A BOTANIC GARDEN AS A POTENTIAL SOCIAL LEADER IN EDUCATION FOR SUSTAINABLE DEVELOPMENT THROUGH COMPUTER-MEDIATED COMMUNICATION

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ABSTRACT

When many are experiencing the impact of human disconnect with the natural environment,

botanic gardens are well-positioned to contribute to reconnection through sustainability education.

Globally, whilst many botanic gardens highlight the impact of human endeavours on the natural

world, we question the use of computer-mediated communications (CMC) to enhance knowledge

sharing and encourage pro-sustainability actions across communities. Through the lens of social

leadership and undertaking a mixed methods study, we explore the potential for one UK-based university botanic garden to lead on education for sustainability with the broader community using CMC. The findings highlight the desire of the staff and volunteers to increase the usage of CMC tools to enhance community engagement and disseminate information. Findings also indicate a need for greater autonomy and an intrapreneurial mindset to amplify knowledge and strengthen action across diverse networks that are not predesigned or imposed by organisational constructs.

Keywords: sustainability, education, digital technology, social leadership, botanic gardens, intrapreneurship.

INTRODUCTION

Sustainable development has grown as a concept since its inclusion in the Brundtland Report (Brundtland Commission, 1987), where it was defined as meeting "the needs of the present without compromising the ability of future generations to meet their own needs" (p.15). More recently, the United Nations Educational, Scientific and Cultural Organization (UNESCO, 2017) highlighted a central focus on integrating sustainability into education as a catalyst for change, arguing that there has never been greater momentum for change than now. More than ever, sustainability education is necessary for everyone if we are to minimise human-related planetary destruction (Zelenika *et al*., 2018; UNESCO, 2020). As the realities of global climate change are becoming increasingly observable, education for sustainable development (ESD) permits everyone to critically review how the world is and visualise how the world might be in the future (The Quality Assurance Agency for Higher Education and Advance HE, 2021).

With over 3,000 botanic gardens (Romano, 2008) and, globally, an estimated 240 million physical visits per year (Zelenika *et al*., 2018), botanic gardens are well-placed to enhance ESD. Beyond the physical visits, there is an opportunity to extend ESD to a much larger audience by using computer-mediated communication (CMC) tools. As Romiszowski and Mason (1996) outlined, CMC elucidates how individuals share information through digital technology and can play a supportive role in facilitating conversational discourse (Ahern *et al., 1992)*. Such tools include social networking sites (SNS), for example, Facebook, X (formally Twitter), LinkedIn and Instagram. Note, due to the date of the data collection being completed before the rebranding from Twitter to X (Counts and Levine, 2023), we maintain the name Twitter throughout the paper. Through a small-scale case study of one botanic garden, we question to what extent and how a botanic garden uses CMC to lead ESD.

LITERATURE REVIEW

Education for sustainable development
The turning point for ESD was during the 1992 Rio de Janeiro Earth Summit, when the UN escalated Agenda 21, recognising the role of education as a necessity if we are to progress towards a sustainable future (United Nations, 1992). Complementing this, at the World Conference on Education for Sustainable Development, ESD was defined as "an approach to teaching and learning based on the ideals and principles that underlie sustainability" UNESCO (2009: 8). The blueprint for ESD is located within the United Nation's 2030 Agenda for Sustainable Development and its 17 Sustainable Development Goals (SDGs), alongside its inclusion in landmark agreements, namely, the

UN Framework Convention on Climate Change (UNFCC) and Convention on Biodiversity (United Nations, 2015; Maruna *et al.*, 2018). Essentially, ESD points to the practice of teaching for sustainability (Grosseck *et al.*, 2019) regardless of the discipline, sector or field. As a result, it is crucial to recognise that educating for sustainable development requires diverse learning and teaching approaches to be accessible to all.

With the evermore pressing global concerns such as climate change and large-scale ecological and environmental degradation, sustainability is a topic that we all need to understand (Simionescu *et al.*, 2020) if we are to respond to these issues as a global collective. Yet, according to Zelenika *et al.* (2018), promoting public engagement to encourage individual action continues to be challenging for institutions, organisations and governments. Still, the authors acknowledge using innovative methods to promote sustainable understanding and practices. Regardless of the learning format, ESD aims to change the approach to sustainability education by incorporating values, principles and successful practices into learning (Elmassah *et al.*, 2021). For this reason, ESD is an educational change agenda (The Quality Assurance Agency for Higher Education and Advance HE, 2021).
One of the 17 SDGs in its own right, integrated, inclusive, quality education underpins all other SDGs as well. For example, promoting integrated water resource management, ocean sustainability, protection of biodiversity, mitigating and adapting to climate change, advancing sustainable cities and deepening social inclusion. Within UNESCO's (2017: 6) report,

> "*Education is both a goal in itself and a means for attaining all the other SDGs. It is not only an integral part of sustainable development but also a key enabler for it. That is why education represents an essential strategy in the pursuit of the SDGs.*"

Accordingly, education is a powerful means to develop a more sustainable future (Blessinger *et al.*, 2018); it is a foundation for acting upon all sustainability goals constituting the environmental, economic and social realms for sustainable development (Albarenda-Tiana *et al.*, 2018; Bolmsten and Kitada, 2020). With this view, ESD is a dominant force for a prosperous future as continuous, quality education enables individuals and communities to flourish through increased knowledge and skills development (David and Ibrahim, 2020). ESD supports people in identifying and addressing sustainability-threatening problems (UNESCO, 2008), enabling adaptive and responsive action to our ever-changing realities, and facilitating transformation to alternative planetary futures (Sharma and Kelly, 2014). If education is the inclusive and integrated keystone in tackling global issues, then we must consider education beyond formal education systems. Using CMC may provide a valuable medium for ESD to establish learning across the broad spectrum.

