized tools for measuring and comparing academic libraries' SDG contributions.

Evidence Based Library and Information Practice

Review Article

Are Academic Libraries Doing Enough to Support the Sustainable Development Goals (SDGs)? A Mixed-Methods Review

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Data Availability: Dabengwa, I. (2023). A thematic synthesis of sustainability literacy in academic libraries using the Global Indicator Framework for the Sustainable Development Goals, Mendeley Data, V1, https://doi.org/10.17632/mpgfpd5cbt.1 The paper is also available as a preprint on Qeios. However, the preprint version differs significantly from this version: Dabengwa, I. M. (2024). Are academic libraries doing enough to support the Sustainable Development Goals (SDGs)? A state-of-the-art review. Qeios. https://doi.org/10.32388/CTF03V

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Introduction

The United Nations' (UN) 2030 Agenda for Sustainable Development, themed "leaving no one behind", is anticipated to bring about heightened peace and prosperity for the global population (UN Department of Economic and Social Affairs [UNDESA], 2018). The Sustainable Development Goals (SDGs), also referred to as the Global Goals, are enshrined in the 2030 Agenda for Sustainable Development document (see Appendix A). Despite the establishment of the SDGs in 2015, it was not until two years later that nations set objectives for each SDG. The all-encompassing framework, which is the 2030 Agenda, incorporates 17 SDGs alongside a staggering total of 248 targets and indicators intended to measure progress towards achieving these goals (United Nations, 2017). All components including SDGs, targets, and indicators form part of the overarching 2030 Agenda. In envisioning its development process, greater partnerships among stakeholders were deemed necessary by UN officials, and libraries were included among the partners (IFLA, 2015a).

As part of the SDGs development process, academic libraries play a crucial role in providing decision-makers with essential information for socio-economic advancement. Libraries are inherently positioned to support the SDGs because of their capacity to offer access to resources and information, facilitate learning and education, and promote community involvement. This aligns with the traditional humanistic objective of libraries, which focuses on transforming society by delivering pertinent information that meets the needs of communities (Cyr & Connaway, 2020). Furthermore, librarians across various sectors have emphasized that the right to information access is integral to achieving the SDGs. Consequently, librarians worldwide endorsed the Lyons Declaration on Access to Information and Development (International Federation of Library Associations and Institutions [IFLA], 2014). Initially, the IFLA (following the Lyons Declaration) believed that library contributions to the SDGs could be identified in Target 16.10 (social justice and freedom of information), Target 11.4 (cultural and natural heritage) and Target 5. b (investment in infrastructure development), Target 9.c (enhancing financial cooperation), and Target 17.8 (strengthening the statistical capacity for monitoring progress) (IFLA, 2015b). Librarians from member states were then encouraged to urge their respective countries to integrate the Lyons Declaration and information access, along with the necessary skills, into the localization of SDGs (Garcia-Febo, 2015).

Nevertheless, the role of libraries within the SDGs goes beyond the IFLA's conceptualization of these five targets.

Consequently, libraries are expected to strive towards achieving four fundamental pillars of sustainability in their operations: environmental sustainability, economic stability, social sustainability, and cultural vibrancy (see Figure 1).

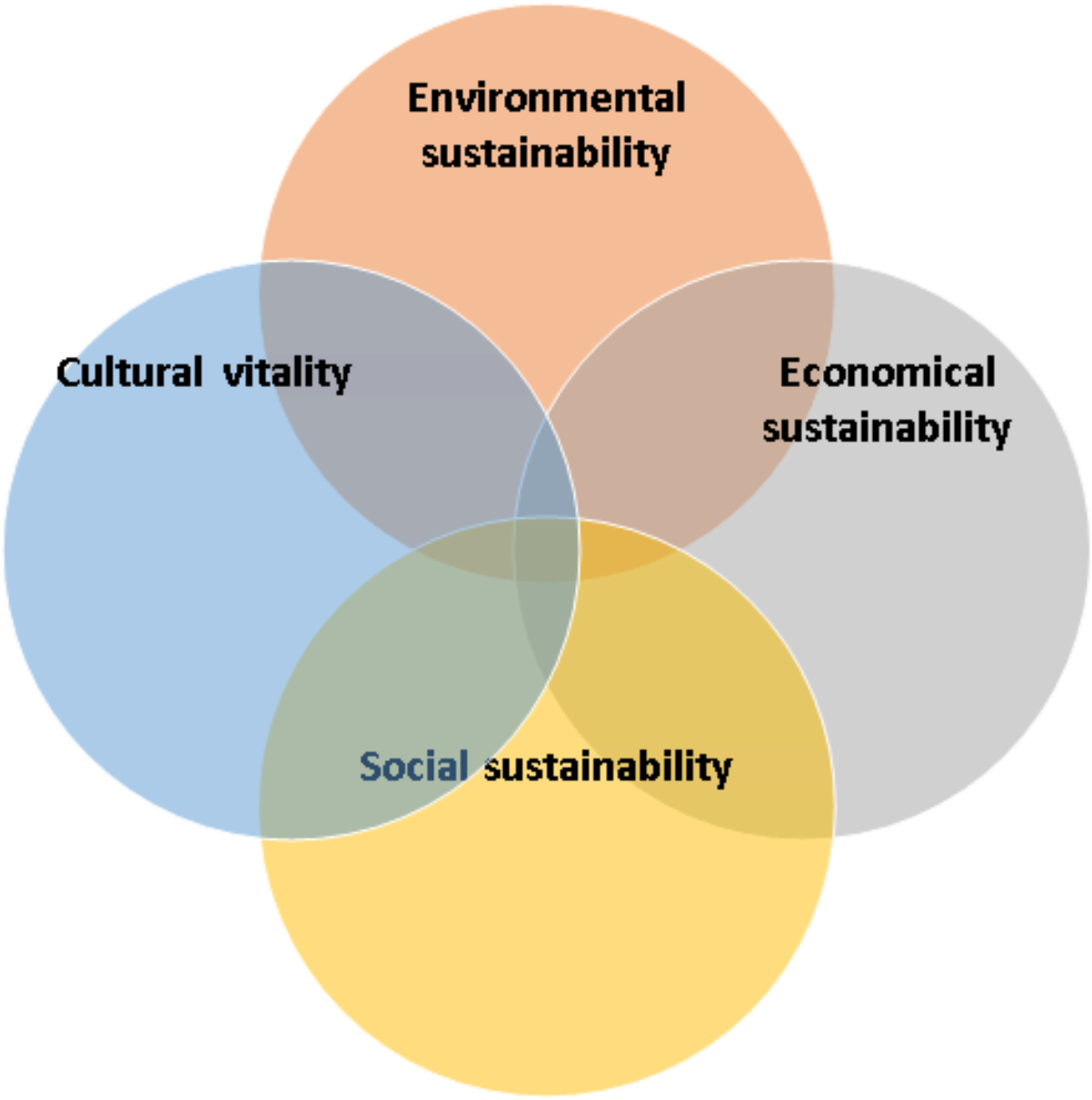

Figure 1
Four pillars of sustainability (the author's concepts).

The four pillars of sustainability represent the interplay between sustainable methodologies in library infrastructure and activities, resources, services, and procedures. Consequently, libraries embody the four pillars of sustainability and the SDGs through the application of "sustainability literacy." According to the United Nations Department of Economic and Social Affairs (UNDESA, 2018), sustainability literacy is

defined as 'the knowledge, skills, and mindsets that enable individuals to wholeheartedly contribute to the creation of a sustainable future and facilitate making well-informed and impactful decisions.' Sustainability literacy holds significance as it empowers individuals to take action towards the realization of SDGs.

Academic libraries can significantly advance the SDGs through various strategies. Unlike routine activities, SDG programming is specifically aligned with the SDG agenda, which aims to enhance sustainability literacy. Routine activities lack intentional alignment with the SDGs or the 5Ps (people, planet, prosperity, peace, partnership). Academic libraries are particularly effective because they focus on research and education, offer extensive resources on SDGs, serve diverse user populations, uphold a tradition of collaboration, and often function as health science, national, and public libraries in regions with less-developed library systems. These roles underscore their contributions to social inclusion, gender equality, and community engagement, extending their reach beyond traditional boundaries.

An illustrative example of library contributions to the SDGs can be seen in the findings of a policy analysis carried out by Chowdhury and Koya (2017), which revealed that the Agenda 2030 framework encompasses 34 information-related themes that are interwoven through numerous goal statements, declarations, and indicators. While the Lyons Framework may not encompass all targets, it is crucial to emphasize that it motivates librarians and information professionals to disseminate their awareness of the SDGs.

The literature on library contributions to SDGs is fragmented and lacks focus. While evidence of academic library contributions to the SDGs exists, no cross-case comparisons between libraries exist. IFLA (2018; 2023) has collected examples of SDG stories (e.g., self-reflective practice) from various types of libraries worldwide that demonstrate how libraries contribute to achieving these goals. IFLA measures this programming using the following measures:

a. SDG-related activities conducted by patrons at the library or librarians within the library building;
b. community engagement outside the library walls;
c. organizational culture (library-specific sustainability policies linked to the SDGs);
d. library partnerships; and
e. key performance indicators used to measure the SDGs (IFLA, 2018; 2023).

However, the IFLA SDG stories are subtle on issues such as individual agency of academic librarians (e.g., librarians' conceptualization of sustainability literacy), attitudes and perceptions of the SDGs (e.g., intentions to share SDG information and practices), and library leadership (characteristics of academic library management). Furthermore, library SDG stories are not holistic. For example, they do not show all library activities and their impact. These are constructed using voluntary submissions; hence, there are a small number of academic libraries. In some cases, certain library activities that spill into more than one goal have not been reported, and there has been no mention of the specific SDG targets and indicators achieved. SDG stories are also limited because of reporting from the perspective of the library that writes the report and may miss out on primary studies, such as surveys and document analyses, which may also provide valuable information.

Another strand of evidence on library SDG contributions employs literature searches to evaluate how libraries in general contribute to sustainability and sustainable development to increase information

access to several of the SDGs (e.g., Mathiasson and Jochumsen, 2022). However, sustainability and sustainable development are not synonymous with an SDG framework.

The 2030 Agenda for Sustainable Development consists of 17 SDGs, 169 targets, and 231 unique indicators; however, sustainability generally refers to meeting present needs without compromising future generations' ability to meet their own needs. Although the SDG Agenda includes sustainability principles, sustainability extends beyond the specific goals outlined. The SDG Agenda should be seen as a specific, attainable, measurable, and time-bound (SMART) framework, whereas sustainability is broad and has no time-bound measurements. Insufficient collated evidence exists on how academic libraries contribute to the SDGs and the entire Agenda 2030 framework. This is not to say that there is no evidence; however, the current focus of some literature synthesis reviews scratches the topic at the surface and does not relate to specific SDGs, targets, and indicators that have been attained by academic libraries. Furthermore, there is no evidence of a study that systematically makes cross-comparisons between various academic libraries' contributions to the SDGs and the methodologies used in the studies. Comparing academic libraries provides a much richer analysis as they have common characteristics, rather than comparing them with other types of libraries.

