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Sustainability Teaching and Learning in Information Systems: Reflections on Over a Decade of Experience

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Abstract:

Despite calls to integrate sustainability topics into information systems (IS) curricula, there is little concrete direction on how to do it. The purpose of this paper is to share the author's experience in developing and delivering a master's level course on information systems and sustainable development. The paper highlights key considerations related to designing such a course, discusses the advantages and limitations of different approaches, and offers practical suggestions for IS faculty who seek to develop similar courses for their own programs.

Keywords: Education, Ethics, Green IS, ICT4D, SDG, Sustainability

[Department statements, if appropriate, will be added by the editors. Teaching cases and panel reports will have a statement, which is also added by the editors.]

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1 Introduction

The information systems (IS) community has a role to play in solving grand social problems and slowing the progression of unsustainable development (Pernici et al., 2012; Seidel et al., 2017). There is a palpable interest within the community, but meaningful action is constrained by a casual understanding of sustainability and how it applies to practice. Through the Sustainability Task Force and the Sustainability Summit at ICIS 2019, the Association for Information Systems (AIS) has taken strides to deepen the community's knowledge on this complex problem and inspire changes in research activities and approaches (Watson et al., 2021). However, these efforts are only part of the equation, as current and future IS practitioners also require sustainability knowledge and skills that will allow them to be change agents within their organizations and business sectors.

A multidisciplinary body of research has developed around the question of how IS can be used to increase the sustainability awareness of individuals in formal educational settings (Oz et al., 2021), as well as in the home (Mogles et al., 2017) or in organizations (Corbett, 2013). However, the literature gives less attention to the challenges and opportunities for teaching sustainability to IS students. The actual number of sustainability-related IS courses and programs globally is difficult to determine, but preliminary research paints a bleak picture. In 2019, the Education Workgroup (part of the AIS Sustainability Task Force), surveyed business school programs in three countries: Canada, Iran and Ghana. It found that there were no majors or minors in sustainability in IS programs in the three countries (at the time of data collection), and that only a small proportion (7.4%) of Canadian business school courses in sustainability relate to IS or operations (Watson et al., 2021). Anecdotally, we find evidence of IS professors developing sustainability-related courses or integrating elements of sustainability into their instruction (e.g., Calloway, 2011; Scott et al., 2012; Toland et al., 2021). New teaching resources have been published (e.g., Watson et al., 2008) and some introductory IS textbooks now include a brief discussion of sustainability and green IS (e.g., Baltzan, 2022).

Despite these advances, the practice of IS as it relates to sustainability has not changed substantially. IS graduates finish their programs with a minimal understanding of the challenges and opportunities of IS in relation to sustainability concerns such as climate change, social justice, and equality. According to one study, soft skills (e.g., creativity, leadership, communication), technical skills (e.g., systems development, technologies), and business skills (e.g., governance, strategy, project management) are considered to be of greatest importance for new business analysts, whereas sustainability skills (e.g., awareness, sustainable IT management, sustainability assessment) are viewed as least important and suffer from the largest knowledge deficit (Richards et al., 2011). This situation is perhaps not surprising considering the rapid pace of technological change and the competitive pressures for digital transformation.

Beyond perceptions of importance, those who teach IS courses face another important barrier: teaching sustainability is different from teaching traditional 'core' IS courses. It requires different knowledge and pedagogical approaches (Richards et al., 2011). A lack of teaching tools and materials is also an important challenge for integrating sustainability concepts into management education (Oz et al., 2021). Addressing these challenges by building our collective knowledge and toolkit for sustainability education in IS curriculum is an essential prerequisite to changing real-world practice. Through this article, I contribute to that cause by reflecting upon my experiences over the past ten years related to building and teaching a master's level course on IS and sustainability.

The IS and Sustainable Development course evolved through three main phases during the past decade. From 2012 to 2017, the groundwork for the course was laid by introducing green IS concepts into introductory IS courses. The second phase, from 2017 to 2018, involved the approval and development of the new course. The third phase, beginning with the first cohort of students in 2018 and ongoing, involves the refinement, updating, and adjustments to the course in response to changing conditions. Accordingly, January 2023 marks the five-year anniversary of the introduction of the course "Information Systems and Sustainable Development" at my university. As written in the course plan, the overall objective of this course is:

> *to allow students to develop a deeper understanding of the challenges and complex issues associated with information systems and technologies in the context of sustainable development. It is expected that students will also improve their critical thinking skills and enhance their abilities to act in a responsible and professional manner* (Corbett, 2022, p. 4).

Since its inception, I have given the course six times — three times in English and three times in French — for 162 students. The course also transitioned from a comodal (simultaneously in person and online) format to a fully online format. The course continues to be a work-in-progress. In what follows, I share what I have learned and offer suggestions to others who may have or be contemplating sustainability related courses for IS students. Section 2 describes the lead-up to a sustainability course. Section 3 describes the development and structure of the course. Section 4 reflects on the evolution of the course since its introduction. Section 5 discusses key learnings and section 6 concludes with my final thoughts.

2 Laying the Groundwork: Integrating Green IS Concepts into IS Courses

An important prerequisite for teaching sustainability in IS is relevant subject matter knowledge. I began working in the area of green IS in 2008. My PhD in Management Information Systems included a minor in environmental studies. During the PhD program, I took a graduate level course covering the methodological and conceptual basis for environmental studies, worked on multiple related research projects, and published several green IS articles (e.g., Branker et al., 2010; Corbett, 2010; Watson et al., 2012). In addition, I was involved in the creation and teaching of an undergraduate business course on sustainability measurement, implementation and evaluation at Queen's University. These experiences provided me with an essential knowledge foundation for teaching IS and sustainability.

In June 2012, I joined my current university as a faculty member with the expectation of having the opportunity to develop a new course on green IS. At the time, green IS was enjoying a peak of popularity as influential IS journals published a series of commentaries, special issues, and research articles (e.g., Berthon, 2011; Butler, 2011; Dedrick, 2010; Elliot, 2011; Jenkin et al., 2011; Melville, 2010; Pernici et al., 2012; Watson et al., 2010; Watson et al., 2011; Watson et al., 2012). However, not long after my arrival, the government implemented major funding reductions to universities (Bradshaw, 2012) that resulted in budget cuts and course rationalizations. Optional new courses, such as one on green IS, were shelved. At the time, I was involved in teaching the introductory IS courses at both the undergraduate and graduate (Master's level), thus my department agreed that integrating green IS concepts into existing introductory courses was the best course of action given the constraints.

The concept of green IS was presented our undergraduate students for the first time in the Fall term (September-December) of 2012. At the Master's level, I added a short module on green IS in that course beginning in the Winter (January-April) 2013 term. At the time, none of the available textbooks contained any mention of environmental concerns related to IS. As a result, my colleagues and I drew on a variety of practitioner and scientific literature to define the content of these presentations focusing on the first, second, and third order effects of green IS (Dedrick, 2010). The undergraduate introductory IS course is required for all business students. The course is given every term and has averaged 780 students per year for the past 10 years. At the graduate level, the introductory IS course is required for all students not enrolled in an IS program, such as students in the MBA program. Students in the M.Sc. program in Information Technology Management are not required to take the introductory course because prior education or experience in the field is required for admission. Like the undergraduate course, the introductory IS course for Master's students has been offered every term, with enrolment averaging 440 students per year since 2012.