Botanic gardens

Whilst the focus for botanic gardens has typically centred on horticulture and taxonomy developments, more recently, emphasis surrounds addressing the broader *ex-situ* sustainability and conservation challenges alongside public education (Wyse Jackson and Sutherland, 2000; Donaldson, 2009; Williams *et al*., 2015; Frediani, forthcoming). As noted by Zelenika *et al*. (2018), institutions such as botanic gardens, whilst holding documented collections of living plants for scientific research and plant conservation, 'there is a tremendous, yet untapped opportunity for gardens to re-connect communities with the natural world' (p.1582). Also, as Williams *et al*. (2015) highlighted, they constitute meaningful educational contexts and are working to increase audiences. From this, it is evident that education should be viewed as a principal function of botanic gardens (He and Chen, 2012; Gao and Weibang, 2018; Faraji and Karimi, 2020). In essence, ESD is a primary objective for botanic gardens (Willison, 2006).

Educational initiatives within botanic gardens register different forms. These include coordinating workshops, guided tours (Kneebone, 2006; Jensen, 2014), community outreach (Krishnan *et al*., 2019), adult education and certification programs, internships, family activities, children's summer camps, and field trips as part of school programs and teacher training (BGCI, 2010; Krishnan and Novy, 2016). Additionally, Faraji and Karimi (2020) report that community-based research and education collaborations provide meaningful opportunities for botanic gardens and nature-based organisations to contribute to sustainability education directly. Against this backdrop, and as a result of their multifaceted wealth of resources (Willison, 2006: 8), botanic gardens have a responsibility concerning ESD and challenging the public to live sustainably with others, including their relationship with the non-human world (Huckle, 1996: 35).

In addition to the environmental aspects, botanic gardens also hold responsibility for various economic (Benfield, 2013; Connell and Page, 2014; Flôres Limberger *et al*., 2014) and sociocultural elements (Connell, 2005; Ward *et al*., 2010; Frediani, forthcoming). As previously indicated, many of these elements are located within the SDGs, such as Responsible Consumption and Production, Good Health and Wellbeing, and Zero Hunger (United Nations, no date). Thus, the research underlines the value and importance of botanic gardens as an educational catalyst (Moskwa and Crilley, 2012; Catahan, 2018), going beyond horticulture. Indeed, Willison (2006) and Sellmann (2014) document that by providing information and sharing expertise to support the development of ESD programmes, particularly in the local environment, botanic gardens offer appropriate learning spaces. In turn, this aids in helping individuals and communities to make informed decisions about

sustainability issues that may impact life, now or in the future; therefore, botanic gardens need to remain at the forefront of ESD.

Computer-mediated communication

A way for botanic gardens to remain at the forefront of education for sustainable development is to use CMC. CMC describes how people disseminate information to others using digital technology (Romiszowski and Mason, 1996) and can assist in conversational discourse (Ahern *et al*., 1992) between 'groups, or individuals separated by time and space' (Marani *et al*., 2020: 97). Whilst we are not suggesting that digital interaction replaces the direct contact of physical visits, where connecting with nature as a sensory experience takes place, there is a space to share ESD knowledge through CMC. The internet has no doubt revolutionised learning and offers powerful opportunities to utilise technology for educational purposes inside and outside of the formal classroom (Wang *et al*., 2022). Using CMC promotes self-directed learning (Asfar and Zainuddin, 2015), public awareness of environmental subjects such as climate change (Mavrodieva *et al*., 2019), and allows individuals and organisations to appear more visible (Treem *et al*., 2020). However, keeping abreast of CMC applications is crucial as these change over time in tandem with the development of new social norms and technology platforms (Treem et al., 2020). A popular application of CMC is disseminating information through SNS. Recognising this and the intensive use of social media by young people, alongside their interest in the sustainability and climate issues affecting the world (Thigpen and Tyson, 2021), has been one of the reasons behind our consideration of the use of this media. Moreover, the general use of social media across all age groups has increased, driven in part by this becoming the way of communication (Petricini, 2022), and this is seen as an important mechanism by which to share information on sustainability.

When developing digital content for internet distribution, creators must establish an imagined audience to guide online behaviour. The development of such an audience can consider behaviours displayed by a real audience, the creators' skills in developing socially acceptable content and the motivation to engage with social media content (Litt, 2012). The quality of digital interactions can vary depending on the platform used (Oz *et al*., 2018) and the skill set of those developing content. For successful use of CMC, organisations must consider i) the motivation that staff have to engage with specific media, ii) the knowledge that staff have in a given subject area, and iii) their overall skill in using technology (Le *et al*., 2022). Furthermore, many end-users can be classified as lurkers, where they will read the content but not engage with it (Cranefield *et al*., 2015). This passive online

behaviour can be related to users' unwillingness to create a social investment in future content from a given source (Ellison *et al.*, 2020).

CMCs, such as SNS and websites, have become significant for organising various human activities, including economic, social and political interactions (Asadullah *et al.*, 2018). Whilst the use of CMCs is an opportunity to provide content developed to raise awareness and understanding through connectivity with their audience, studies investigating their impact on informing the public of sustainability endeavours remain limited. Moreover, our exploration of the literature suggests a gap when positioning the research in the context of botanic gardens.

Social leadership

In this study, we do not consider 'leading' as an individual endeavour. Instead, we aim to understand 'leadership' in the field of ESD as a collective, knowledgeable community. Here, we draw from Guglielmo and Palsule (2014), who define a community as a group of individuals with a shared passion. Progressing from the industrial age, we require leadership that detaches from hierarchical power structures and advances knowledge and digital eras into the social age. The social era requires leadership forged through, among other things, communities, connections, networks, collaboration and communication (Stodd, 2016) and individuals being prosumers who are engaged, proactive contributors (Guglielmo and Palsule, 2014: xiv). All of these are central to social leadership (SL), a stance that underpins our research.

Leadership through an SL lens removes itself from many common concepts in leadership texts, such as leader-centric personalities and decision-making. Social leaders are altruistic (Saunderson, 2018) and drive change by constructing, connecting and engaging the power of diverse and inclusive communities where reputable meaning is co-created, curated and shared through narratives (Stodd, 2016; Saunderson, 2018). Social leaders orchestrate adaptive change across various groups and communities (Porteous, 2013: 524) and release geographical shackles (Guglielmo and Palsule, 2014). The power of SL builds upon discovery (Porteous, 2013), transparency, trust, integrity and collective ventures (Stodd, 2016); it is founded on content and reputation rather than 'simple positional authority" (ibid., p.8).