Aims

This mixed-methods review aims to explore how academic libraries contribute to the SDGs by systematically comparing SDG design and programming and proposing strategies to align library missions with the SDGs for a more significant impact. In doing so, this review aims to bridge the existing gap in the literature. This review seeks to answer the overarching research question: How do academic libraries contribute to the attainment of SDGs?

The main research question was further explored using the following secondary questions.

- How do library activities, such as collection development, programming, and outreach, contribute to the achievement of the SDGs?
- How do the actions of individual librarians and library staff contribute to achieving the SDGs?
- How does the organizational culture of a library support or hinder its ability to achieve the SDGs?
- How does library leadership play a role in achieving SDGs?
- How can libraries partner with other organizations to achieve SDGs?
- How can libraries use key performance indicators to improve their efforts to achieve the SDGs?
- What are the future directions for SDG research in academic libraries and other types of libraries?

Methods

Mixed-Method Review

A mixed-method review combines data from quantitative and qualitative studies to streamline what is known for future analysis. The mixed-methods review approach involves a sensitive search that retrieves both qualitative and quantitative studies. According to Booth et al. (2016), the synthesis for a mixed-methods review can be narrative (e.g., the usage of the thematic synthesis) or can be tabular with frequencies and percentages applied to the codes and takes a statistical turn to examine the relationships between the study's characteristics (e.g., codes). This mixed-methods review is an entry point for library and information science professionals to find possible directions for additional SDG research in academic libraries as it covers the scope and salient features of the topic. The author conducted a mixed-methods

review to report diverse, measurable outcomes and contextual nuances of SDG programming from different regions, triangulating data from various papers to enhance the reliability and validity of the findings, and to improve the generalizability of the evidence.

Database Searches

The author gathered data from literature searches in Scopus and Web of Science Core Collection. These interdisciplinary databases were selected because they include LIS concepts. Outside these interdisciplinary databases, EBSCO's Library and Information Science & Technology Abstracts (LISTA) were searched. A test search was performed for the term sustainability literacy, and it was found that the literature was quite small. Revisions were made to the search string to include the library, sustainability literacy, and SDGs in order to retrieve relevant results. Tables 1 through 3 show the sample search strategies used in this study and their translation to other databases. The title, abstract, and keyword fields were searched using Scopus. The syntax from the other databases was searched in All Text (TX) in LISTA, and All Fields (ALL) were searched in WoS. The expected outcomes were not included in the search strings, but these concepts were later exploited to select relevant articles. Boolean operators (AND and OR) combined the search terms, while the NEAR proximity operator was added in LISTA and Web of Science to certain terms to increase the relevance of the results in selected databases. The January 1, 2017, to February 15, 2024, date limit was selected because the SDG targets and indicators were published in 2017. It was then necessary to audit the literature from 2017 to the current year, 2024. The searches were translated according to the function of each database.

The SPICE (setting, perspective, intervention/interest, comparison, evaluation) framework was used to frame the main research question to develop the search terms for the database searches (Booth et al., 2016). The following was used as the framework:

a. The setting was determined as the terms related to the SDGs.
b. Perspectives were considered as academic libraries and related terms.
c. The intervention included literacy, training, and education terms.
d. Comparison was not needed in this study.
e. The impact of academic libraries on SDG was evaluated.

Table 1
Search for Scopus

#	**Search strings**	**Results**
S1	TITLE-ABS-KEY ("sustainable development goal*" OR "Agenda 2030" OR "sustainab*" OR "SDG*" OR "United Nations")	1,272,008
S2	TITLE-ABS-KEY ("libra*")	621,209
S3	S1 AND S2	6,239
2017-present		4,071
English only		3,520

NOTE: Last search conducted on 15 February 2024.

Table 2
Search for Library, Information Science & Technology Abstracts

#	**Query**	**Results**
S6	English Language	611
S5	Limit to Academic Journals	755
S4	Limit 2017-Present	1,101
S3	S1 AND S2	2,940
S2	TX "librar*"	1,085,280
S1	TX “sustainable development NEAR/5 goal*” OR “Agenda NEAR/5 2030” OR “sustainable*” OR “SDG*” OR “United NEAR/5 Nations”	6,588

NOTE: Last search conducted on 15 February 2024.

Table 3
Search for Web of Science

#	**Search Query**	**Results**
S1	ALL= (“sustainable development N5 goal*” OR “Agenda N5 2030” OR “sustainable*” OR “SDG*” OR “United N5 Nations")	718,514
S2	ALL=("librar*")	657,787
S3	S1 AND S2	4,788
S4	ALL= (“literacy" OR "educat*" OR "train*" OR "information access" OR "curricul*" OR "teach*" OR "learn*" OR "course*")	7,682.885
S5	S4 AND S3	1,467
S6	#4 AND #3 and 2024 or 2017 or 2018 or 2019 or 2020 or 2021 or 2022 or 2023 (Publication Years)	1,156
S7	#4 AND #3 and 2024 or 2017 or 2018 or 2019 or 2020 or 2021 or 2022 or 2023 (Publication Years) and English (Languages)	1,108

NOTE: Last search was conducted on 15 February 2024.

Hand searching (manually searching for additional journal articles not included in the databases that are not indexed in scholarly databases) was performed using Google Scholar and LitMaps (https://www.litmaps.com/about) to avoid publication bias. A hand search retrieved literature on similar concepts, such as green literacy and environmental literacy, while keeping in mind that these concepts had to be applied to the SDGs. LitMaps uses artificial intelligence (AI) to identify similar articles. Relevant articles were “seeded” (chain searching) to find matching articles, and the results were reviewed for relevance. Reference lists were also read to identify potentially relevant articles.

Inclusion and Exclusion Criteria

The following criteria were used to obtain high-quality articles to build an evidence base:

1. Peer-reviewed journal articles representing primary research using written research methods.
2. Articles exploring individual SDGs, targets, or indicators within the realm of academic libraries, encompassing academic library staff, policymakers, and the communities they serve.
3. Articles that include elements of sustainability literacy, regardless of whether the concept is fully or partially explained.

4. Investigations of sustainability literacy within the context of the United Nations Agenda 2030 framework, including information literacy on sustainability to reduce information poverty.
5. Library activities focusing on sustainability and sustainable development.
6. Applications of library concepts and practices in the context of sustainability literacy.
7. All research designs (e.g., qualitative and quantitative)
8. Publications from 1 January 2017-15 February 2024.
9. Only English language publications.
10. Full-text PDFs.

The following criteria were used to exclude articles:

1. Articles that discuss sustainability within libraries or LIS without linking the concept to the United Nations SDG/Agenda 2030 framework.
2. Broad LIS concepts, such as knowledge management, open access, and semantic web are not specifically applied to libraries or library settings' contribution to the SDGs.
3. Bibliometric studies, conceptual papers, news opinion pieces, and systematic reviews.
4. Articles on other types of libraries including school libraries, public libraries, national libraries, museums, galleries, and archives.
5. All other kinds of reviews.

Selection of Articles

In total, 5,282 records were found (Scopus = 3,520, Library, Information Science & Technology Abstracts = 611 and Web of Science = 1,108) using database searches and hand searching (manually searching for literature that is not covered in database searches =43). The results were imported into Mendeley [https://www.mendeley.com] to identify duplicates. In total, 510 duplicates were removed, leaving 4,772 records for screening in their titles and abstracts. Rayyan [https://www.rayyan.ai], a web-based tool for screening and selecting studies, was then applied. The artificial intelligence features of Rayyan were used to sort the data by keywords, including Sustainable Development Goals, SDGs, global goals, academic library, college library, and university library. These terms were also searched with variations on sentence cases as Rayyan cannot retrieve these terms in sentence cases, lower case, or if each term has been capitalized. Rayyan picks up the identified keywords within the titles and abstracts, sorts them, and highlights where they appear, making it easier to quickly identify relevant articles. A human reviewer was involved in the selection process of all articles. A total of 4,314 records were excluded, and 59 Full-Text PDF were assessed for eligibility, of which 25 articles met the inclusion criteria.

Critical Appraisal

The Mixed-Methods Appraisal Tool (MMAT) (McGowan, et al., 2018) was used to appraise the selected studies critically. Critical appraisal is used to evaluate published research using transparent methods that cover the whole paper (Booth et al., 2016). For example, the MMAT tool covers the following categories: appropriateness of the aim, clarity of the research questions, methodological quality, data quality, analysis adequacy, and conclusions' appropriateness. Therefore, each paper was read and then scored as poor, moderate, or satisfactory. The results of the MMAT tool show that although most of the studies had only a moderate score on their methodological quality, the aims, research questions asked, analysis, and conclusions were satisfactory in most cases (see Table 4). Hence, all 25 papers were synthesized.

Table 4
Critical Appraisal of the Selected Papers Using the MMAT Tool (N=25)

Category	% Articles Scored as Satisfactory	% Articles Scored as Moderate
Appropriateness of the aim	88%	12%
Clarity of the research questions	88%	12%
Methodological quality	12%	88%
Data quality	44%	56%
Analysis adequacy	64%	36%
Conclusions' appropriateness	80%	20%

Data Analysis

The PDF articles were imported into MaxQDA 20 (VERBI Software, 2021.), a qualitative data analysis software package, for thematic synthesis. This process involved both deductive (a predetermined schema for codes) and inductive coding (open coding). The thematic synthesis was conducted by the researcher. The software aided in identifying the frequency of codes, themes, and cross-case analyses. Meanings in context were based on interconnections between the SDGs, targets, and indicators. This method of analysis enables the identification of both the catalyst and co-dependent relationships in SDG programming. Statistical inferences were made for some data using MaxQDA 20 as the software package can transform qualitative data into quantitative data.

Thematic Synthesis

Thematic synthesis analysis is a qualitative research method that is known for its flexibility, systematic approach, and transparency (Thomas and Harden, 2008). It involves the combination of evidence from multiple studies to produce new insights and findings. Unlike summary, thematic synthesis requires the "translation" of original texts into meaningful themes through the development of descriptive and analytical themes (Thomas & Harden, 2008). Translation occurs when passages have the same meaning but do not express their content in exact words. Similar codes were then grouped into categories, which were used to develop overarching themes and subthemes. To summarize this information effectively, tables, models, graphs, and charts are often utilized. Additionally, examples such as quotes and references from these studies are incorporated to demonstrate how the findings are grounded in the data (Thomas & Harden, 2008). Overall, thematic synthesis analysis provides an effective means for synthesizing qualitative data across multiple studies while maintaining rigour and transparency. The thematic analysis was conducted as follows:

1. **Translation of original texts:** The coders analyzed and deciphered data from the selected studies, transforming raw findings into more generalized concepts.
2. **Identification of themes:** As the coders analyzed the translated texts, they identified recurring patterns or ideas that emerged across multiple studies.
3. **Interconnection analysis:** The method was used to identify relationships between various SDG programs and their outcomes, seeking connections that individual studies might overlook.
4. **Synthesizing the findings:** The completed synthesis identified themes, interconnections, and patterns to formulate a comprehensive understanding of the SDG programs and their impacts.