Although the content, delivery approach, and instructors for the courses have changed over the past decade, the courses still retain a short learning module on IS and sustainable development. While the content is modest in scope, the integration and continuance of sustainability concerns in to the introductory courses means that over 12,000 undergraduate and graduate students have been introduced to the topic, gaining a basic awareness of the linkages between IS and sustainability.

While I would have liked to have created a dedicated green IS in 2012 or 2013, the delay had the unanticipated benefit of allowing me to continue to extend my understanding of sustainability and how to teach it. In 2015, I completed a MOOC on the issues and directions for sustainable development and also participated in a five-day intensive summer school program on education in sustainable development and the environment. The interdisciplinary summer school was designed principally for future primary school teachers. The content ranged from scientific discussions on the environment to creating stronger human-ecological bonds using visual, literary and performing arts. Although many of the pedagogical strategies were not immediately transferable to a master's level IS course, I took away three key lessons:

- Sustainability education requires an interdisciplinary approach. Presenting facts and information is not sufficient to evoke real sensitivity and change. The facts need to be viewed from different angles and perspectives. Students must be encouraged to reflect on and debate the different perspectives.
- Sustainability education must push students (and teachers) out of their comfort zones. We cannot take a "business as usual" approach to teaching sustainability and expect to have non-"business as usual" outcomes.
- Sustainability education requires creativity. Although our work in business schools does not often manifest on painted canvases or in musical compositions, those who work in IS are among the most creative people I have met. This creativity must be harnessed to build IS-based solutions for sustainability.

As I elaborate in the following sections, I have tried to integrate these ideas in the pedagogical approach and structure of the course.

3 Development of a New Course

Following four years of compression and stabilization, in January 2017, our department undertook a strategic review of our M.Sc. in Information Technology Management. During this reflective process, the department identified key areas of knowledge and competencies required of professionals in the IS field. Among other more technical and managerial competencies, we identified ethics, professionalism, awareness of social issues, social responsibility, environmental sustainability and sustainable development, and issues associated with the digital society as important elements. For the next couple of months, I researched and reflected on how we could create a course to adequately cover these diverse topics. I presented my preliminary ideas for a course focused on IS and sustainable development to my department in March 2017. Based on the feedback, I revised certain elements and developed the proposed course plans. As my university is a francophone institution, our courses are predominately offered in French. However, we also wanted to be able to offer the course in English. Thus, two equivalent course plans (with different course numbers) were created. The course plans were presented to and approved by the MIS department in May 2017. Following departmental approval, the course plans proceeded through various levels of faculty and university-level approvals and the course was added to the calendar for the 2018 Winter (January-April) term. At the time of approval, the course was required for the M.Sc. in Information Technology Management and optional for MBA students.

3.1 Course Content

The IS and Sustainable Development course is a three-credit Master's level course. Following North American norms, a three-credit course corresponds to about 135 work hours for students (45 hours per credit). The work effort can take the form of classes, labs, class preparation and homework, studying, examinations, and completing assignments. My university's main Fall and Winter terms are 15 weeks in length, including the midterm and final exam periods and a mid-term reading week. During these terms, the course comprises 12 classes (each 2 hours and 50 minutes).

Table 1. Structure of Course

Module	Number of Classes	Topics	SDGs Discussed*
Introduction	2	Definitions of sustainability and sustainable development, UN's SDGs, IS threats to sustainable development	All
Ecological Dimensions	3	Green IS and the three levels of impact (direct, indirect, systematic)	6, 7, 11, 12, 13, 14, 15
Economic Dimensions	3	Technology innovation, responsible innovation, economic development	3, 8, 9, 17
Social Dimensions	3	IT professionalism, IS as a means of alleviating social challenges (e.g., poverty, gender inequality, digital divide), ethics of artificial intelligence	1, 2, 3, 4, 5, 6, 10, 16, 17
Consolidation & Conclusion	1	Indivisible nature of SDGs, positive and negative potentials of IS, possible paths forward	All

*Note: Primary SDGs related to topic of module. Not all SDGs are discussed to the same extent. Some SDGs are discussed in multiple modules due to their transversal nature.

As shown in Table 1, the course is organized into three main modules aligned with the three commonly accepted dimensions — ecological, economic and social — of sustainability. As bookends to the course, both the introductory and concluding classes discuss the integrated and indivisible nature of the United Nation's Sustainable Development Goals (SDGs) (United_Nations, n.d.) and sustainability. The content for the course is derived from a selection of scientific and practitioner articles as well as news articles, blogs, videos and other material available on the Internet or through the university's library system.

3.2 Instructional Approach and Evaluations

To accommodate part-time and employed students, the course was designed for a comodal delivery approach. This approach allows students the option of attending weekly classes in person, synchronously online, or participating in the course asynchronously by watching class recordings. In comodal classes, evaluations cannot disadvantage students completing the course at a distance, for example, by requiring in-class attendance. In such cases, equivalent evaluations must be offered. However, the university permits in-person exams, which can be written at the main campus, in an affiliated testing centre in Canada, or under the supervision of an approved proctor.

The course was initially developed as a seminar style course whereby students were required to read assigned readings and participate in discussions during class time or on the online class forums during the week. The disruptions caused by COVID-19 changed students' behaviors regarding real-time attendance in class (whether in person or by Zoom) and real-time participation has dropped significantly. As a result, I reduced the in-class time to two hours, during which I present a 'guided tour' of the week's readings. Recognizing that lecturing can be a component of, and support for, other teaching approaches (Lozano et al., 2017), I use my comments to focus the students' attention on key points, highlight connections between readings, and provide questions for personal or group reflection. Informed by the sustainable development teaching literature, which suggests that a diversity of approaches including case method, service learning, problem-based learning, discussions, projects, teamwork, and simulation games, be used (Schimperna et al., 2022), I employ a variety of individual and group evaluation approaches. Table 2 summarizes the types of evaluations I have used, the specifics of which are adjusted each term according to enrollment numbers and specific considerations.

Table 2. Course Evaluations

Evaluation	Type	Description
Point-Counterpoint	Pairs	Students write competing op-eds on a sustainability-related topic.
Case studies	Individual	Students analyze a case by applying concepts discussed in the course.
Be a Part of the Discussion! In-class or online forum discussions	Individual	Students offer new insights related to course content either through in-class participation or by posting comments on class forum.
Exams	Individual	Mid-term and final exams on course content done in person.
Term Project	Group (3-4 students)	Teams comprised of 3-4 students develop a written proposal for a novel IS-based solution to address one of the SDG targets.