Effective use of CMC can drive high levels of engagement and connection. In turn, through sharing co-constructed narratives to educate and empower the audience, not only does CMC help to build reputation and momentum, but according to Stodd (2016), it also brings about social change and, subsequently, environmental change. While we realise that not everyone has access to digital

technology or wishes to utilise it, its use does mean that cross-boundary dialogic communication is enabled synchronously and asynchronously across a broad audience. Accordingly, digital technology is central to SL (Biro, 2013), with Stodd (2016: 33) reporting, "without the technology, you can't be a Social Leader".

Bearing in mind the complex nature of botanic gardens in terms of their continuously evolving social and environmental roles and the communities they serve, SL is a valuable lens to explore the use of CMC in leading ESD. Social leaders balance the complexities between formal and informal organisational structures. Therefore, it is particularly relevant to the context of the botanic garden situated within the larger organisation of a university.

In summary, the existing body of literature presents persuasive evidence of botanic gardens' role in advancing ESD, offering a unique and advantageous opportunity to integrate the different SDG fields (Leal Filho *et al.*, 2019; Michael *et al.*, 2020). The utilisation of CMC not only offers innovative avenues for botanic gardens to disseminate their expertise in ESD but also serves as a powerful catalyst in enhancing public awareness and fostering self-directed learning. As a result, we explore how one UK-based university botanic garden utilises opportunities to lead environmental ESD through CMCs and underpin our work with SL.

METHODOLOGY

In response to our research questions - (i) 'To what extent does a botanic garden use CMC to lead ESD?' and (ii) 'How does a botanic garden use CMC to lead ESD?', we adopted a case study methodology. Case studies allow researchers to penetrate multiple realities and unique portrayals of situations (Lincoln and Guba, 1985) whilst recognising the complexities and numerous variables in operation within any given case (Cohen *et al.*, 2018). A case study is preferred when the research questions surrounding a contemporary social phenomenon are 'how' or 'why' (Yin, 2014). By way of such an approach and "bounding the case" (Yin, 2014: 33) within a social boundary (Gerring, 2017), this research aimed to explore the use of CMC in leading environmental ESD through an SL perspective within one botanic garden.

Context

The study was conducted in a UK university botanic garden, Sequoia Botanic Garden (pseudonym). The over 50-year-old garden is located on almost ten hectares in an affluent area of a coastal city. With a team of 32 paid and voluntary staff and three students, the garden accommodates over 80,000 visitors annually and works closely with multiple partners across the city and neighbouring regions. The garden hosts many activities, such as educational visitors, nature-based art exhibitions

and theatre groups. As part of a larger organisation, this brings additional complexities to the garden's operational and strategic activities.

Like many botanic gardens, the site has seen the demise of botany and the rise of life (plant) sciences with a key focus on the impacts of climate change, population increases and conservation efforts. We purposefully selected the site as the garden is located within a wider organisation—a university—and this potentially increased the constraints and opportunities for ESD, therefore providing us with a deeper understanding of the impacts and possibilities. Moreover, the garden makes an ideal context to explore the leading of environmental ESD using CMC tools because of the curator's unique and specific focus on environmental and ecological sustainability as a management approach and its role as a sustainable development research and outreach hub.

Research design

We employed a complementary mixed methods approach (Bazeley, 2018; Poth, 2018), drawing from content analysis and questionnaires. By collecting data and integrating the findings, we obtained a deeper understanding of the phenomenon by weaving two data types from different sources based on common themes.

Following the piloting for each data type, we collected data from the following sources:

1. *Content analysis*: A sample of social media platforms (such as Twitter, Instagram and Facebook) and the garden's web pages were selected for scrutiny and analysis through quantitative data (such as the number of followers and engagement) and qualitative content. Using the questionnaire themes as a starting point, we obtained and analysed data for three months (January to March 2022).

2. Questionnaire: The use of questionnaires enabled participant anonymity, which allowed more honesty (Blair *et al*., 2014). Using Jisc (no date) online survey platform offered an opportunity for volunteers and staff from the garden to anonymously share their insights on the garden's use of CMC to promote ESD. We obtained institutional ethical permission, and all respondents provided consent as part of the questionnaire design. We prepared a 23-item questionnaire with a series of short sections on:

    - General views on sustainability
    - Use of technology
    - Use of and views on social media
    - Views on the botanic garden's social, web pages, and other technologies.

Applying mixed methods, we elicited quantitative data in the form of yes/no or rating scale responses to provide a numerical description of participant opinion. Further, each section also allowed an opportunity for qualitative responses by providing additional space for participants to expand their answers to give greater insight. It also included four open-response questions surrounding the garden's strengths, weaknesses and recommendations for using CMC tools for ESD.

For this research, we have drawn from two independently generated data sources. We used descriptive analysis for the quantitative data. Cohen *et al*. (2018) note that descriptive analysis often uses frequencies and percentages and visual presentation showing the relationships between the variables. The questionnaire themes were then utilised to drive the qualitative data analysis. An oscillating approach was applied to the data analysis through a back-and-forth movement between the questionnaire's quantitative descriptive statistics and qualitative thematic analysis (Beresford-Dey, 2020). The findings for the content analysis were then integrated. Throughout this phase, we used Bazeley's (2018: 282) reflective questions to aid the analysis:

- What have we learned?

- What do we know?

- How do all of the pieces of evidence fit together?

- Is there a story to tell?

Recruitment and sample

Taking a voluntary participation approach, participants were invited to complete the questionnaire via an email invitation, which the garden administrator shared across the garden's paid and voluntary staffing team. Whilst we recognise that the perspectives of different stakeholders, including the end-users of the garden, would be beneficial, we have targeted the staffing team in the first instance as they have specific knowledge of the garden working within the realms of the university alongside the garden's aims and vision. The sample consisted of 25 volunteers and paid staff, resulting in a 78 per cent response rate. None of the participants indicated being under thirty years old, twenty-two were between the ages of thirty and sixty-five, three identified as sixty-five or over, and two-thirds of the sample were male.