Deductive Coding

The SDGs mentioned in the selected articles were deductively coded using a Global Indicator Framework (GIF) (United Nations, 2017). GIF was selected because it covers all 248 indicators and targets. A combination of metrics (scales and their dimensions) and narrative (anecdotal evidence) was used to map statements to SDGs/targets/indicators using the SDG# Mapping Tool (Ochôa & Pinto, 2020). The SDG# mapping tool works by moving from the right to the left:

- The author of the work is noted (sources and notes)
- Verbatim quotations from the article are selected to reflect work done on the SDGs (Indicators/other)
- The research design of the article is noted (Research design), and the sector in which the SDG is relevant is noted
- The relevant SDGs or targets are noted for each statement

The coder can return to the Sources and Notes to write any observed analytical memos. In some cases, the IFLA (2019) document and SDGLinked app (https://linkedsdg.officialstatistics.org/#/) were used to explore SDGs/targets/indicators.

For this study, two coders independently coded the selected articles and subsequently shared their findings to establish a mutual understanding. Each article was read by both coders, and selected passages were translated in line with the SDGs/targets/indicators. As part of this process, a codebook was developed to inform coders of the inclusion and exclusion criteria to be used when there was an instance of translating passages within the texts.

Inductive Coding

The coders kept an open eye on new codes that emerged as passages were read. Each new code was placed in a bin (e.g. code, sub-theme, or theme) referring to the sentences in which it occurred. The codebook was updated to capture new codes used in subsequent instances where there were similar behaviours, passages, and patterns.

Data Transformation

The qualitative codes generated from thematic analysis were transformed into categorical data, which were used to run statistical tests to predict the interaction of one or more variables.

Cronbach's Alpha

Cronbach's alpha was calculated across the codes to determine the inter-rater agreement on the coding of the SDGs, targets, and indicators. Cronbach's alpha was 0.810, which means that there was strong agreement between the codes used in the studies.

Results

This study consists of 25 papers with data from academic libraries. Most of the academic libraries were located in Asia (26.32%), Africa (21.05%), North America (5.26%), Europe (10.53%), Oceania (5.26%), and International (15.79%, a paper including data from Australia, North America, South Africa, United Kingdom). MapChart (https://www.mapchart.net/world.html) was used to visualize the selected

literature on a world map (see Figure 2). The retrieved articles contain evidence on SDG programming from academic libraries, academic library employees, academic library policymakers, and communities that use academic libraries.

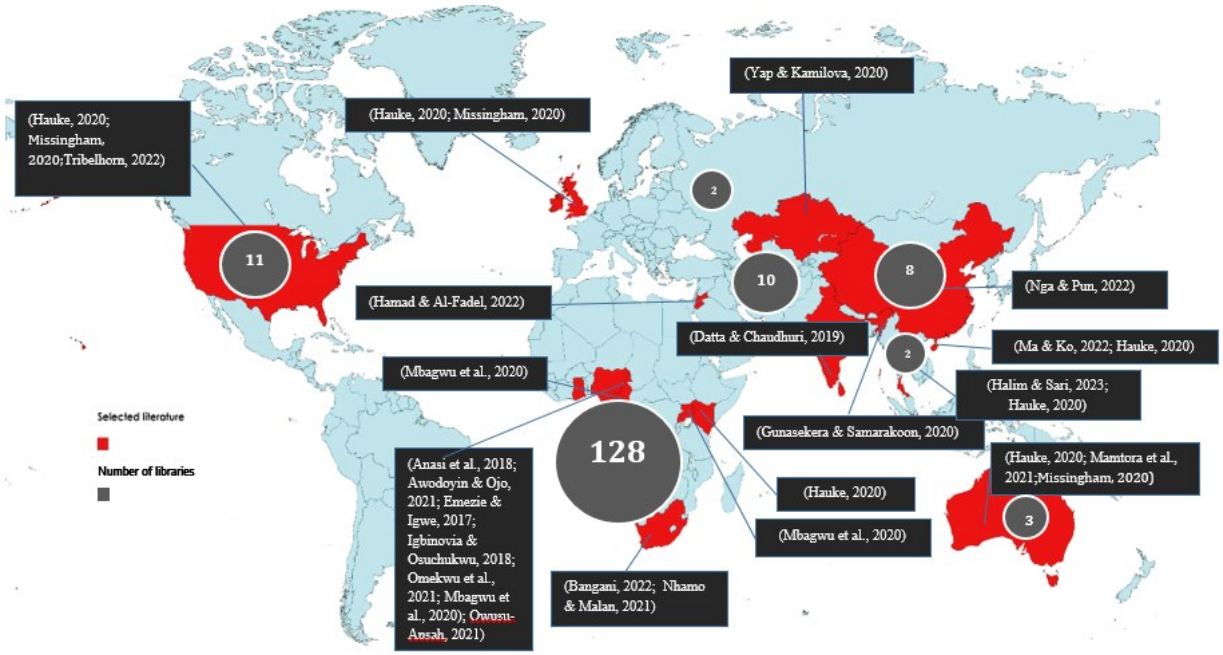

Figure 2
Global map showing the origins of the selected literature. (Study results were drawn using MapChart.)

Thematic Synthesis

The data in this review show that academic librarians achieve the SDGs through these themes: SDG-related library activities, interaction of sustainability awareness, organizational culture, library leadership, culture and policies, partnerships, and key performance indicators (see Table 5).

Table 5
An Overview of the Codes Used in the Study

Themes	Sub-themes	Sources
SDG-related library activities	Mapping SDG-related activities and their interconnections using the GIF	All articles
Community engagement	VosViewer exploration of the citations of selected articles Examples of community projects conducted by academic libraries	All articles

Interaction of sustainability awareness	Definitions of sustainability awareness Training as a means of raising sustainability awareness	Atta-Obeng and Dadzie 2020; Awodoyin and Ojo, 2021; Datta & Chaudhuri, 2019; Dei and Asante, 2022; Hauke, 2020; Gunasekera & Samarakoon, 2020; Mbagwu et al., 2020; Tribelhorn, 2022
Organizational culture	Supportive government policy on SDGs	Anasi et al., 2018; Atta-Obeng & Dadzie, 2020, Awodoyin and Ojo, 2021, Datta & Chaudhuri, 2019; Dei & Asante, 2022; Hamad & Al-Fadel, 2022; Hauke, 2020; Gunasekera & Samarakoon, 2020; Gupta, 2020; Ma & Ko, 2022; Nhamo & Malan, 2021; Omekwu et al., 2021; Tribelhorn, 2022; Yap and Kamilova, 2020
Library leadership	Strategic direction	Awodoyin and Ojo, 2021; Halim and Sari, 2023
Culture and policies	Government policies Organizational culture	Anasi et al., 2018; Awodoyin and Ojo, 2021; Datta & Chaudhuri, 2019; Dei & Asante, 2022; Ma & Ko, 2022; Nhamo & Malan, 2021; Omekwu et al., 2021; Tribelhorn, 2022; Yap & Kamilova, 2020
Partnerships	Partnerships and collaborations for mobilizing resources	Bangani & Dube, 2023; Bangani, 2023; Hauke, 2020
Key performance indicators	Monitoring and evaluating SDG implementation	All articles

The themes can be categorized as global factors, national factors, community factors, organizational level factors, and individual level factors (see Figure 3). Library activities went beyond teaching information literacy on the SDGs all the way to conducting activities that impacted one or more targets and indicators. The sections that follow explore each of the themes identified in Table 5 in more detail.

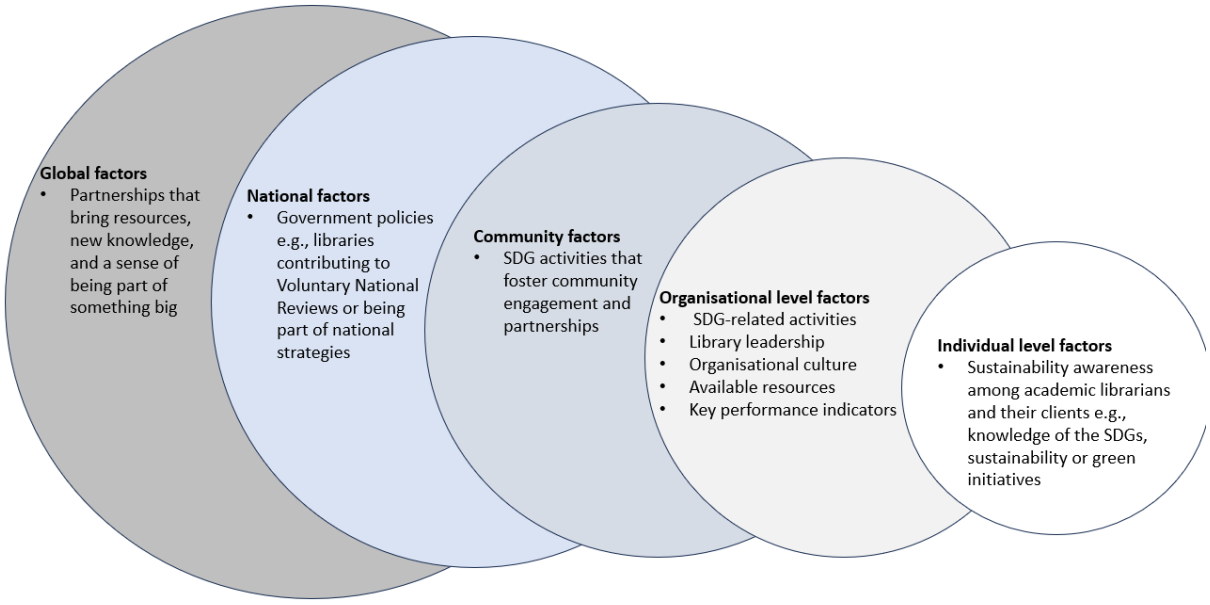

Figure 3
How libraries attain sustainability literacy centred on the SDGs (study results).