4 Maintaining and Reshaping the Course

Based on program enrolment estimates and instructor (my) availability, the initial plan was to offer one version (either French or English) of the course each year in the Winter term on an alternating basis (i.e., English in 2018, French in 2019, English in 2020, Winter in 2021, etc.). This rhythm was maintained for the first two years; in the 2021-2022, the department decided to offer both the French and English version annually. Enrolment in the course has grown: from two in the English cohort to 59 students four years later. As of the end of the 2021-2022 academic year, 162 students have completed the course.

Several changes have been made to the course over the past five years as I discuss next.

4.1 Content Renewal and Evolution

As with all IS courses, the course content has been renewed each year to remain current with trends, progress, and backsliding on sustainable development. In addition to foundational readings on sustainable development, the course uses scientific (research) and practitioner readings. Relevant new publications have been integrated into the course. A particular challenge given the dual-language nature of this course is finding appropriate French-language content on the subject of IS and sustainability because the corpus of IS research on green IS and sustainability is predominantly published in English. While Canada's past and present are marked by the conflicts and compromises between two colonizing forces, French and English, the latter has become the predominate language of business and research. As a result, most of our master's students have a certain level of proficiency reading English and French-language courses may use English language readings. However, my experience supports two main arguments against the latter approach. The first relates to the importance and complexity of the subject. Sustainability concepts are difficult enough to master in one's first language and by having students try to learn them in a second or third language, many of the nuances get lost. Students develop only a superficial understanding of the concepts. This is particularly true for research articles that are presented in a language and form that is not always accessible to practitioners. Second, the approach of using a foreign language, specifically English reflects a form of linguistic colonialism that discriminates against minority cultures and non-English voices (Corradi, 2017) and reinforces harmful colonial practices (Walls, 2011) that go against the basic principles of sustainable development. (Corradi, 2017)Although there is no explicit SDG related to language (Tesseur, 2017), literacy is captured within SDG 4 that champions inclusive and equitable quality education and lifelong learning for all. Further, despite views that through globalization English is becoming detached from any particular culture (Corradi, 2017), research shows the inseparability of language and culture (Galante, 2022). Through my own experiences and as I have learned more about sustainable development, I have become increasingly convinced of the need to consider and challenge our choice of language of instruction (and by extension, publication), in this context.

Various options are available to deal with the language issue. One is to undertake a translation process of all the relevant English texts. This option comes with multiple drawbacks regarding the quality of the translation, costs and maintainability. Despite the advancement of AI-enabled automated translators, perfect translations are hard to come by and usually require human intervention/correction from someone proficient in the languages. There are additional costs to hire translators and time required, not to mention gaining the necessary approvals from copyright holders. The teaching budgets for most professors would not cover such an expense and the investment made to do a proper translation would reduce flexibility to add and remove readings 'on the fly'. I have used this option (i.e. translation) for key content, such as

cases that I have prepared for the course or evaluations. However, the main strategy I have used is to source equivalent articles on a particular subject. By equivalent, I mean that the articles deal with the same dimension of sustainable development, even if the theory, findings, and practical implications are different. For instance, one of the classes discusses the role of IS in agriculture as a means to addressing SDG 3 – Zero hunger. In the English version, I have used an article by Louis Columbus (2021) entitled: "10 Ways AI Has the Potential to Improve Agriculture in 2021." In the French version of the course, I use an article by Véronique Bellon-Maurel and Christian Huyghe (2016) entitled: "L'innovation technologique dans l'agriculture." The two articles present different technologies for increasing agricultural productivity, but both have been effective for stimulating students' learning regarding the challenges and opportunities of IS in relation to SDG3. As result of this equivalency approach, both versions of the course benefit from the diversity of the literature; however, the two versions are more different in terms of content (readings) now than they were at the beginning.

4.2 Catering to Different Audiences

If the teaching approach for this course is successful, students should finish it with strong knowledge and interest in both IS and sustainability (top right box in Figure 1). During the original conceptualization of the course, the expected learning pathway (indicated by arrow 1 in Figure 1) was to layer sustainable development concepts and practices onto students' already strong knowledge in IS. The course was designed at the outset for students with an existing background in the IT industry and knowledge of IS. It was not designed to offer detailed learning on more technical topics (e.g., cybersecurity, data analytics). However, due to the option for students from other non-IS programs to take the course, a second learning pathway became evident (arrow 2 on Figure 1). In this situation, students with a strong interest or knowledge of sustainability are attracted to the course, many of who have limited or 'everyday user' knowledge of IS. Students who enroll in the course with a limited Interest or knowledge in both IS and sustainability (bottom left box) tend not to stay in the course for long. Approximately 50-60% of students have taken the course because it is required (for an IS program).

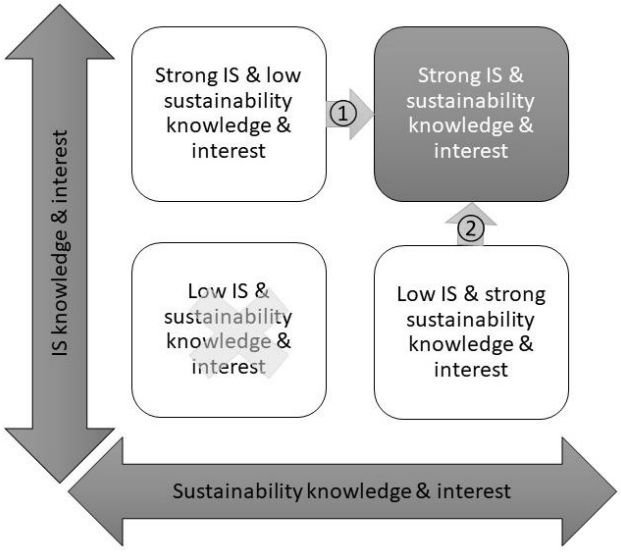

Figure 1. Student Profiles and Learning Pathways

Given that almost half of the students come into the course from outside of the IS field, I have had to eliminate highly technical required readings or discussions and focus more on the social side of socio-technical systems. I have moved more technical discussions (e.g., server virtualization, sustainable software development) to the online forum where students can choose to participate in these discussions based on their areas of interest. When a reasonable understanding of an underlying technology is required, such as AI or blockchain, I provide basic instruction or readings to ensure that students have the requisite knowledge to then determine how (specifically) such a technology could support (or threaten) sustainable development. Without this foundation, the concepts and application of IS to sustainability challenges remain generic and undefined.

A main benefit resulting from the multidisciplinary nature of student profiles is in the enhanced richness of the in-class and online discussions. With more homogeneous students groups, for instance, all IS practitioners, the status quo of industry practices and norms dominate. The injection of new voices from outside of the industry creates discomfort by challenging assumptions and values and highlighting otherwise hidden sustainability considerations. For the team project, where students are required to propose an IS solution to one of the targets of the SDGs, I encourage students to form groups comprising members from both domains and find that groups so composed develop on average more holistic socio-technical-ecological solutions.