FINDINGS

The data from the 23-item questionnaire and the content analysis provided details surrounding the delivery of environmental sustainability at the botanic garden through CMC and how the

participants perceived this. This section explores five themes drawn from the twenty-five participants, as reported above.

The topic of sustainability

All participants considered sustainability an important topic (Fig. 1). Also, 84 per cent of the respondents reported understanding the concept of sustainability well or very well, with some stating their professional and/or academic expertise. For example, having previously studied for a Master's degree in sustainability, working in the field and lecturing land-based studies. Regardless, with almost all respondents considering this an important subject, there was still a willingness to learn more about the subject matter. One participant highlighted the need to "learn more from experts". Others indicated the need to know more about the positive and negative impact of action alongside cost-effective sustainability, particularly because the botanic garden was "tempered by financial challenges".
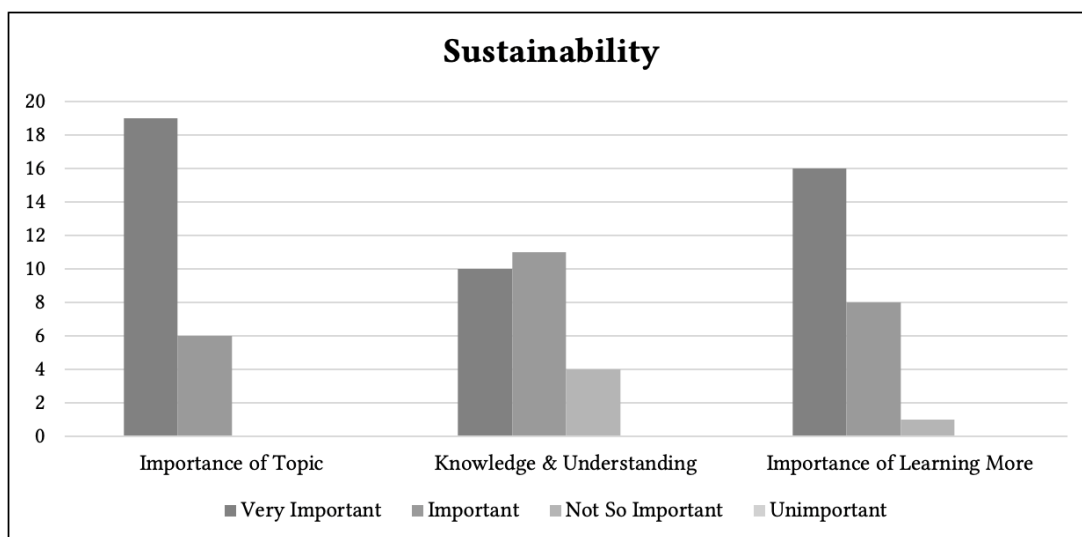

Fig. 1. Questionnaire data showing participant perceptions about sustainability.

Sustainability and CMC tools

Next, we explored the usefulness of CMC tools in sharing information on sustainability (Fig. 2). All participating voluntary and paid staff considered social media platforms helpful; the majority also reported web pages as valuable. Five respondents who indicated not utilising CMC tools highlighted various reasons, for example, lack of access to personal technology, lack of know-how, perceived as time-consuming, disengaging content and lack of information. One respondent commented that although they "look things up" when needed, they had not considered doing so concerning

sustainability. Whilst it is crucial to consider individuals who do not have technological tools or know-how, for those who do, the provision of environmental sustainability information requires a proactive approach from the botanic garden's team to enhance user engagement by sharing valuable and current content through instant and simple methods—such as, through regular e-newsletters and various social networking sites. Unfortunately, none of the participants provided any insight as to why they thought CMC tools were useful.
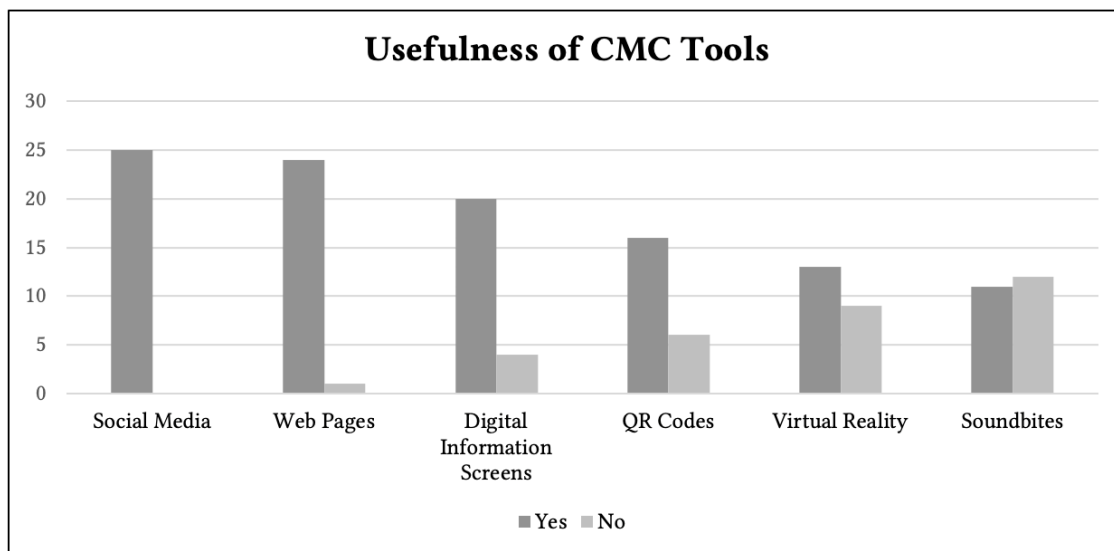

Fig. 2. Questionnaire data showing participant perceptions about the usefulness of Computer-Mediated Communication.