Community Engagement

An analysis of the papers from an overall perspective shows that the work conducted by academic libraries had a great impact on community engagement (see Figure 4). Bangani (2022; 2023), Bangani and Dube (2023), and Halim and Sari (2023) are typical examples of library SDG community engagement. Halim and Sari (2023) discuss the Corporate Social Responsibility (CSR) initiatives of the Tengku Anis Library (PTA), an academic library at UiTM Kelantan, Malaysia. Halim and Sari (2023) include activities such as the following: initiating reading programs, distributing books, organizing gatherings, establishing mini-libraries, conducting literacy drills. Bangani (2023) observed that South African academic libraries are engaged in activities such as imparting information literacy skills to schools and librarians from other sectors (e.g., school librarians and public librarians), promoting reading and writing for all ages, library visits by school learners, donating school shoes and uniforms to learners, donating computers, and teaching digital literacy training to schools.

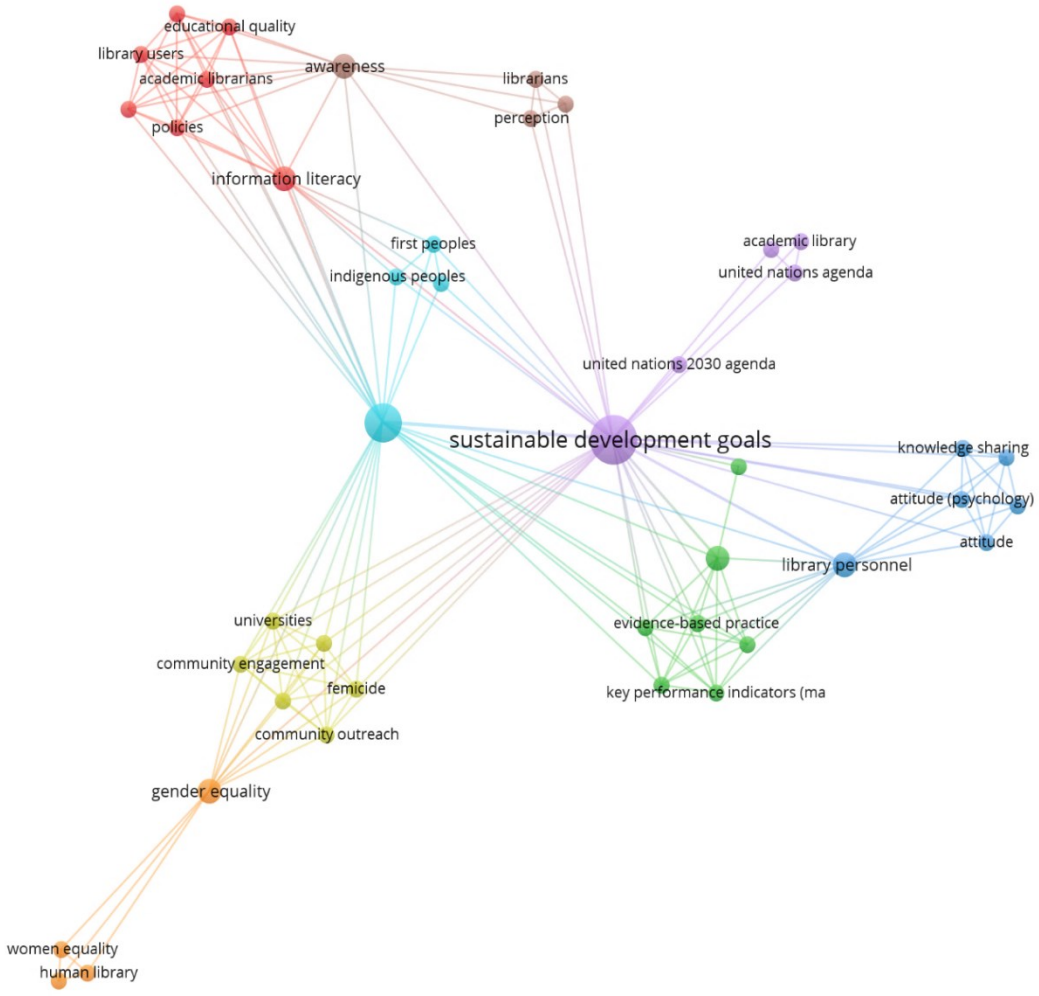

Figure 4
VosViewer keyword concurrence found in the selected literature (van Eck & Waltman, 2010).

Library Activities With an Impact on SDG Targets/Indicators

At a broad level, Figure 5 shows the SDGs reported in the selected studies. SDG 4 (23.5%) was ranked the highest, followed closely by SDG 16 (18.6%) and SDG 12 (9%). No data were found for SDG 14. Most libraries mapped their activities to broad SDGs rather than specific targets or indicators. In some cases, authors selected goals they wanted to map. For example, Missingham (2020) mapped the activities of academic research libraries from various countries to four SDGs (SDGs 4, 5, 9, and 11), and Thorpe and Gunton (2022) mapped the activities of the University of Southern Queensland, Australia, to eight of the 17 SDGs. The mapping applied in this review found instances of interconnectedness, whereas the original studies did not. For instance, Missingham (2020) maps library activities addressing gender violence to SDG 5. Yet this review connects these activities to Target 5.2 (ending violence against women and girls) and to Target 16.10 (information access). Additionally, increasing women's employment opportunities can be found in Target 5.5 (promoting women's leadership and equal participation), Target 8.5 (employment and decent work for all by 2030) and Target 10.2 (promoting social, economic, and political inclusion for all by 2030).

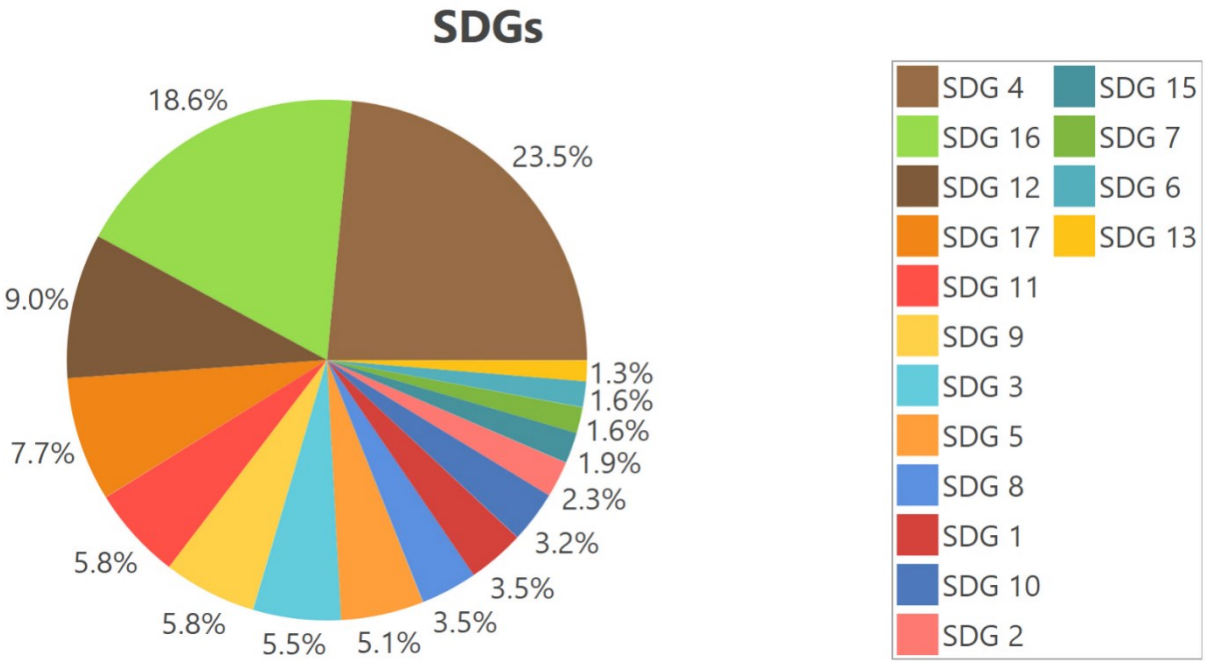

Figure 5
Overall SDGs found in the papers.

The most commonly reported targets in the papers follow:

- 1.2 poverty reduction, inclusive growth
- 3.3 health services accessibility, epidemic control
- 3.7 universal health coverage, healthcare access
- 4.7 quality education, sustainable development
- 5.5 gender equality and women's empowerment
- 6.5 water resource management, water scarcity
- 7.3 renewable energy, energy access

- 16.10 information access, transparency, accountability
- 17.9 financial services, infrastructure development
- 17.16 global partnership, cooperation, aid effectiveness
- 17.17 data sharing, knowledge exchange

The common indicators in this paper were 5.5.2 legal framework, discrimination prevention, 6.5.1 water resource efficiency, sustainable practices, 5.2 elimination of violence, gender equality, 7c renewable energy adoption, infrastructure investment, 9.c infrastructure development, and technology access.

SDG washing was observed in some cases where librarians reported activities as contributing to the SDGs, but the activities may not have been relevant. Dei and Asante (2022) reported an instance where librarians thought general information literacy activities (e.g., tutorials on reference managers) were the same as delivering sustainability literacy on SDG 4. Another case is Mbagwu et al. (2020), who provided an example of an SDG program that was conducted by the Makerere University Library in 2011 (four years before the SDGs were established).