4.3 Course Format

The third major modification over the past five years has been in relation to the course format. The seminar format on which the course was initial designed was effective the first 2.5 times the course was given, in 2018, 2019 and 2020 pre-COVID. In March 2020, the course went to a full online mode and it was difficult to maintain real-time class discussions as everyone adjusted to new platforms, equipment, and learning environments. In Winter 2021 (January-April), the course was offered in an online only format where students could attend the classes synchronously or asynchronously. This seems to have been a turning point for students' expectations, with many (especially master's students with families and jobs) preferring the option of online courses. When the course returned to comodal with the possibility for in-person attendance in the fall (September-December) 2021, only one or two were present in the classroom for the first couple of classes before moving to online. In 2022-2023, the course will be offered in an online asynchronous only format. Although the changes caused by the pandemic are not specific to sustainability teaching and learning, the net result is that just five years after inception, the course format is almost diametrically opposed to the in-person seminar-type format that was envisioned at the outset.

The motivation for developing the course initially using a seminar-based approach was driven by substantial literature in sustainability education that calls for active learning approaches (MacVaugh & Norton, 2012). I elaborate more on this topic in section 5.3. By engaging students in a critical discussion of different topics, research findings and practical examples, I hoped that students would come to appreciate the complexity of sustainable development, the grey zones and tradeoffs that are sometimes required, rather than just memorizing concepts and facts. As noted in Section 3.2, with comodal courses, evaluations cannot disadvantage students learning at a distance compared to those attending in person. Therefore, I use an evaluation called "Be part of the discussion" where students were required to reflect of different topics on the online forum. Marks are given not just for initiating a discussion, but also continuing and extending a discussion and applying one or more of the four types of thinking from the Sustainability Education Framework for Teachers (Warren et al., 2014), discussed in Section 5.3. On the positive side, online discussions force students to delve deeper into certain questions and take a position on a topic. However, these discussions can become lifeless and superficial and require strong moderation and instructor involvement to push the discussions further. Another evaluation that has been used since the inception of the course is called "Point-Counterpoint" for which students, working in pairs, write short (800-word) op-eds presenting two divergent sides of a sustainability debate. For instance, one of the assigned questions asks whether all IS professionals should have to take sustainability training, and another asks whether CIO compensation should be tied to the environmental performance of the organization. Finally, case studies, including most recently, an online interactive case study, have been used to present real-world examples and situations.

In sum, the course has evolved from a seminar-style format with real-time discussion to a mostly asynchronous online format. Although lecturing is more passive, it is good way for the teacher to show excitement, discovery, and present subject matter. It can contribute also to systems, strategic and futures thinking, addressing concepts of justice, responsibility, ethics, showing empathy, and encouraging changes of perspective (Lozano et al., 2017). With this in mind, I deliver a live or recorded 'guided tour' of the readings each week in which I highlight key concepts, findings, and ideas, while also adding my personal reflections and critique, and raising questions for students. The lectures are supplemented with one or two third-party videos (usually publicly available) and 20-30 pages of readings. Then, through the various evaluations, such as discussion forums, cases, and the Point-Counterpoint, students engage in more active learning. The average student satisfaction for the course from inception is 96.3%, with the last two online versions receiving 100% overall satisfaction[1].

[1] Includes Very much and Somewhat satisfied on the overall appreciation of the course.

5 Reflections and Discussion

Over the past ten years, I have had to address various questions and challenges regarding sustainability teaching and learning for IS students. The next sections discuss these issues, highlight important considerations, and where possible, offer recommendations.

5.1 Where to Locate Sustainability Teaching and Learning

At the 2011 SIGGreen Workshop, Pattinson and Gordon (2011) discussed the question of whether a specialist or generalist approach should be taken to teaching green IS. They noted that the topic of green IS could be located as part of an introductory session, within specialized sustainability courses, within other IS courses, or as part of a specialist course or curriculum (e.g., certificate, profile) on IS sustainability. Similarly, Schimperna (2022) found that corporate social responsibility (CSR) teaching can follow three strategies: CSR can be incorporated into an existing course, CSR can be taught in separate courses, and CSR concepts can be integrated into disciplines, programs, and course materials. In 2012, with the option of a specialized course or curriculum off the table for budgetary reasons, my department opted for the first approach: integrating the topic of sustainability (mostly environmental sustainability) into our introductory courses in IS. This was also a decision of convenience as I was involved in teaching the introductory courses and the other professors and instructors did not have sufficient knowledge in the area to develop sustainability modules within their own IS courses. Five year later, pressures to reinvigorate our IS program with new courses, as well as greater awareness and institutional (university) commitment to sustainability, drove the decision to create a new course on IS and sustainable development. Other departments within the business school (e.g., accounting, management, real estate development) had created CSR and sustainability-related courses at both the undergraduate and graduate levels during that interval. Thus, introducing a course in IS became imperative to ensure that the MIS programs remained on par with those of the other departments.

Today, the same (or even more) options exist for introducing sustainability into the IS curriculum and the decision of where to locate this teaching and learning will depend on the local, institutional contexts and constraints. Table 3 summarizes my assessment of the advantages and disadvantages of the two main approaches.

Table 3. Advantages and Challenges of Sustainability Teaching & Learning Locations

Location	Advantages	Challenges
Integrated within introductory courses	• Signals the importance of sustainability in IS, particularly for non-IS students • Introduces basic concepts of sustainability that can be built upon in other courses • Easier to find introductory level materials • Potential to reach higher numbers of students	• Deciding what aspects (environmental, social, economic development) to include/exclude • Risks minimizing the importance of the problem as the topic becomes just one of many considerations for IS • Insufficient time to adequately explore the complexity of sustainability concerns • Ensuring that instructors are adequately prepared, sufficiently knowledgeable of subject
Dedicated course	• Opportunity to address the chosen subject in detail, getting past a superficial understanding of the topic and challenges • Greater visibility for sustainability at the program level • Likely requires fewer 'trained' instructors and leverages a particular instructor's interest, enthusiasm and expertise in the subject	• Deciding on the focus of the course • Justifying the course within the IS curriculum, particularly if it takes the place of more desirable/popular courses (e.g., data analytics) • Smaller numbers of students, especially if course is not required

Based on my experience, I suggest that instead of adopting an either/or approach, IS departments and universities need to emphasize an "and" approach. Addressing sustainability is a sufficiently big and urgent problem, requiring that we overcome competitive tendencies (e.g., between professors,

departments, faculties) and find ways to work together to achieve the goal (Moore, 2005). The main benefit of introducing sustainability within the introductory IS course is to signal the importance of this topic to students and create awareness around both the potential threats and opportunities that IS offers to individuals, organizations, and society. If done right, this initial introduction can generate students' interest in the power of digital technologies and sustainable transformations whether they pursue further studies in IS or other disciplines such as management, accounting, or marketing.

Turning to IS students more specifically, my experience suggests that integrating sustainability only within the introductory course is not sufficient. In my particular context, students in Master's level IS programs (i.e., M.Sc.) are not required to take an introductory IS course because they enter the program with previous education or experience in the field. Thus, to expose all students to the topic of sustainability we would have had to integrate sustainability into one of the more specialized courses in IS (e.g., security, project management, digital transformation). Although we did not pursue this option, I expect that the challenges would be similar to those associated with an introductory course. For these reasons, I recommend that IS departments develop and offer dedicated courses on sustainability for IS students, which, with a sufficient number of offerings, could form part of a certificate or program concentration.