Social networking sites (SNS)

We unpacked social media further to establish which sites were used the most, commencing with general access. When questioned about engaging with the botanic garden's SNS, just over half of the respondents indicated they did not engage. Of those who did (Fig. 3), it seems that engagement via social media is weak, particularly for Instagram, TikTok and YouTube. However, from the content analysis (Table 1), it soon became apparent that the gardens did not have accounts for TikTok and YouTube, nor a formal account for Instagram; therefore, the lack of engagement was unsurprising. The questionnaire reported a larger number of participants accessing Facebook, Twitter and WhatsApp, yet a particular frontrunner remained elusive. From the content analysis, the largest audience was via Facebook, but the informal Instagram account had slightly higher postings. The data suggest some overlap between the content on the two platforms, yet there was little evidence of ESD postings. We could not access a WhatsApp group, so no further information could be obtained surrounding this platform. LinkedIn, Google News and Tumblr were identified within the

qualitative responses as spaces for occasional engagement. However, the garden does not appear to use these platforms formally, particularly surrounding ESD. Instead, some individual members disseminated garden-related information via their personal accounts.
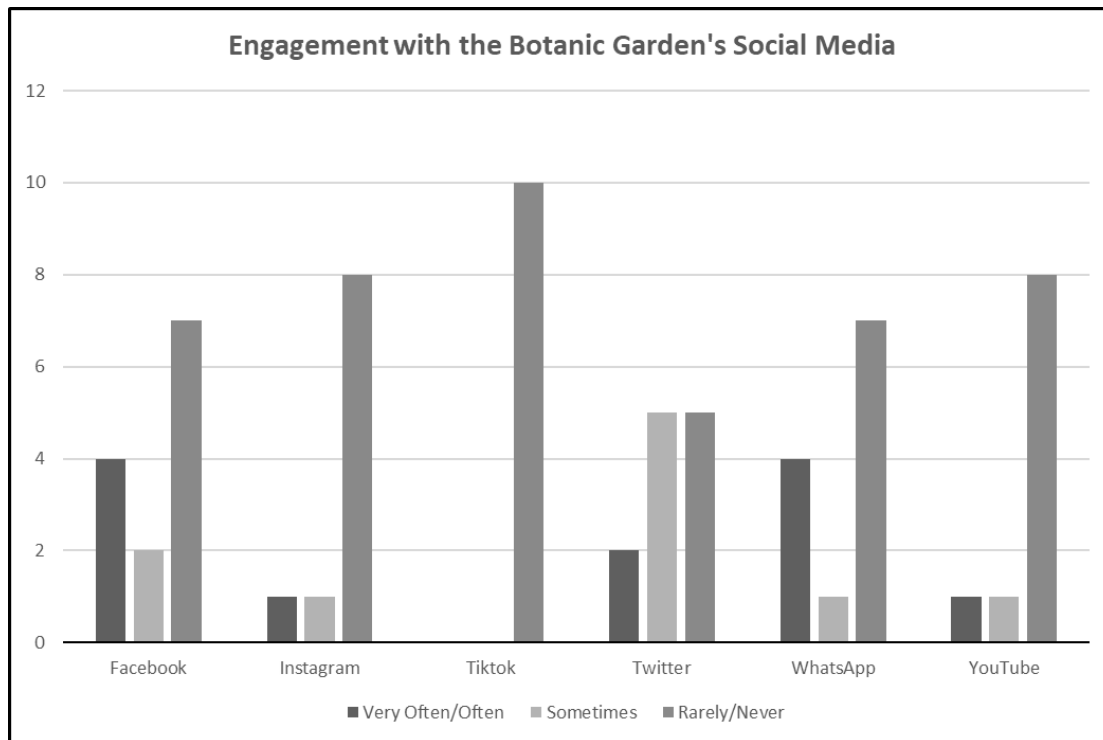

Fig. 3. Questionnaire data showing participant engagement with the various social media platforms related to the botanic garden.

Table 1: Content analysis data of various social networking sites.

Platform	Account	Number of followers	No of Postings	Content
Facebook	Formal	Almost 3000	13	Gardens-based arts and culture events Local project information Videos about the garden Weather-related closures Wider organisational events Other
Instagram	Informal	Less than 1000	14	Gardens-based arts and culture events

				Image of flowers/plants/trees (no narrative)
				Images: flowers/plants/trees (with narrative)
				Local and national project information
TikTok	No account	N/A	N/A	N/A
Twitter	Formal	Less than 1000	0 (the last posting appeared in 2020)	N/A
WhatsApp	N/A	N/A	N/A	N/A
YouTube	No account	N/A	N/A	N/A

Overall, 78% of the participating voluntary and paid staff thought the garden used social media well to inform the public about sustainability. However, one open response emphasised the need for more coordinated posts across the platforms; it noted their struggle in locating the botanic garden on Instagram (perhaps due to the informal account) alongside Twitter's limitations in giving in-depth information. Despite this, the qualitative data highlighted several strengths. For example, the mix of information shared through images and information, including event notifications—according to one participant, this demonstrates the authenticity of the garden's work. Furthermore, positive views of postings surrounded the garden's connection to the (local) city. That said, the content analysis did not reflect these strengths concerning ESD.

Some offered suggestions to strengthen ESD across the garden's different media platforms. These included:

- A need for a dedicated role where "resources are allocated" to "build a programme of posts linked to key themes and activities taking place within the garden across the whole year"
- "Developing stories that connect with live projects and ongoing sustainable work in the garden and across the [organisation] grounds"
- "More advice on what people can do as individuals"

- From a local perspective, it "would be good to see more about local sustainability—both how the Botanics works on this and things you can do locally to live more sustainably".

Continuing the sense of the local community, one highlighted the potential for a "better connection with academia" to act "as a local and regional exemplar to promote ongoing initiatives and research programmes". Finally, another noted the potential of utilising the platforms to share general sustainability information, giving examples of "traditional materials used in horticulture such as peat", "alternative power" […] and "water collecting and saving" methods.