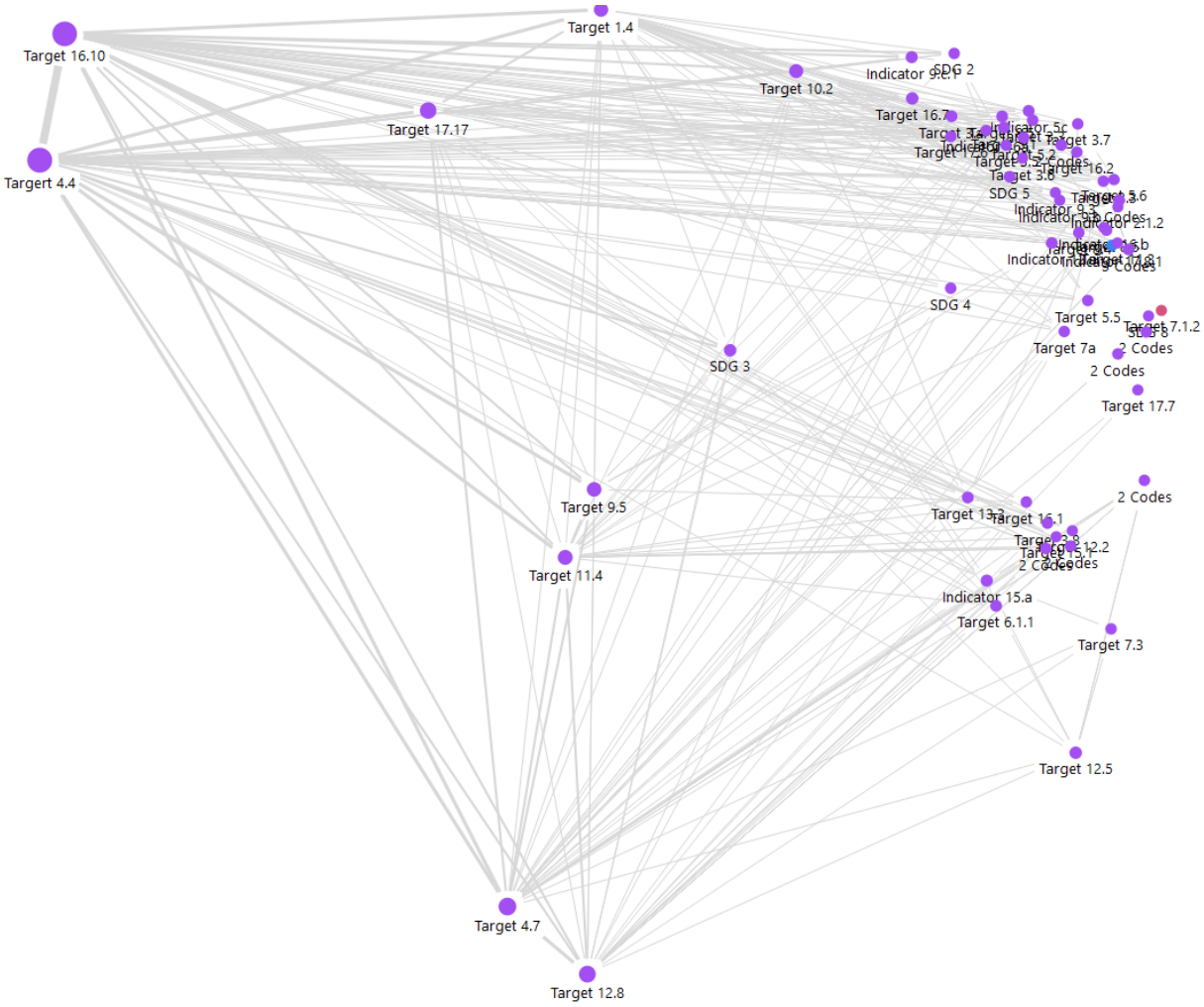

Figure 6
Interconnection of SDG targets and indicators. Drawn using MaxQDA 20.

Figure 6 shows an analysis of the data showing interconnecting relationships. The figure was generated using MaxQDA 20 by interconnecting the coded SDGs in each article. The rule of mapping in Figure 6 is that the larger the line connecting an item or a set of items, the stronger the association. Target 4.4 (human capital development) had the most associated codes, followed by 16.10 (information access), 4.7 (global citizenship), 17.17 (partnerships), and 12.8 (sustainable lifestyles). The difference between Targets 4.4 and 16.10 was quite small.

The qualitative data were transformed into quantitative categories (the number of times a code appears) to conduct data reduction. Figure 6 shows that the interactions between the codes are quite complex. Therefore, transforming the qualitative data into categories helped to simplify the analysis and examine the strengths of the associations between the codes. A Pearson correlation *R* test was conducted on the entire dataset using MaxQDA 20 (see Table 8). Target 4.4 had positive linear relationships with 4.7, 16.10, and 17.17, seven moderately weak relationships, 15 weak relationships, and 39 weak downhill linear relationships with other SDGs/targets/indicators. Target 16.10 seems to be a reinforcer, a key target that leads to the attainment of other goals/targets or indicators. This is shown by the thick line that joins with Target 16.10.

Table 6
Sample ANOVA Conducted on Targets 4.4 and 16.10

	Sum of squares	Df	Mean square	*F*	*p*-value	Eta squared
Between groups	171.52	7	24.50	18.68	0.00	0.91
Within groups	17.05	13	1.31			
Total	188.57	20				
Homogeneity of variance						
Levene	2.89					
p-value	0.05					

Sustainability Awareness

Academic librarians' awareness of sustainability extends beyond their familiarity with the SDGs to encompass the practical implementation of sustainable practices within library environments. This encompasses cognizance of how library activities, services, and resources can support sustainability objectives and disseminate information to patrons regarding these critical topics. Furthermore, librarians' approaches to incorporating sustainable practices into their professional roles and responsibilities may be significantly influenced by their perceptions and conceptualizations of sustainability literacy. The findings that follow elucidate these issues with greater depth. Only Tribelhorn (2022) defined sustainability literacy within the context of the participants' quotations, describing it as an initiative that supports student learning and strongly links it to environmentalism, social equity, and economic activities. Tribelhorn (2022) observed academic librarians' low awareness of sustainability literacy. The author further argued that academic librarians should be given more information on sustainability literacy to understand the concept holistically.

Other variations of sustainability literacy found in the papers are "sustainable information" (Gunasekera & Samarakoon, 2020), "sustainable library" (Datta & Chaudhuri, 2019; Gunasekera & Samarakoon, 2020; Tribelhorn, 2022), and "green library" (Hauke, 2020). Gunasekera and Samarakoon (2020) understood sustainable information to "consist of two distinct parts: information for sustainable development (e.g.,

seen as a resource for the project of sustainable development) and development of sustainable information (e.g., creating sustainable information and communication technologies)" (p. 50). Although Datta and Chaudhuri (2019) mention the term "sustainable library corner," they do not properly define it. Rather, it appeared in their questionnaire as a substitute term for "green library" or "eco-friendly library." Gunasekera and Samarakoon (2020) define a "sustainable library corner" as a one-stop shop space within the library where users can access information on sustainability programs around campuses and SDG reference information. An example of a sustainable library corner was found at Makerere University in Uganda (Mbagwu et al., 2020). Tribelhorn (2022) considered the sustainable library an initiative that shows the "library's commitment to environmental stewardship, economic feasibility, and social equity" (p. 3). Hauke (2020) conceptualized a green library as both an ecological building and a social role (information provision) that libraries play in raising sustainability awareness.
Although the term *sustainability literacy* is not explicitly stated in certain publications, the authors emphasize the significance of literary initiatives and information accessibility in promoting sustainable objectives. Programs aimed at enhancing literacy skills, fostering a culture of reading, and offering educational resources to communities align with broader sustainability objectives and the SDGs. These programs promote lifelong learning, bolster critical thinking abilities, and empower individuals to tackle social, economic, and environmental issues.

Awareness of Sustainability and SDGs

Awareness of the concept of sustainability and SDGs is closely linked to their conceptualization. Hence, this study determined the level at which participants from various studies were aware of sustainability or the SDGs and the reasons behind their level of awareness. The results showed mixed reactions across different continents. For instance, Datta and Chaudhuri's (2019) study in India found that 56.25% of librarians were unaware of sustainable development, and 31.25% were unaware of the SDGs. Datta and Chaudhuri (2019) explained that their participants were unaware of sustainable development because they were unsure if they could engage in activities such as "promotion of local and cultural practices" and "supporting the local economy" (Datta & Chaudhuri, 2019). It was not surprising that 87.5% of these participants agreed that "inadequate awareness, knowledge, and expertise" was the largest barrier to transforming an academic library into a sustainable one. Similarly, Atta-Obeng and Dadzie (2020) and Dei and Asante (2022) found that Ghanaian librarians' knowledge of SDG 4 (the studies considered this to be the most basic goal) was at a broad goal level, and they were not familiar with the targets and indicators. Atta-Obeng and Dadzie (2020) also found that academic librarians' low knowledge is caused by a lack of participation in SDG advocacy campaigns and a lack of awareness of their social responsibility (Dei & Asante, 2022).

Training as a Means of Raising Awareness of the SDGs

Tribelhorn (2022) surveyed academic librarians in the United States and found that sustainability and SDGs were not attained because of a lack of training opportunities. These librarians had a negative attitude towards sustainability and the SDGs because they associated the concepts with environmentalism (a sociopolitical movement to protect and preserve the natural environment and its resources) rather than holistically relating them to the four pillars of sustainability. In contrast, Omekwu et al. (2021) found that 65% of Nigerian academic librarians were fully aware of sustainability and SDGs because they thought it could solve national human development problems. In a separate Nigerian study, Awodoyin and Ojo (2021) found an acute awareness of the SDGs, especially SDG 2 (end hunger, achieve food security, improve nutrition and promote sustainable agriculture).

Culture and Policy

Anasi et al. (2018), Omekwu et al. (2021), and Awodoyin and Ojo (2021) identified the lack of supportive government policy on SDG monitoring and evaluation as one of the barriers to SDG localization in libraries. Both Indian and Nigerian librarians felt that their governments had a bad track record of delivering inaccurate and misleading information (Datta & Chaudhuri, 2019; Omekwu et al., 2021). This mistrust eventually resulted in the low usage of government-related SDG information in academic libraries. Another related challenge is the lack of institutional policies that support sustainability and the SDGs (Atta-Obeng & Dadzie, 2020; Dei & Asante, 2022; Hamad & Al-Fadel, 2022; Tribelhorn, 2022). In turn, this meant that sustainability/SDG programs were not funded. Furthermore, the lack of funding is the largest reason why SDG efforts are not implemented.

Of the 164 libraries reported in the studies, four have won the IFLA Green Library Award, namely, the Chinese University of Hong Kong Library (CUHKL) (Ma & Ko, 2022), Rangsit University, Thailand (Gupta, 2020; Hauke, 2020), the University College Cork Library, and the Library of the United States International University-Africa (Hauke, 2020). There are good examples where library SDG activities are part of an institutional mandate that fits into national development plans, such as Voluntary National Reviews (VNRs). These good examples include the Chinese Hong Kong Library (Ma & Ko, 2022), the University of South Africa Library (Nhamo & Malan, 2021), and the Library of Buddhist and Pali University of Sri Lanka (Gunasekera & Samarakoon, 2020). However, other studies have mentioned the lack of national policies to support SDG implementation in libraries as a key challenge. In North America, Tribelhorn (2022) reported that libraries practicing sustainability/SDGs often include this in their mission statements, policies, and in-house training and have a library committee to oversee implementation. In Europe, Yap and Kamilova (2020) observed that there are instances where libraries face competing or shifting priorities that cause sustainability/SDG initiatives to be shelved. Other reasons for the low uptake of sustainability/SDGs were mostly related to the lack of training, interest among academic librarians, community involvement, and resources (Yap & Kamilova, 2020). African libraries with SDG policies relied on the GIF (United Nations, 2017) as a guide (Dei & Asante, 2022).

Leadership

Data from the selected papers show that library leadership is a key component in developing successful SDG programs. Academic library leadership was seen to provide strategic direction that could influence policies, provide resources, and advocate for government and partners to buy into library activities. A good example is Halim and Sari (2023), who discuss how the library's leadership was instrumental in planning, preparing, implementing, and evaluating the CSR program. Interestingly, participants from the study by Awodoyin and Ojo (2021) noted that sustainability/SDG programs were hindered by library leaders who misappropriated funds for training and acquiring resources.