Once a decision is made to develop a dedicated course on sustainability, a second question arises with respect to where to place such a course within the program or programs, in particular, whether it is a required course or an optional course. My department took a prescriptive decision by making the IS and Sustainable Development course a required course for all M.Sc. students based on the view that the content of the course was fundamental knowledge that all graduates of our program should possess. Admittedly, I did not have an abundance of research to support this decision. Starting in January 2023, the course will also be required for the MBA program in IS. While employers may not specifically request that students have knowledge of sustainability, as they would for instance with capabilities in IT security or data analytics, more and more organizations are adopting sustainability or corporate responsibility strategies that will leverage IS (Bersohn & Podder, 2022). Thus, employees working in diverse IS-related jobs from enterprise architecture to system development, strategy, business analysis, security and data science, should have base knowledge and competencies in sustainability. Future research that explores the level of sustainability knowledge and competencies in these different roles would be helpful to inform future IS sustainability teaching and learning.

5.2 Defining the Scope of Sustainability Teaching and Learning

Sustainability is a large and complex topic and a wicked problem. As such, a first step to successful IS sustainability education is recognizing that we cannot cover all aspects in detail. Choices must be made regarding the boundaries of what will be taught and what skills or knowledge we want students to acquire. IS educators can choose between two main approaches, which I call: 1) the dimensions approach and 2) a holistic approach. Table 4 outlines differences between these two approaches.

Table 4. Sustainability Scoping Approaches

	Dimensions approach	Holistic approach
Learning objective	Provide students with an in-depth understanding of IS in relation to one specific dimension of sustainability	Provide students with a comprehensive view of IS and sustainability in which the dimensions of sustainability are necessary and interconnected
Example frameworks or topics	• Environmental impacts (addressed through Green IS, Green IT) • Energy informatics • Green supply chain • Green process management • ICT4D (ICT for development) • Sustainable water management • Poverty • Food security and hunger • Ecosystem services and biodiversity • Ethics • Equity, diversity, inclusion • Responsible, frugal, or sustainable/sustainability innovation • Indigenous AI	• Sustainable Development Goals (SDGs) • Triple Bottom Line (TBL) • Corporate Social Responsibility (CSR) • Environmental, Social and Governance (ESG)
Advantages	• Allows for deeper examination and capacity building in a focused area • Builds on a particular educator's expertise and interest • Allows for more specialized course offerings on dimensions of sustainability that align with students' interests and institutional objectives/strategy	• Students gain an appreciation for the complexity and tradeoffs involved in sustainable development • Introduction of all the dimensions of sustainability within a single course, reducing pressure to add additional sustainability courses
Challenges	• May limit students' understanding of the complexity of sustainability by ignoring interactions between economic, social and environmental dimensions • Large list of potential topics on which to focus • Topic may not appeal to all students within program	• Defining sustainability and choosing an appropriate integrative framework • Instructor must have a sufficiently broad and deep understanding of sustainability • Potential for overlap with CSR courses in other disciplines

Alternatively referred to as pillars, components, factors or aspects of sustainability, the three dimensions of sustainability are commonly accepted to include the environment, society and the economy. Rather than emerging from rigorous theoretical grounding, these dimensions have emerged from different discourses, critiques, and debates regarding sustainable development and sustainability among diverse stakeholders and perspectives (Purvis et al., 2019). In some representations, sustainability occurs at the nexus of environmental, social, and economic sustainability; whereas other representations view the three dimensions as nested, and others still view them as pillars that stand alone but collectively support sustainability (Purvis et al., 2019).

5.2.1 Dimensions Approach

The dimensions approach seeks to enable students to develop an in-depth understanding and skills in one specific dimension or content area of sustainability as it relates to IS. A main advantage of this approach is the potential for a deeper examination of a particular topic, such as energy informatics (Watson, 2021; Watson et al., 2010). Teaching and learning about these topic can, like the holistic approach, emphasize systems and futures thinking and integrate multidisciplinary perspectives. However, by placing the focus on a single dimension of sustainability, students may not gain a full appreciation of the complexity of sustainability and interactions between the broader social (e.g., hunger, equality), economic (e.g., poverty, innovation), and environmental objectives (e.g., pollution, climate change) of sustainable development.

Another challenge of the dimensions approach is choosing the focus of the module or course. Given the breadth of sustainability related concerns, there are numerous topics that could be the object of an IS course (a small sample is shown in Table 4). In the early 2010s, the most prominent topics related to sustainability were green IT and green IS. While green IT focuses to improving energy efficiency of IT equipment (computers, servers, networks), green IS is a more encompassing umbrella (Watson et al., 2010) that extends to the use of IT and IS to address environmental problems that threaten sustainability (Dedrick, 2010), such as by reducing greenhouse gas emissions caused by individual or collective activities. In 2008, the influential Smart 2020 report predicted that the growing information and communications technology sector would be responsible for 3% of total global emissions by 2020, but that it also held the potential to help other sectors and consumers reduce their own emissions by five times that amount (The Climate Group, 2008). Between 2010 and 2019, net emissions of anthropogenic greenhouse gas emissions continued to rise, leading to a high likelihood that global warming will exceed 1.5^{o}C during the 21st century (IPCC, 2022). The need to limit global warming to below 2^{o}C will require rapid reductions in greenhouse gas emissions, providing a strong argument for choosing climate change and environmental sustainability as the main concern for IS students. This led to my choice to focus initially on environmental dimensions (captured under the umbrella of green IS) as the core of sustainability teaching and learning activities.

5.2.2 Holistic Approach

In the last decade, there has been growing appreciation of sustainability as a concept that extends beyond climate change and environmental considerations, leading to a more holistic approach to sustainability teaching and learning. Chapter 2 of the Brundtland Commissions Report entitled *Our Common Future* opens with: “Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs” (Brundtland, 1987). Since that time, the definition has been massaged in different ways to define sustainability overall and its dimensions. While intuitively appealing, the definition has also been criticized for lacking precision particularly around what constitutes current and future needs and offering limited direction on how to measure sustainable development (Brinkman, 2016). There has also be significant debate around the perceived conflict between continued economic growth (development) and planetary well-being (sustainability) (Ekins, 1993). Over time, the word ‘sustainability’ has been substituted for ‘sustainable development’ such that today, in English, the two terms are generally treated as synonyms even if certain underlying tensions remain.

The concept of sustainable development has evolved in response to global crises, social movements, and growing awareness of the problem and consequences (Brinkman, 2016). On that evolutionary path lies the United Nations’ Millennium Development Goals and the subsequent Agenda 2030 SDGs. The SDGs comprise 17 interrelated goals and 169 targets that, it is hoped, if achieved, will lead to “peace and prosperity for the people and the planet, now and into the future” (United Nations, n.d.). Although ambitious in nature, the SDGs provide a comprehensive action-oriented guide that has inspired IS research and corporate action, thus making it an appealing framework for sustainability teaching and learning in IS.