Web page usage

The key findings of the web page content analysis highlighted the embedded nature of the garden's web page within the larger organisation's website. They included features such as the homepage, an "about the gardens" page, news, visitor information, event listings and education. The education section contained information about the garden's onsite projects alongside those further afield. Although these projects are not directly related to ESD, some narratives were given in the periodic newsletters highlighting wildlife news within the garden. While the information was clearly presented, the ESD content appeared limited.

Turning to the questionnaire, only three respondents indicated using the garden's web page often. For most, web page visits were an occasional undertaking, and six respondents indicated they had never used it. When questioned about the purpose of their visits, the responses (Fig. 4) mainly focused on events and garden information such as opening times. Three responses reported seeking information on sustainability, whilst other areas included conservation, horticulture, research and education. Yet, the content analysis showed a lack of information regarding these themes.
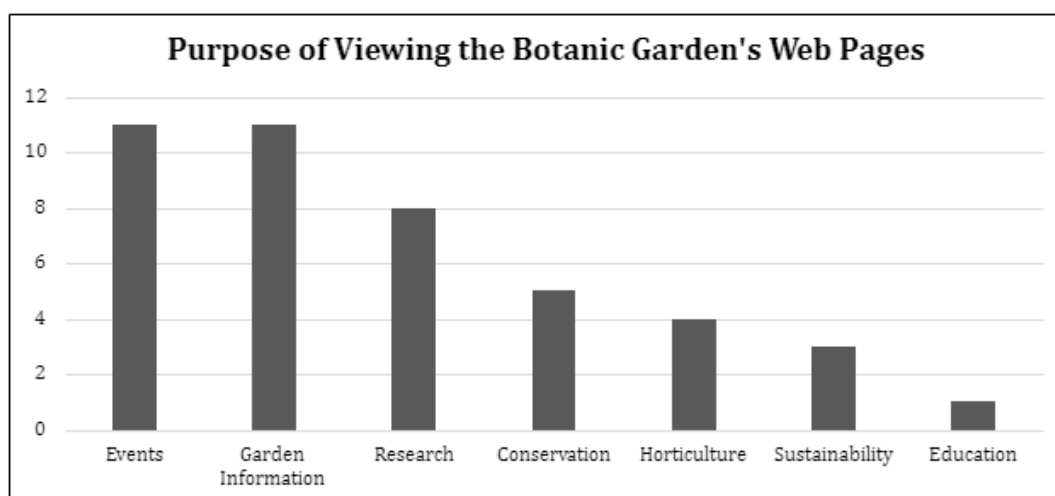
Fig 4. Questionnaire data showing the purpose of the participants' botanic garden web page viewings.

One individual commented, "There's a lot of great stuff on there, and the overall design seems nice and uncluttered". While others were less than positive in their comments, for example, "There is room for improvement", and "[I] can't find information on sustainability on the garden's web page". Although we need to recognise the garden as part of a larger organisation and the need to align the organisational design and brand, both comments chimed with our analysis. Similarly, one respondent stated:

> "This [the website] is not a strength currently, while initiatives that have begun in 2021 [name of initiatives removed to preserve the garden's identity] are embedded in the web pages, the content is not clear nor easily navigated by a visitor".

Several recommendations were suggested to enhance the web pages, including "embedding clear messages about sustainability", promoting broad "climate change challenges", and "sustainability research". Focusing on the web page's operational components, a respondent highlighted the need for "a dedicated page with nested levels of knowledge embedded", including "hyperlinks to work taking place in the garden or elsewhere within [the organisation]". Others suggested the use of "podcasts" or a "blog style format" rather than "static web pages" and including information about physical visits such as "self-guided trails" alongside showcasing "local case studies". Regardless of these suggestions, one participant noted that the virtual space would need widely promoting by "making it a more prominent and explicit part of the site", which chimes with the need for a dedicated page with nested levels.

Beyond SNS and the web pages, many respondents (65 per cent) did not have an awareness of the garden using other CMC tools. Of those who did, QR codes appeared to be the primary mechanism for distributing information. Information from the qualitative data highlighted that QR codes have only recently been trialled (2021) in collaboration with other partners and linked to specific events promoting education for sustainability.

Perceptions of the Botanic Garden's role in leading ESD

All participating voluntary and paid staff reported the importance of the botanic garden in educating on sustainability and environmental issues. Delving further, half of the respondents indicated that the garden uses social media and their website well (53 and 50 per cent, respectively), with other

technologies appearing under-utilised, with 85 per cent not using this well or only 'somewhat'. Thus suggesting further opportunities to educate the community on sustainability issues through CMC.