Partnerships to Achieve the 2030 Agenda

Partnerships were encouraged and initiated when academic libraries did not have adequate resources. Target 17.17 has received considerable attention in the codes, showing that partnerships and collaborations are important for mobilizing resources to carry out sustainability literacy efforts. The partnerships discussed were both on campus and with external institutions at the local and global levels. A typical example is the library of the United States International University-Africa in Nairobi, Kenya, which was able to run green library initiatives because of its partnership with North America (Hauke, 2020). The partnerships formed by the academic libraries and local high schools in Bangani and Dube

(2023) and Bangani (2023) were possible because they were undersigned with memorandums of understanding (MOUs).

Key Performance Indicators for Measuring Sustainability Literacy in Libraries

Key performance indicators (KPIs) are needed to monitor and evaluate the extent to which a library has implemented sustainability/SDGs. KPIs are mostly measured using qualitative approaches, such as self-reflective SDG stories (16 papers) and survey tools (9 papers). See the scales in Appendix B Scales for measuring sustainability literacy in the context of the Agenda 2030. SDG stories are usually obtained using participatory approaches, such as those in Nhamo and Malan (2021). SDG stories may allude to metrics like the number of people participating in library-driven SDG activities, the degree of community engagement, the quality of services rendered, or the degree to which the initiatives aid in the accomplishment of SDGs.

There is a similarity in some SDG activities at libraries as they are aligned with one or more SDGs. Of particular note is Missingham (2020), who used ISO 16439 to evaluate four international libraries; Nga and Pun (2022), who mapped scholarly output from Macao in terms of SDG research throughput relative to the world; and Nhamo and Malan (2021), who reported the number of hits on a library web page dedicated to sustainability resources and their reliance and conducted user satisfaction surveys. However, there are no uniform survey tools used across different countries, and each author adapts their questions according to the context and needs.

The most common dimensions of the tools include the following: information sources used to gain knowledge of the SDGs, requirements to actualize the SDGs, awareness of sustainability/SDGs, perceptions of SDGs, relevance of the SDGs in libraries, requirements/strategies to achieve the SDGs, and challenges in achieving the SDGs (Awodoyin & Ojo, 2021; Datta & Chaudhuri, 2019; Hamad & Al-Fadel, 2022; Omekwu et al., 2021). The authors vary the contents of the listed items in each dimension. In some instances, sustainability or SDGs are used interchangeably. In addition, evaluating the quality of each tool in meeting sustainable development and the SDGs is beyond the scope of this paper.

Among the authors who conducted surveys, Igbinovia and Osuchukwu (2018) adapted a tool from Tohidinia and Mosakhani (2010) to study academic librarians' SDG knowledge-sharing behaviour. Tribelhorn (2022) developed a tool to assess the library's key performance indicators on sustainability and the SDGs while linking these activities to mission statements, structures needed to support sustainability and the SDGs, and the means of measuring these. Although librarians in Tribelhorn's (2022) study were not aware of how to measure KPIs for sustainability, they had positive attitudes toward the process (80%). Hence, they felt that certification was an excellent incentive, as it could frame library policies toward the SDGs and raise support from university administrators. Nhamo and Malan (2021) and Gunasekera and Samarakoon (2020) mentioned that participatory awareness-raising and support workshops are needed before the implementation of SDG initiatives to reinforce. Both studies showed that it is critical to discuss key performance indicators of SDG implementation from the onset.

Discussion

Although the number of retrieved publications fitting into the inclusion criteria was not high, this review found more academic libraries reporting on achieving the SDGs than those found by IFLA (2023). The number of reporting libraries alone is not a clear demonstration of representation. It does, however, suggest that more libraries are reporting their use of SDGs in 2024 than in 2023. In addition, the study

presents real-world examples of work done in academic libraries rather than theorizing about it. The discussion that follows amplifies the available evidence on the attainment of SDGs in academic libraries.

Four Pillars of Sustainability

There is a sufficient indication from bibliometric studies that sustainability efforts are already practiced but have not been categorized according to types of libraries (Mathiasson and Jochumsen (2022). This gap in the research literature suggests that the evidence has not tied academic library activities with the SDGs and their targets or indicators. Hence, Mathiasson and Jochumsen (2022) highlight the need for libraries to be explicit about how their activities connect with sustainability, sustainable development, or the SDGs to adequately measure the four pillars of sustainability. This level of reporting has been attempted and fulfilled in the current review.

The current study found that many African academic libraries are taking part in the SDG agenda compared with other regions. This may be attributed to the fact that there is a high diffusion of the SDGs in Africa because the SDGs are rooted in the Millennium Development Goals (MDGs), which were targeted at developing countries, mostly found in Africa (UNESCO, 2017). From the onset of the establishment of the SDGs, some African libraries received high-level political buy-in from their governments, thereby fitting library contributions into national development plans (IFLA, 2015b). This trend is also found in other regions, such as Asia, and may be attributed to the history of the MDGs and the IFLA guidelines (IFLA, 2018, 2019). The evidence from this study is valid because three of the identified libraries (one in Africa and two in Asia) have been awarded the IFLA Green Library Award (Hauke, 2020), which signifies a library's commitment to environmental sustainability and environmental education.

Library Activities With an Impact on SDG Targets/Indicators

In attaining the SDGs, academic libraries concentrate more on the activities linked to Target 4.4 (human capital development), 16.10 (information access), 4.7 (global citizenship), 17.17 (partnerships), and 12.8 (sustainable lifestyles). These targets can be considered as pillars for any sustainability literacy program. For instance, Target 4.4 is closely tied to the university's mission, which is to develop persons with skills that can fit into different industries. Hence, academic libraries can build on Target 4.4 to achieve other targets and indicators if their programing is focused on the SDGs. However, this must be closely connected with obtaining Target 16.10. The interlinkage shows that public access to information on educational resources, job opportunities, and skill development programs reinforces the attainment of Target 4.4. This means that sustainability literacy activities often have a symbiotic relationship if these targets are conjoined, thereby leading to other targets and indicators. However, Pearson's test indicates that this interconnectivity does not work in some circumstances. Figures 4, 5, and 7 highlight the fact that targets and indicators may have better synergies depending on the organizational culture and policies, library activities pursued, sustainability awareness, library leadership, partnerships, and the key performance indicators being sought. This means that the results of this study cannot be generalized without taking these points into account.

Possibly, the differences between this study's findings and the targets and indicators found in the Lyons Declaration could be that the former is empirical, collecting data from academic libraries, while the latter was a conceptualization with no particular library and SDG programming in mind. Target 16.10 is common in both instances; whereas targets related to quality education (Target 4.4 and 4.7) are not found in the Lyons Declaration but are needed for Education for Sustainable Development. Although Target 11.4 and indicators 5b, 9c, and 17.8 are found in this study, they have weak relationships with other

indicators and targets. This may show that the implementation of the Lyons Declaration did not have clear outcomes. Unfortunately, no further comparisons can be made because there is a lack of empirical literature on the declaration, although 600 libraries have given their signature to date.

The review found that most academic libraries map their activities to broad SDGs rather than specific targets or indicators. While some libraries claim to have achieved all 17 SDGs, mapping these activities using target and indicator levels has provided a more accurate picture and uncovered cases of SDG washing. A rule from systems thinking is that the whole is greater than the sum of its parts, yet many parts (targets and indicators) remain unattained for every goal. Reporting at the goal level may be thought of as SDG washing, which is when institutions put up an image that they are engaged in all the SDGs, often to please a funder or the government, but have no full commitment (Heras-Saizarbitoria et al., 2022). Another related problem is that libraries are selective in what they report instead of taking a holistic approach to the process. Bangani (2023) encourages academic libraries to be explicit about their contributions to the SDGs so that they are relevant to both the public and the authorities.

Academic Librarians' Sustainability Awareness

Although there is a low usage of the term *sustainability literacy* in the papers, where it is employed, its conceptualization is similar to that in Hauke (2018). Quite notably, academic libraries have a low interest in green libraries in the pursuit of SDGs. Instead, they adopted a holistic approach, as demonstrated by the complex interconnection of several SDG targets/indicators. Green libraries are appropriate if the library is defined as a place that does not lead to SDG attainment, whereas a holistic approach looks at the library as a place that provides services. Mathiasson and Jochumsen (2022) argue that library activities with a holistic understanding of sustainability and sustainable development recognize SDGs as complex problems that require complex solutions. In this sense, academic librarians are attempting to solve complex societal problems vis-à-vis the SDGs.

Conversely, there are mixed results on the awareness of sustainability literacy and SDGs among libraries. Some librarians are aware of the two concepts, but some have reported a low level of awareness and lack of clarity about the library's involvement. This finding is not relative to a particular region but occurs across different continents. The level of awareness cannot be viewed in a vacuum because it is influenced by the complexity of factors such as the availability of resources, organizational culture, overarching government policies, library leadership, and library activities (using sustainability literacy centred on the SDGs). In this manner, the academic librarian is embedded within the nexus of these issues and has to navigate each of them in a much more complex manner. Dabengwa et al.'s (2019) model, which attributes academic librarians' agency at various levels of embedding information literacy programs, can be adopted to explain why there are various levels of awareness in practising sustainability literacy for the SDGs. Dabengwa et al. (2019) posited that academic librarians embed information literacy in four stages (aspiring, intermittent, partially, and transcending blended librarians) because of the degree of access to resources, organizational culture, and library activities. While Dabengwa et al.'s (2019) model is generalized and was not constructed for any particular course, it can show that embedding SDG information literacy is both an evolutionary and revolutionary process.

There could be instances where librarians evolve into any stage, or this could happen through revolutionary processes when there is a need to do so. For instance, the SDG implementation at the CUHKL and UNISA saw existing library programs being transformed to align with the SDGs while adding new programs as well (Ma & Ko, 2022; Nhamo & Malan, 2021). In other instances, there are differences between SDG implementation in the reported academic libraries, even from the same country or region. However, it is beyond the scope of this paper to categorize each academic library's SDG

implementation according to the model because there is insufficient evidence to make such a distinction from the retrieved studies. However, it is important to note that an academic librarian's level of awareness is not binary but can have different levels, each with unique characteristics.

Organizational Culture and Policy

The lack of resources and supportive policies for sustainability and the SDGs shows the low uptake of sustainability thinking. In some cases, this is part of a larger national problem in which academic libraries are not included in national development plans, such as VNRs. Additionally, librarians may not play an active role in contributing to policy development and advocacy regarding the SDGs. In the literature, Balôck (2020) decries the lack of a supportive national framework in support of SDG localization among Cameroonian libraries. As a result, there are no identified strategic objectives (implementation plan), general objectives (summary of the overall activities), or operational objectives (day-to-day activities aligned with the SDGs) that integrate libraries into the GIF. Islam et al. (2022) found that policymakers failed to include libraries in the SDG agenda because of a lack of awareness, misunderstanding of the importance of libraries, negative attitudes, and general unwillingness. When libraries do not have policies closely linked to the SDGs, the use of the GIF has been encouraged to link library activities (Dei & Asante, 2022).