Despite the growing popularity of the SDGs, other frameworks warrant consideration, particularly for sustainability courses within university business schools. The first of these is the triple bottom line (TBL or 3BL) proposed by John Elkington in 1994, The TBL was proposed as a way to rethink capitalistic approaches to business with the central idea that the traditional financial bottom line pursued by business (profit) must be extended to include social (people) and environmental (planet) performance (Elkington, 2018). Highly popular and adopted in practice, the TBL is often considered to be synonymous with sustainability and has served to entrench the three pillars of sustainability (Purvis et al., 2019) in the mainstream business lexicon. However, despite the stream of development and experimentation that has been inspired by the TBL, its author has suggested a “recall” of the original version of the framework to make way for a new wave of TBL innovation with sufficient scale and speed to radically restructure the business environment and managerial focus as needed “to stop us all from overshooting our planetary boundaries” (Elkington, 2018). Approached from this perspective, rebooting the TBL through the transformative power of IS could provide a meaningful foundational framework for teaching sustainability within IS curriculum.

A second alternative to the SDGs is corporate social responsibility (CSR), which has become a lens through which stakeholders evaluate business organizations. CSR broadly relates to the integration of

social, environmental, and ethical considerations into business strategies and practices (Jones & Comfort, 2021) with the recognition that businesses have societal obligations that extend beyond financial returns to shareholders. CSR highlights the importance of promoting socially responsible business practices and ethical management practices (Holzer & Junglas, 2013). As with environmental sustainability, IS can be both a threat to ethical behavior and a potential solution for ethical dilemmas (Holzer & Junglas, 2013). To increase the adoption of ethical behaviors, stakeholders must be empowered so they are aware of unethical behaviors and can make more ethical decisions (Holzer & Junglas, 2013). Using CSR as a framework for teaching and learning about sustainability can make managers more sensitive to the temptations and traps of unethical behavior and help them align with their current or future employers' CSR goals and strategies. Business schools, including my own, have developed corporate social responsibility education (Lozano et al., 2017) and leading IT companies, such as Miscrosoft, IBM, SAP and Capgemini have adopted CSR agendas that include priorities such as environmental sustainability, human rights, responsible sourcing, inclusion and diversity , privacy and cybersecutiry and corporate governance (Jones & Comfort, 2021). Such training contributes to more positive attitudes toward social responsibility, better ethical decision making, and improved business performance, as well as increased legitimacy for universities and business schools (Schimperna et al., 2022).

Related to TBL and CSR is the environmental, social, and governance (ESG) framework that has become a popular mechanism for investors to evaluate the responsibility of organizations (Ketter et al., 2020). Organizational ESG goals are also starting to shape the priorities of CIOs (Bersohn & Podder, 2022). The environmental factor relates to issues such as climate change and pollution; the social factor relates to human resources and relationships in terms of justice and equity; and the governance factor relates to structures, norms and practices such as compliance with laws, lobbying, information and governance mechanisms (Ketter et al., 2020). Building on the ESG framework and integrating it with three dimensions of individual well-being, community welfare ad economic resilience, Ketter et al. (2020) offer a ESG-ICE framework to identify opportunities for using analytics to address societal challenges. Using a framework such as this that includes various dimensions of sustainability (in this case ESG) at multiple scales could offer an interesting path forward for IS sustainability IS education.

For IS departments that may have only a single course in a program devoted to sustainability, I recommend a holistic approach that will allow students to learn about the complexities, tensions and choices. Where multiple courses, a certificate, or microprogram is possible, a dimensions approach can be used to delve into specific areas. In terms of frameworks, I have learned that there is no single best choice. The SDGs have provided a relevant and comprehensive framework for my course over the past five years. There is sufficient scope within the SDGs to explore different, non-traditional areas of IS while still remaining anchored to the overall objective. As an international framework, there are many resources available in multiple languages to support teaching and learning based on the SDGs, including another UN-sponsored initiative, PRME – Principles for Responsible Management Education (PRME, n.d.). However, 2030 is not very far in the future and what will follow the SDGs is unknown.

The institutional context will also play a part in deciding which framework is best within a given university or college. My university has published sustainable development and greenhouse gas emission reports[2] annually since 2010. The university has also embraced the SDGs as a means of setting local goals and measuring progress, publishing its first SDG contribution report for the 2019-2020 year. In July 2018, the business school signed on to PRME and its first report was submitted in June 2021. From a perspective of sustainability teaching and learning, there was an advantage to aligning the course framework with the institutional vision, not only to leverage a common language of the SDGs, but also to provide tangible examples and opportunities for students to directly apply course learnings to the university community's initiatives.

5.3 Pedagogical Approach

The choice of pedagogical approach depends on the objectives of the teaching and learning. Specifically, the educator must determine whether the particular course involves education *about* sustainability or education *for* sustainability (Shephard & Furnari, 2013). My course falls into the latter category, as reflected in the overall objective (section 1), and the specific objective that upon completion, students will be able to "develop innovative ideas and opportunities for using information systems and technologies to advance sustainable development" (Corbett, 2022, p. 4). That said, education for sustainability must also include, to

[2] In 2017, Université Laval became the first university in Canada to voluntarily achieve a carbon neutral position.

a certain extent, education about sustainability depending on the students' level of knowledge and awareness of the subject. Education for sustainability differs from other types of university-level business school education, not only because of the interdisciplinary and complex nature of sustainable development, but also because it requires affective learning involving values and attitudes, and is prescriptive in nature with an inherent social agenda, which may reduce autonomy and openness for diverse perspectives (Shephard & Furnari, 2013). I have struggled with this last challenge as I try to seek a balance between promoting sustainability objectives, while also encouraging students to develop their own values and critical assessments of the what, where, how, when, and why of using IS in the context of sustainable development.

Due to the unique elements of sustainability education in higher education, there is a rich practice-oriented and scientific literature, dating back to the 19070s when the 1975 Belgrade Charter and 1977 Tbilisi Declaration set out a global framework for environmental education with the aim of developing environmentally literate citizens (McComas, 2013). The Tbilisi Declaration (McComas, 2013; UNESCO, 1978) targets five goals, all of which remain relevant in the context of sustainability teaching and learning in IS: building awareness, developing knowledge, fostering attitudes of concern and motivation; developing skills, and providing opportunities and encouraging active participation in solving environmental problems. Since then, a plethora of additional guides, frameworks and tools have been developed. In 2020, UNESCO published the book *Education for Sustainable Development: A Roadmap* and then complemented it with the ESD (Education for Sustainable Development) for 2030 toolbox[3] to provide resources to support achievement of sustainable development education goals.