Referring to Fig. 5, sharing internal event information was a strength, with 68 per cent of respondents reporting this as being done well or very well, yet this reduced to less than half when sharing external event information. Sharing ideas on sustainability was viewed positively by 58 per cent of the respondents. Still, when questioned about the garden providing tips for improving sustainability, the data flipped, with 58 per cent identifying this as a weakness. Enhancing knowledge through videos was viewed negatively by 80 per cent of the participants. The data was split even when improving knowledge through images was considered. Similar outcomes were reported for improving knowledge through well-researched posts, with 56 per cent noting this feature positively. Once again, the overall perception of the gardens making sustainable education easy and convenient did not show a substantial strength, with 53 per cent reporting this positively. These results align with the content analysis findings of limited information surrounding ESD.
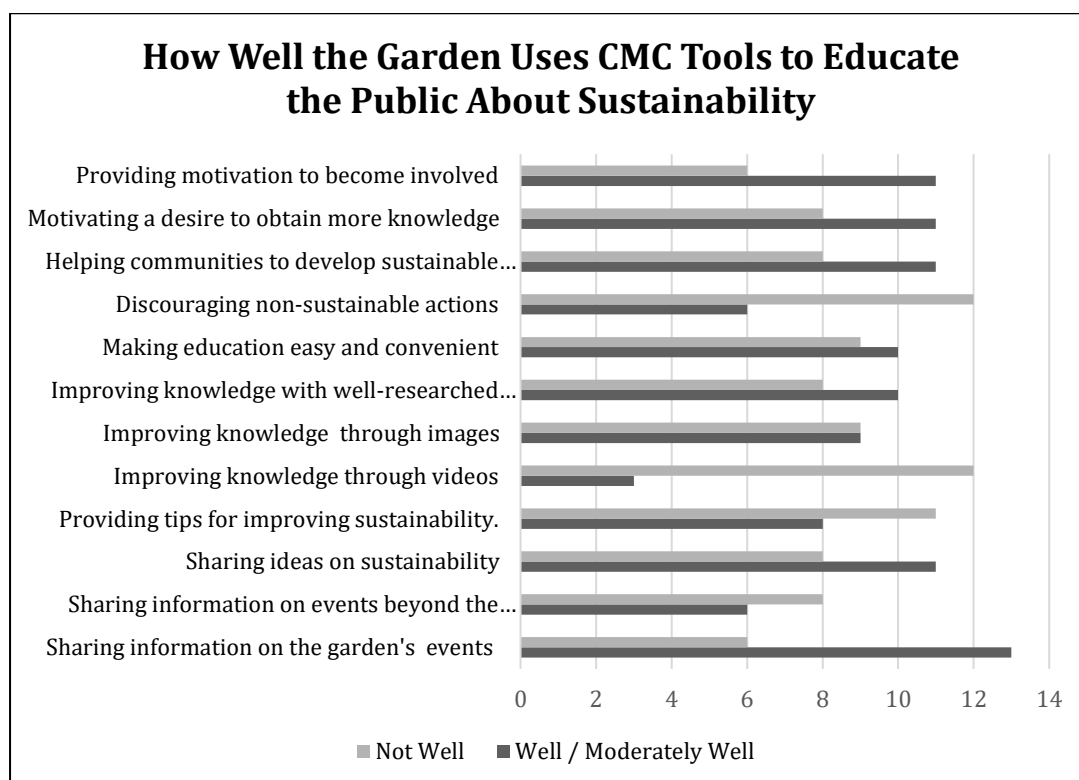

Fig. 5. Questionnaire data showing the participants' perceptions of how well the garden uses CMC tools to educate the public about sustainability

When asked about the garden's use of CMC as a source of motivation to learn more about sustainability or to be involved in sustainability activities, the results (Fig. 6) were weighted in a favourable direction, with 58 and 65 per cent (respectively) reporting this to be well or moderately well.
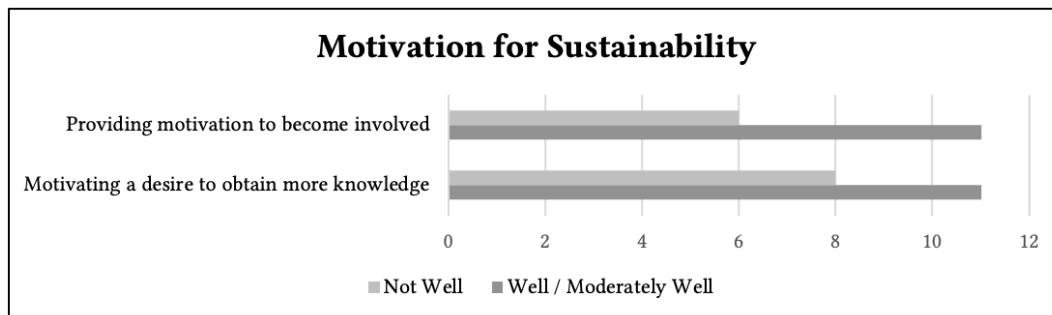

Fig. 6. Questionnaire data showing participant perception of the garden's use of CMC as a source of motivation relating to sustainability.

Finally, we asked the participants for their perspectives on how well the garden uses CMC tools to discourage non-sustainable actions and help communities develop sustainable activities (Fig. 7). Regarding discouraging non-sustainable actions, 67 per cent responded that this was not a feature that the Botanic Garden did well with 42 per cent of participants responding "not well" when focusing on helping communities to develop sustainable practices. The evidence suggests there is a need for some improvement to drive pro-sustainable activities.
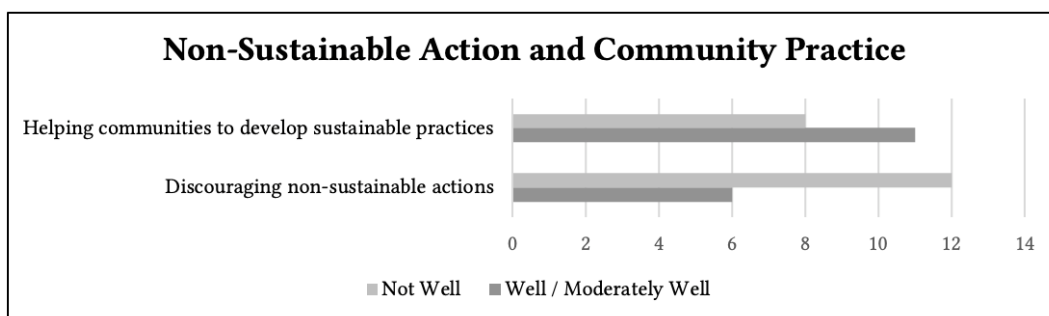

Fig. 7. Questionnaire data showing participant perceptions concerning sustainable and non-sustainable actions.

DISCUSSION

Within the context of a botanic garden underpinned by social leadership (SL), this mixed methods study set out to learn more about how SL offered us a model that illuminated insights into the extent and how a botanic garden uses CMC to lead education for ESD. Education is a catalyst for change toward building a more sustainable future (UNESCO, 2017; Blessinger *et al*., 2018), and as we have

highlighted, educating others on sustainability is a fundamental role of botanic gardens (Romano, 2008). Although our findings have drawn primarily from the questionnaire data with the paid and voluntary staff as the sample, the target audience of the general public should be kept in mind when considering the outcomes and enhancing ESD for the end-user. Our findings align with Albarenda-Tiana *et al. (2018)* and Bolmsten and Kitada (2020) concerning the importance of ESD, alongside the desire of users to learn more. To enable this across various contexts, using CMC is an approach that can help ESD beyond physical boundaries.