Leadership

The role of library leadership is central in guiding policy and advocating and liaising with government agencies responsible for SDG localization. However, it is unfortunate to note that there are cases where library leaders misappropriate resources that are critical for SDG attainment (Awodoyin & Ojo, 2021).

Partnerships to Achieve the 2030 Agenda

Partnerships are essential to achieve the 2030 Agenda framework because no one library can afford to perform the activities needed to contribute to the SDGs. In some cases, academic libraries may lack the capacity to advocate for the SDG agenda. Good partnerships then provide resources and lobbying, especially at national forums in which the SDGs are discussed, such as SDG steering committees and VNRs. Although partnerships are critical, the data show that there must be mutual trust between the library and potential partners. It is possible that MOUs can support such trust, e.g., Bangani (2023).

Key Performance Indicators for Measuring SDGs in Libraries

Most studies used SDG stories to determine key performance indicators. Thorpe and Gunton (2022) stated that mapping approaches are more appropriate than measurement or assessment approaches in determining library contribution to the SDGs. Perhaps mapping studies are preferred because there is no standardized tool to measure the SDGs in libraries. The current tools lack content validity because they do not measure the same statements, although some may have similar dimensions. Hence, there is a need to construct a standardized tool that can be applied to academic libraries or perhaps any type of library. This tool should include information sources used to gain knowledge of the SDGs, requirements to actualize the SDGs, awareness of sustainability/SDGs, perceptions of SDGs, relevance of the SDGs in libraries, requirements/strategies to achieve the SDGs, and challenges in achieving the SDGs.

Whether an academic library uses a mapping approach or survey tool, it is important to keep in mind that its mission statements should be aligned with achieving sustainability/SDGs. Business-as-usual

activities should align with sustainability/SDGs, and appropriate structures must be established (e.g., dedicated staff, library SDG committees, and resources).

Positioning the Study in the Current Landscape

This mixed-methods review brings in new insights that have not been explored in previous research—for example, mapping SDG targets to library programs and services and leveraging on sustainability literacy and developing key performance indicators. The usage of the SDG targets to measure library activities instead of the overall goal is more systematic. This strategy may be used by academic libraries to develop specific programs that focus on sustainability or the SDGs rather than relying on business-as-usual activities. Potentially, academic libraries can use the SDG targets to evaluate the weaknesses in their SDG programming to come up with more robust services. Sustainability literacy is shown as a strategy that can be used to teach or reinforce knowledge, skills, and attitudes about the SDGs.

Just like traditional information literacy, sustainability literacy can be imparted using information sources, tutorials, workshops, and awareness campaigns. Finally, key performance indicators are exposed as a monitoring and evaluation tool that should be used by academic libraries to expose success or failure in SDG programming. The review highlights this as a growing area that does not have well-defined tools. It is then up to academic library administrators to develop their tools, perhaps by looking at the best practices from the cited literature or combining the various tools found in this study.

Limitations of the Study

This study endeavoured to review the existing peer-reviewed literature regarding the implementation of Sustainable Development Goals (SDGs) in academic libraries as comprehensively as possible. Nevertheless, the process of coding SDG activities is intricate and not entirely precise, as a single activity may align with multiple goals, targets, or indicators (Thorpe & Gunton, 2022). It is plausible that certain sentences may have been overlooked or assigned codes that were not entirely appropriate. Such limitations are inherent in all qualitative syntheses.

Another limitation pertains to the number of studies identified in comparison to works such as Mathiasson and Jochumsen (2022). Nonetheless, this disparity can be attributed to the study's exclusive focus on academic libraries, as opposed to other library types, to facilitate result comparisons. This approach can be likened to comparing similar entities rather than dissimilar ones. Additionally, Mathiasson and Jochumsen (2022) have examined articles on sustainability alongside those on the SDGs, even though these two concepts, albeit interconnected, are not synonymous. Notably, Mathiasson and Jochumsen (2022) had fewer studies specifically dedicated to the SDGs in comparison to the present study. Despite the limited number of libraries analyzed, the inclusion of academic libraries from various regions and sociocultural backgrounds aims to enhance the generalizability of the findings on a global scale.

Although the evidence originates from 164 libraries worldwide, it is crucial to proceed with caution. All of these libraries may not be fully representative of the practices of other academic libraries omitted from this study.

Future Research

Future studies ought to make decisions on whether these intricate relationships can be integrated into specific narratives related to SDGs or if survey tools complemented by narratives would be more suitable

for evaluation purposes. These decisions should be made after thorough consideration. Notably, reporting on library initiatives using the Global Impact Framework (GIF) provides a more accurate assessment of progress towards achieving SDGs compared to assessments at the goal level, which are susceptible to underreporting or SDG washing. Given the apparent complexity of implementing an effective contribution plan while maintaining regular operations in an academic library setting, GIF-based solutions become even more crucial. Or better still, future studies can use the selected papers to develop a standardized tool to measure the extent to which academic libraries contribute to the SDGs.

Conclusions

This mixed-methods review has answered the overarching research question *In what ways do academic libraries contribute to the attainment of the SDGs?* by demonstrating diverse ways in which academic libraries contribute to the achievement of the SDGs. This review highlights that academic libraries contribute significantly to SDG 4 (Quality Education) by enhancing access to educational resources and supporting lifelong learning. Targets 4.4, 16.10, 4.7, 12.8, and 17.17 were found to be the most influential in SDG programming within academic libraries. A Pearson correlation *R* test showed positive correlations between Target 4.4 and both Targets 16.10 and 17.17. These contributions can be seen through a variety of programs and services that include access to information resources on the SDGs, such as encouraging sustainability literacy and participating in outreach initiatives in the community and partnerships.

However, the review found limited references to sustainability literacy in the context of the SDGs. While some papers mention sustainable library corners and green library activities to promote environmental awareness, their scarcity does not undermine the argument presented in this paper but rather reflects the current situation in a select group of academic libraries. This may indicate that there are few instances in which these academic libraries raise awareness about sustainability and the SDGs despite the increasing importance of the concepts in higher education. The paper also uncovers that some academic librarians lack awareness of SDGs and are hesitant to incorporate them into their library operations.

Nevertheless, this should not deter other libraries that are more familiar with SDGs and have related programs from pursuing their objectives. The reality is that challenges related to the adoption of SDGs exist among the academic libraries included in the study, posing both a challenge and an opportunity to bring about significant change within communities through awareness campaigns and strategic implementation by institutions committed to making a positive impact in line with sustainability's four core principles. In conclusion, academic librarians must meticulously evaluate the complex interrelationships among various factors, including organizational culture/policy, partnerships, KPIs, and leadership roles, when assessing their contributions to the SDGs.

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Appendix A
United Nations Resources

Table 1
Global Indicator Framework for Sustainable Development Goals (United Nations, 2024)

Goal	**Number of targets per goal**
Goal 1. End poverty in all its forms everywhere	7
Goal 2. End hunger, achieve food security and improved nutrition, and promote sustainable agriculture	8
Goal 3. Ensure healthy lives and promote well-being for all people of all ages	13
Goal 4. Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all	10
Goal 5. Achieve gender equality and empower all women and girls	9
Goal 6. Ensure the availability and sustainable management of water and sanitation for all	9
Goal 7. Ensure access to affordable, reliable, sustainable, and modern energy for all	5
Goal 8. Promote sustained, inclusive, and sustainable economic growth, full and productive employment, and decent work	12
Goal 9. Build resilient infrastructure, promote inclusive and sustainable industrialization, and foster innovation	8
Goal 10. Reduce inequality within and among countries	11
Goal 11. Make cities and human settlements inclusive, safe, resilient, and sustainable	10
Goal 12. Ensure sustainable consumption and production patterns	1
Goal 13. Take urgent action to combat climate change and its impacts	5
Goal 14. Conserve and sustainably use oceans, seas, and marine resources for sustainable development	10
Goal 15. Protect, restore, and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and biodiversity loss	12
Goal 16. Promote peaceful and inclusive societies for sustainable development, provide access to justice for all, and build effective, accountable, and inclusive institutions at all levels	12
Goal 17. Strengthen the means of implementation and revitalize the Global Partnership for Sustainable Development	19

Appendix B
Scales for Measuring Sustainability Literacy in the Context of the Agenda 2030

Table 1
Survey Tools

Authors	Response options	Context	Test	SDGs\ Targets/Indicators	Country
Anasi et al., 2018	4-point Likert scale on 3: 1. Awareness of sustainability, 2. SDG activities, 3. Use of ICTs in the SDGs and 3-point Likert scale on 1 dimension: Challenges of implementing the SDGs	Usage of ICTs in academic libraries to contribute to the SDGs 77 academic librarians	Means and standard deviations (SDs)	SDG 4\Target 4.7 SDG 9\Target 9.5	Nigeria
Awodoyin & Ojo, 2021	1. Awareness of sustainability (5-point Likert scale), 5 dimensions with a 4-point Likert scale: 2. Perceptions of SDGs, 3. Relevance of libraries, 4. Challenges and 5. Strategies to achieve SDGs	Librarians' awareness and perception of SDG attainment60 academic librarians	Means and standard deviations (SDs)	SDG 4\Target 4.4 \Target 4.7 SDG 5 SDG 9\Target 9.5 SDG 16\Target 16.10 SDG 17\Target 17.17	Nigeria
Datta & Chaudhuri, 2019	3-point Likert on 2 dimensions: 1. Awareness of sustainability, 2. Sources of information and 4-point Likert on 3 dimensions: 3. Perceptions of ideal activities/relevance of libraries, 4. Challenges and 5. Ideal outcomes	Academic library administrators ' awareness and understanding of sustainability16 academic librarians	Descriptive statistics	SDG 1\Target 1.4 SDG 3 SDG 4\Target 4.4\Target 4.7 SDG 6\Indicator 6. a SDG 7\Target 7a\Target 7.1.2 SDG 8 SDG 10\Target 10.2 SDG 11\Target 11.4 \Target 11.6 SDG 12\Target 12.8 SDG 13\Target 13.3 SDG 16\Target 16.10\Indicator 16.6.1 SDG 17\Target 17.10\Target 17.7	India
Emezie & Igwe, 2017	4-point Likert scale on 3 dimensions: 1. Social responsibility on the	The study explores how librarians'	Spearman rank order correlation	SDG 1\Target 1.4 SDG 2\Target 2.1 SDG 3\Target 3.8	Nigeria