Research has examined the question of sustainability education in multiple disciplines and contexts, including in higher education institutions (Lozano et al., 2017). Several key messages emerge from that literature. First, integrating sustainable development into curricula requires systems thinking and interdisciplinary approaches and pedagogical approaches that provide interactive, experiential, transformative and real-world learning (Lozano et al., 2017; Toland et al., 2021). As teachers, we must also recognize and leverage the fact that expertise may exist within the classroom; that is, that our students may possess knowledge and skills that exceed those of the teacher. The literature places a high priority on active learning, defined as a learning process that engages students in activities that require higher order thinking, such as reflection and discussion, in contrast to passive listening to lectures (Freeman et al., 2014). Active learning approaches, such as management games and business simulations, are effective learning techniques because they stimulate imagination and help students understand complex issues (Hoffmann, 2009). As compared to passive learning, active learning offers the possibility to repeat the learning content easily and to test new competencies. Active learning approaches can help learners reduce their dependency on their educators and engage more fully with issues related to sustainability (MacVaugh & Norton, 2012). Universities can support these activities by creating physical and temporal space and reducing barriers for pedagogical transformation that includes flexible curricula as well as cooperative and de-linearized learning (Takacs et al., 2022). Such actions can include promoting, enhancing and rewarding community service learning, participatory group learning, critical thinking/reflective learning, student-centered learning/problem-based learning and experiential learning (Moore, 2005).

Second, the literature has identified many different competencies for sustainable development to help guide teaching and learning activities. Competencies are a way of describing desired educational outcomes and include a wide range of skills, abilities and behaviors that should be measurable and observable (Warren et al., 2014). Competencies may be cognitive, functional, ethical, and personal (Lozano et al., 2017). Among the competencies often mentioned is sustainability literacy, an umbrella term that refers to one's ability to understand the symbiotic relationships between the social, economic and environmental dimensions of sustainability in order to be able to develop creative solutions to complex problems and initiate and manage change (Winter & Cotton, 2012). Other competencies include: systems thinking; interdisciplinary work; anticipatory thinking; justice, responsibility and ethics; critical thinking and analysis; interpersonal relations and collaboration; empathy and change perspective; communications and use of media; strategic action; personal involvement; assessment and evaluation; and tolerance for ambiguity and uncertainty (Lozano et al., 2017). However, the debate around which competencies are most valuable and why some are essential continues (Warren et al., 2014).

[3] https://en.unesco.org/themes/education-sustainable-development/toolbox

Third, there are a variety of different pedagogical approaches for sustainability education (see: Lozano et al., 2017). The choice of pedagogical approach depends on the target (educational goals) and the context (students, instructors, learning environment) (Lozano et al., 2017). For my course, I choose to adapt the Sustainability Education Framework for Teachers (SEFT), which targets a "fundamental shift and transformation in how they [teachers] act, think and engage with the world around them" (Warren et al., 2014, p. 3) based on my belief that a similarly fundamental shift and transformation is also relevant for IS students and current/future IS professionals.

5.3.1 Sustainability Education Framework for Teachers

The SEFT framework is meant to build students' capacity for understanding the broad and complex nature of sustainability, the problem-oriented and solution-driven approach to achieving sustainability, and how sustainability connects to the student as a citizen (Warren et al., 2014) and manager. Core to the SEFT are four interconnected ways of thinking as summarized in Table 5. These four ways of thinking provide a means for analyzing sustainability problems and potential solutions.

Table 5. Four Ways of Thinking (Adapted from Warren et al., 2014)

Futures Thinking	**Values Thinking**
• Also known as anticipatory thinking, foresight or trans-generational thinking • Requires one to consider how past decisions led to today's crises, and what crises today's decisions could create in the future • Requires comfort with uncertainty, ambiguity, resilience, adaptability	• Also known as value-focused thinking or ethical thinking • Requires integrating concepts of justice, equity, social-ecological integrity, and ethics, within and across cultures • Requires the ability to identify, analyze and communicate (often implicit) values
Systems Thinking	**Strategic Thinking**
• Requires the ability to identify configurations of systems and to analyze them across different domains and scales • Focuses on cascading effects, inertia, feedback loops and other systemic features	• Involves designing and implementing a plan (strategy) to achieve a particular vision or objective • Requires the ability to leverage opportunities for creativity, innovation and learning in order to achieve transformational change

Different learning activities can help students develop the ability to think from different perspectives. For instance, the in-class reflection questions specifically target different elements, such as values, strategy, or systems and on the discussion forum (Be Part of the Discussion!), student contributions are marked based on the extent to which they relate to the course material and reflect the four thinking perspectives. The Point-Counterpoint evaluation, structured as a debate between two positions, encourages values thinking because students must consider a question from different points of view (Warren et al., 2014). Case studies, as a keystone of active learning in business schools (MacVaugh & Norton, 2012), contribute to building a variety of competencies, including systems thinking, interdisciplinary work, and critical thinking (Lozano et al., 2017). Thus, I construct the case questions specifically to target the four ways of thinking. For instance to encourage systems thinking, the question asks: "explain how these green information systems were expected to interact with human (e.g., social, economic, political) and ecological systems." For values thinking, students are asked to outline the main points of a conflict and discuss the different values underlying the competing positions. Over the course of the semester, different activities allow the students to practice analyzing IS events, challenges and solutions through these lenses and gain new insights into sustainable development.

Teaching this course, I have found that IS students are most comfortable with systems thinking, particularly with respect to the socio-technical aspects of IS. Prior to arriving in this course, many already have familiarity with the ways in which human social systems, such as organizations and teams interact with technological systems. Thus, the challenge is to expand their reflections to the ecological level, as suggested by the socio-technical-ecological perspective (Ahlborg et al., 2019; Corbett & Lakshmi, 2022) and consider three-way interactions between IS, people and the environment. Strategic thinking also tends to be a more comfortable space for students, likely because of their training in management and

business, where strategy is often discussed. The two other ways of thinking – futures thinking and values thinking – have posed greater difficulty for students.

Futures thinking or future-oriented technology design has been discussed in the IS literature as a way of helping to reduce the potential for negative effects of new technology development (Chiasson et al., 2018; Markus & Mentzer, 2014). Futures-oriented knowledge about societal consequences of IS can help developers design better artifacts that are more socially accepted, can assist in developing better technology use practices and governance mechanisms, and can improve readiness if and when negative outcomes emerge (List, 2006; Markus & Mentzer, 2014). However, I have found that students have a hard time imagining the future state and impacts of technology, given the fast pace of technological change. They often misunderstand futures thinking as predicting THE future, without understanding the potential for multiple possible, plausible, desirable (or not) futures (Chiasson et al., 2018; Inayatullah, 2007). There is still significant opportunity and upside potential to developing more future-oriented analysis tools and design approaches for IS (Markus & Mentzer, 2014).