The curation, co-creation, and dissemination of information through CMC tools can engage large communities and encourage action by educating individuals, groups, and organisations on sustainability understanding and practices that might otherwise have remained closed to them. The aim of SNS usage should be to deliver and engage end-users in evidence-based information streams (Simionescu *et al.*, 2020). Whilst our data shows the importance of the botanic garden using CMC (specifically social media and web pages), the content associated with ESD requires some strengthening, particularly in increasing user knowledge. Limited use and engagement were also evident depending on the platform used. For example, participants appeared to connect primarily through Facebook and Twitter; LinkedIn was also mentioned. In short, to stimulate the garden's visibility on their commitment to ESD and "strengthen social influences" on sustainability, well-crafted and engaging postings on complementary CMC tools that are "tailored to the populations" require careful consideration (Ballew *et al.*, 2015: 10638). However, whilst staff technological know-how and subject knowledge must be considered (Le *et al.*, 2022), our findings demonstrated barriers beyond these, such as human and financial resources, alongside the broader organisational constraints.

An additional finding surrounds the financial and digital tensions that manifested through the budgetary limitations and the perception that CMC platforms of the larger organisation must be used if ESD to a larger audience is to be enhanced through such mediums. These conditions require creative problem-solving, innovative solutions, and opportunistic activities through intrapreneurial approaches. Yashin-Shaw (2018: 1) defines an intrapreneur as "the act of thinking and behaving like an entrepreneur while working within a large organisation" and includes characteristics such as creativity, collaboration, determination, growth-oriented, opportunistic, resourceful, and trend spotters. Cultivating intrapreneurial thinking and action will enable innovative improvements despite organisational constraints (Martiarena, 2013) and allow the botanic garden to be a knowledge-sharing organisation further afield, i.e., beyond the physical boundary of the garden walls.

The critical strands of community, communication, and digital technology of SL have provided us with a valuable lens to underpin this research. Through curation and sharing a narrative to build a reputation, SL drives change by engaging and connecting diverse individuals and communities (Stodd, 2016; Saunderson, 2018). To navigate this change, energy and commitment are required to achieve the common purpose (Guglielmo and Palsule, 2014). Whilst we are not questioning the energy and dedication of the garden's team in a general sense, the data indicates the limitedness of these features when associated with ESD through CMC. Therefore, returning to Stodd's (2016: 33) statement, "without the technology, you can't be a Social Leader", our data suggests that this requires some extension. To be influential leaders in the social age, working to increase community-centred sustainability ventures and sharing clear and consistent narratives through digital technologies are essential. The botanic garden has an opportunity to use SNS and their web pages effectively to portray the approach adopted by the garden regarding sustainability management to enhance ESD.

CONCLUSION

ESD is essential for addressing global sustainability challenges. CMC offers non-formal educational spaces that enable individuals and communities to act in ways without compromising the needs of future generations. Organisations must actively and consistently facilitate knowledge exchange to make good use of digital technology and add value to these spaces.

The context of this case study was a botanic garden situated within a larger organisation—a university; this containing factor appeared to reduce the garden's opportunities to make the most of CMC to become leaders in ESD. Yet, if large organisations are serious about sustainability, the operational constraints of subunits, such as the botanic garden, need to be addressed, allowing for greater autonomy. Increased autonomy would amplify knowledge and idea propagation and enhance action across diverse networks not predesigned or imposed by organisational structures. Further exploration of sustainability education through CMC could be usefully explored across independent botanic gardens (i.e., not constrained by the practices of a larger organisation) to further understand their role in leading ESD and the subsequent impact of this, alongside obtaining the views of younger audiences.

Overall, the extent and methods by which the botanic garden uses CMC paint a blurry picture because of the limited SNS activity. Whilst the participants viewed some aspects of the garden's use of CMC positively, they also offered recommendations to strengthen weaker areas. We can draw from the data that there is a will and desire for the team to increase usage, enhance community engagement, and disseminate information. Overall, this study makes two contributions to

knowledge. First, it highlights CMC as a potentially valuable tool for the botanic garden to communicate, engage and educate about environmental ESD beyond the garden walls. Second, we show that there is a will and desire for the botanic garden to utilise such educational mechanisms. The limitations of this study's scale— such as drawing from voluntary and paid staff and the lack of younger participants mean we cannot draw broader inferences. However, our participants offer a valuable lens to draw from as they may have a greater insight into the inner workings of the garden and can comment on areas which end-users may not be aware of, for example, financial constraints. Although we have not set out to statistically test nor prove a phenomenon, we have highlighted meaningful conclusions about the perceptions of ESD and user experiences of CMC to expand knowledge and drive sustainability activity.

Recommendations for further research:

- While this study has focused on a single botanic garden from the viewpoints of both paid and volunteer staff, future research should encompass end-users' perspectives while broadening the sample to include a more extensive range of botanic gardens and their respective audiences.

Recommendations for practice

- Identify opportunities for adapting organisational templates to declutter the digital spaces and reorganise them to suit the needs of the garden's community. For example, establish a formal social media presence to share sustainability knowledge and updates. Also, to promote local projects and ways to enhance individual sustainability practices. Ideally, the garden would self-manage the spaces rather than being controlled by the larger organisation.
- Use SL as a lens to drive ESD forward by establishing a reputation through digital technology and creating a straightforward narrative with the community at its heart.
- Increase the connection with academia by working with and sharing insights from academics across the region and inviting scholars to share research via the garden's CMC tools.
- Remain consistent with the monthly newsletters, but perhaps take the format of a blog-style approach; obtaining contributions from guest authors and curators would also benefit.
- Whilst a botanic garden could hire a marketeer, this would be costly. Although financial, personnel, and organisational constraints are evident in our findings, these are not unusual, and the team should adopt intrapreneurial spirits to identify ways to overcome some of these problems. For example, drawing from volunteers or students (perhaps offering

internships or placement opportunities) to help build and deliver a programme of thematic postings and operationalise the garden's ESD vision.

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