	SDGs, 2. SDG services for rural communities and 3. Challenges in implementing the SDGs	views of community information centres relate to corporate social responsibility for achieving the SDGs. Involves 57 academic librarians	technique at 0.05 level of significance	SDG 4\Target 4.4 SDG 8\Target 8.2 SDG 10\Target 10.2	
Hamad & Al-Fadel, 2022	A 3-point Likert scale with the following dimensions: 1. requirements to achieve the SDGs, 2. Awareness of sustainability/SDGs, perceptions of SDGs, 3. Relevance of the SDGs in libraries, 4. Requirements/strategies to achieve the SDGs, and 5. Challenges in achieving the SDGs	Assessing librarians' perceptions of the library's role in the achievement of the SDGs. 233 academic librarians	Multiway analysis of variance (ANOVA) and F tests between the responses based on different variables (gender, job title, educational level, years of experience, and specialization)	SDG 4\Target 4.4 SDG 4\Target 4.7 SDG 9\Indicator 9.c.1 SDG 10\Target 10.2 SDG 11\Target 11.3 SDG 16\Target 16.10 SDG 17\Target 17.17	Jordan
Igbinovia & Osuchukwu, 2018	The Knowledge Sharing Behaviour Scale (KSBS) consists of 22 items and uses a 5-point Likert scale with the following: 1. Willingness to share knowledge related to SDGs, 2. Initiative to share knowledge related to the SDGs, 3. Frequency of sharing knowledge related to the SDGs, 4. Quality of shared knowledge related to the SDGs, 5. Perception of	Determining the status of knowledge-sharing behaviour among library personnel regarding SDGs72 academic librarians	Multiple regression analysis	SDG 3 SDG 4\Target 4.4 SDG 5	Nigeria

	organizational support for sharing knowledge related to SDGs				
Omekwu et al., 2021	Oral interviews; 4-point Likert scale containing four clusters. Dimensions: 1. Awareness of sustainability, 2. Contributions to the SDGs, 3. Sources of information, 4. Strategies to improve information access, 5. Challenges in accessing SDG Information	Examining librarians' views on the contributions of access to SDG information93 academic librarians	Means and standard deviations (SDs)	SDG 1\Target 1.4 SDG 2\Indicator 2.1.2\Indicator 2.b.1\Target 2.4 SDG 3\Target 3.3\Target 3.7 SDG 4\Target 4.4\Target 4.7\Indicator 4.b SDG 5\Target 5.1\Target 5.2 SDG 6\Target 6.1.1\Target 6.2 SDG 7\Target 7a SDG 8\Target 8.3\Target 8.4\Target 8.6 SDG 10\Target 10.2 SDG 11\Indicator 11.b SDG 12\Indicator 12.a SDG 13\Target 13.1\Target 13.3 SDG 16\Target 16.10\Target 16.2 SDG 17\Target 17.17	Nigeria
Tribelhorn, 2022	3-point Likert scale; 6 dimensions; open-ended questions	Assessing key performance indicators for sustainability and the SDGs used in academic libraries12 participants ranging from large private research and PhD awarding institutions, state colleges, and smaller private colleges to	Factor analysis	SDG 4\Target 4.4\Target 4.7 SDG 6\Target 6.1.1 SDG 7\Target 7.3 SDG 11\Target 11.2\Target 11.7 SDG 12\Target 12.5\Target 12.8 SDG 15\Indicator 15.a	United States

		community colleges awarding associate degrees			
Yap & Kamilova, 2020	5-point Likert scale; 5 dimensions; open-ended questions and multiple choice	Evaluating whether events and services held in libraries are dedicated to increasing women's rights67 participants including moderators, resource persons, regular attendees, or volunteers—for example, invited moderators were faculty members who are experts in their field	Descriptive statistics and rich descriptions	SDG 4\Target 4.4 SDG 5\Target 5.1\Target 5.2\ Indicator 5.c\ SDG 8\Target 8.5 SDG 10\Target 10.2 SDG 11\Target 11.4 SDG 16\Target 16.10\Indicator 16.b SDG 17\Target 17.17	Kazakhstan

Table 2
Mapping Tools

Authors	**Response options**	**Context**	**Data analysis**	**SDG\Targets\Indicators**	**Country**
Atta-Obeng & Dadzie, 2020	Open-ended interviews	Investigating the role of academic libraries in promoting knowledge and skills for lifelong learning opportunities	Content analysis	SDG 4\Target 4.4\Target 4.7 SDG 5 SDG 9\Target 9.5 SDG 16\Target 16.10 SDG 17\Target 17.17	Ghana
Bangani, 2022	Open-ended interviews	Academic librarians' awareness and practices of SDG 5	Thematic analysis	SDG 3\Target 3.4\Target 3.7 SDG 4\Target 4.4 SDG 5\Target 5.2\Target 5.6\Indicator 5.c	South Africa

				SDG 8\Target 8.5\Target 8.6 SDG 10\Target 10.2 SDG 12\Target 12.8 SDG 16\Indicator 16.a\Target 16.10\Target 16.2	
Bangani, 2023	Online interviews and focus discussions	Contribution of CE initiatives in South African public university libraries to SDG 4	Thematic analysis	SDG 1\Target 1.4 SDG 4\Target 4.4\Indicator 4.6 SDG 5\Target 5.6 SDG 9\Indicator 9.b\Indicator 9.c.1 SDG 10\Target 10.2 SDG 11\Target 11.3\Target 11.7 SDG 16\Target 16.10\Target 16.7 SDG 17\Target 17.7	South Africa
Bangani and Dube, 2023	Online interviews and focus discussions	Contribution of CE initiatives in South African public university libraries to SDGs 2, 5, and 13	Narrative analysis	SDG 1\Target 1.4 SDG 2\Indicator 2.1 SDG 3\Target 3.4 SDG 12\Target 12.5\Target 12.8 SDG 13\Target 13.3 SDG 17\Target 17.17	South Africa
Dei & Asante, 2022	Open-ended interviews. 16 academic librarians.	Academic librarians' awareness and practices of SDG 4	Content analysis	SDG 4\Target 4.4 SDG 9\Indicator 9. c.1 SDG 16\Target 16.10 SDG 17\Indicator 17.8.1	Ghana
Halim & Sari, 2023	Observations in the field and interviews with program recipients	Discussing the Corporate Social Responsibility (CSR) program implemented by the Tengku Anis Library at UiTM Kelantan	Self-reflective practice/ Document analysis	SDG 4\Target 4.1\Indicator 4.1.1 SDG 17\Target 17.17	Malaysia
Hauke, 2020	Document analysis	Examining an Outstanding Sustainable Library	Document analysis	SDG 4\Target 4.7 SDG 7\Target 7.3 SDG 12\Target 12.5\Target 12.8 SDG 15\Indicator 15.a SDG 17\Target 17.17	International

Gunasekera & Samarakoon, 2020	Key performance indicators: 1. Physical and mental fitness of the university community. 2. Sustainable environment	Highlighting Sri Lankan librarians' actions to achieve SD goals	Self-reflective practice	SDG 3\Target 3.8\Target 3.9 SDG 4\Target 4.4\Indicator 4.a\ Target 4.6\Target 4.7 SDG 6\Target 6.1.1 SDG 9\Target 9.5 SDG 11\Target 11.4 SDG 12\Target 12.2\Target 12.8 SDG 13\Target 13.3 SDG 15\Indicator 15.2.1\Target 15.1 SDG 16\Target 16.1\Target 16.10	Sri Lanka
Ma & Ko, 2022	Document analysis	Documenting how the Chinese Hong Kong Library attains the SDGs	Self-reflective practice/Document analysis	SDG 3\Target 3.8 SDG 4\Target 4.4\Target 4.7 SDG 8\Target 8.4 SDG 9\Target 9.5 SDG 12\Target 12.8 SDG 16\Target 16.10\Target 16.7 SDG 17\Target 17.17	China
Mamtora et al., 2021	Document analysis	Role of the academic library in contributing to the reconciliation process in Australia through the lens of James Cook University	Self-reflective practice/Document analysis	SDG 4\Target 4.4 SDG 10\Target 10.2 SDG 11\Target 11.4 SDG 16\Target 16.7\Target 16.10	Australia
Mbagwu et al., 2020	Document analysis	Exploring the contributions of academic libraries in achieving SDGs 2 and 3 in Ghana, Nigeria, and Uganda	Document analysis/Content analysis	SDG 1\Target 1.4 SDG 2\Target 2.5 SDG 3\Target 3.3\Target 3.4\Target 3.5\Target 3.6 SDG 4\Target 4.4 SDG 8\Target 8.2 SDG 9\Target 9.3\Indicator 9.b\Indicator 9.c.1 SDG 12\Target 12.8 SDG 15\Indicator 15.a SDG 16\Indicator 16a\Target 16.7\Target 16.10	Ghana, Nigeria, and Uganda

				SDG 17\Target 17.6\Target 17.17	
Missingham, 2020	Case study	Evaluating 4 SDGs across the International Alliance of Research Universities network using ISO 16439	Document analysis/Content analysis	SDG 1\Target 1.4 SDG 3\Target 3.4 SDG 4\Target 4.4\Target 4.7 SDG 5\Target 5.1\Target 5.5 SDG 8\Target 8.5 SDG 9\Target 9.5 SDG 10\Target 10.2 SDG 11\Target 11.4 SDG 16\Target 16.1\Target 16.10	International
Nhamo & Malan, 2021	Participatory research and document analysis	How UNISA libraries are achieving SDGs	Self-reflective practice/Document analysis/Content analysis	SDG 1\Target 1.4 SDG 3 SDG 4\Target 4.4\Target 4.7 SDG 9\Indicator 9.c.1\Target 9.5 SDG 11\Target 11.4 SDG 12\Target 12.8 SDG 16\Target 16.10 SDG 17\Target 17.17	South Africa
Nga & Pun, 2022	Document analysis	Evaluating how open science initiatives lead to SDGs	Document analysis	SDG 4\Target 4.4 SDG 9\Target 9.5 SDG 11\Target 11.4 SDG 12\Indicator 12. a SDG 17\Target 17.6\Target 17.17	China
Owusu-Ansah, 2021	Interviews and observations	The role of university libraries in Ghana in contributing to Sustainable Development Goal 4	Document analysis/Narrative analysis	SDG 1\Target 1.2\Target 1.4 SDG 3\Target 3.8 SDG 4\Target 4.1\Target 4.4\Target 4.6 SDG 5\Target 5.5 SDG 8\Target 8.3 SDG 9\9.c SDG 10\Target 10.2	Ghana
Thorpe & Gunton, 2022	Mapping	Mapping library activities and business-as-usual project outcomes and performance to the SDGs	Document analysis	SDG 4\Target 4.7 SDG 16\Target 16.10 SDG 17\Target 17.17	Australia