Values-focused thinking, which allows people to determine what is important by eliciting clear connections between values and objectives (Moore, 2005), is also challenging for students. Most, if not many, students have deeply engrained values regarding the role of business and IT to maximize profit and shareholder wealth. Getting students to even consider different motivations and objectives can be difficult. The values discussion is easier, but also more superficial, when it is framed in terms of business problems, such as the tradeoff between individual privacy and profit motives (e.g., in the case of data sharing and protection in social media). In recent years, the growing interest in equity, diversity and inclusion (EDI) has opened a window of opportunity to talk about values, but the discussion remains too often mired in traditional business concerns, rather than sustainability concerns. Student are also uncomfortable or unable to articulate their own personal values that underlie certain choices. To move sustainability action forward more quickly, value-based thinking and discussions are needed to help managers understand the biases and implications of their decisions.

5.4 IS Solutions for Sustainability

In an effort to move students from theory to action, I require students to develop a proposal for an IS solution addressing one of the 169 targets of the SDGs. This is a term-long, integrative team project that usually contributes a significant portion (30-40%) to the final grade. Project or problem based learning, where students work in self-directed collaborative groups, allows students to explore complex, real-world problems and contributes to systems thinking, strategic action and personal involvement (Lozano et al., 2017). As summarized in Table 6, 12 of the 17 SDGs have been the focus of the 40 different student projects that have been realized. The most popular SDG for students, SDG 12 related to sustainable consumption and production, accounts for a quarter of the projects, with diverse aims from reducing electronic waste, recycling, supporting the circular economy, reducing water and energy use and reducing food waste. SDG 11 has been the second most popular goal, with different solutions proposed for smart, low-emission transportation, the protection of vulnerable territories, services and housing for homeless populations, online voting and citizen engagement and participation. Two other SDGs have also been popular among student groups: SDG 2 for reducing hunger and SDG 3 for good health and well-being.

I have been fortunate to teach some smart and creative students who have been able to propose innovative solutions with the potential to advance sustainable development. The proposed solutions leverage a full range of different information and communications technologies. The Internet of Things has often been suggested as a means of automatically capturing data with sensors in different settings. Data analytics and artificial intelligence (AI) are frequently included in order to translate data into meaningful insights for decision-making. Other AI applications, such as autonomous systems (including drones and vehicles), chatbots, and augmented reality have also been integrated into the students' solutions, as have social media and mobile applications. More recently, blockchain has become a technology of interest for many students.

Table 6. SDGs Targeted by Student Projects

SDG	Number of Projects*	Examples of Solutions
2 – Zero Hunger	6	Applications to support the reduction of food waste by better management, donations; improve greenhouse management
3 – Good Health and Well-Being	6	Personal health applications and monitoring; health education; telemedicine and remote health services
4 – Quality Education	1	Virtual and distance education for primary, secondary students in Africa
6 – Clean Water and Sanitation	2	Systems to support water management
7 – Affordable and Clean Energy	1	Application to reduce greenhouse gas emissions in personal transportation
9 – Industry, Innovation and Infrastructure	2	Approaches to creating green data centres
11 – Sustainable Cities and Communities	7	Applications to support smart transport; protection of vulnerable territories; services and housing for homeless populations; online voting and participation
12 – Responsible Consumption and Production	10	E-waste recycling, circular economy, water consumption, reducing energy use; food waste reduction
13 – Climate Action	1	Decision support tool for GHG reduction of cloud data emissions (green storage)
14 – Life Below Water	1	Tool to support the reduction of plastics pollution in rivers, lakes, oceans
15 – Life on Land	2	Forest health and sustainable forestry
16 – Peace, Justice and Strong Institutions	1	Birth and death registrations in Africa
*Note: SDG of primary focus based on students' assessments; projects may contribute to multiple SDGs.		

Besides the variation in SDG targets and technologies, the reports also speak to the importance of addressing sustainability concerns within a local context. To be able to design a workable solution that conforms to principles of responsible innovation (Ahuja et al., 2022; Stilgoe et al., 2013), students must identify a geographic location or use setting. Many choose to design their applications for the province of Quebec, or a main city, like Montreal. At least two groups have contextualized their solutions for Indigenous communities, such as accessibility to safe drinking water and food security. As many students taking the course have origins in Africa, I have also received proposals for applications to address birth and death registrations in Uganda, cell phone disposal and recycling in Burundi, and virtual and distance learning in sub-Saharan Africa. My experience suggests that this localization of sustainability is important as it allows students to feel a closer personal attachment to the problem and desired outcomes (Mayer & Frantz, 2004).

In 2021, in an experiment aimed at driving more direct, real-world impacts from the project, I offered students the opportunity to participate in the AMCIS 2021 Social Project (https://amcis2021.aisconferences.org/social-project/). The two beneficiaries of the initiative were groups based in Montreal, a nearby city (approximately 260 km from Quebec City) in which many of my students reside. In the end, none of my teams chose to work on the AMCIS 2021 initiative. I believe several issues contributed to this outcome. First, there were certain timing differences between the AMCIS 2021 social project and the course, which made it challenging to integrate within the schedule of evaluations. Second, because the AMCIS 2021 social project involved working directly with organizations and depended on their availability, students could have perceived less control over managing their own work schedule for the project. Third, the geographic dispersion of students and team members could have made it difficult for students to commit to a specific project. Finally, for a variety of reasons, the selected beneficiaries and projects may not have been appealing to students in my course given their particular interests. Despite this unsuccessful initial attempt, I continue to look for opportunities for more hands-on community-based or service-learning opportunities and encourage others teaching sustainability courses in IS to do the

same. With AMCIS 2025 returning to Montreal in 2025, there is also the possibility for a second attempt for collaboration.

6 Conclusion

Through my efforts to build, deliver and evolve the course 'IS and Sustainable Development', I believe I have made some positive impact on changing the ways that current and future IS practitioners and managers think and work. On a personal level, the experience of the past decade has deepened my understanding of sustainability. Teaching sustainability has helped me to improve my research and my research has enriched the teaching. These two aspects, plus other academic service activities, form an important triad of expertise. These three elements need to be integrated to elevate sustainability teaching and learning at the university level (Moore, 2005) and to create effective change agents among our students.

As IS educators, we need to infuse sustainability in all our decisions (Moore, 2005). If IS graduates are going to take what they learn and implement it in practice then we have to integrate sustainability into our decisions as IS departments and faculty members. A small example that I encountered in my course relates to the infamous black boxes (i.e., students who have turned off their webcams) that many of us face during our online courses. Many professors insist on students having their cameras activated during class and exams. Others resign themselves to the situation. I have tried to use it as a teachable moment on sustainability. I acknowledge that the use of video allows me to build a better connection with them (and among the class members) and makes my job more enjoyable. However, I also acknowledge that not every student may be able to afford the technology (digital divide) and that using video streaming in conjunction with audio increases the energy demand for webconferencing, resulting in higher emissions (threat to environmental sustainability). Thus, I am willing to accept blank screens while I am presenting and students make more conscious efforts to turn on their cameras when they speak or want to ask a question allowing us to repersonalize the interaction.

Before concluding my reflections, there are two limitations worth noting. First, the experiences that I have presented relate to teaching and learning in comodal and online formats. I have never taught this course in a 100% in-person class. Online teaching offers a different set of opportunities and constraints than in-person teaching. The latter offers more opportunities for real-time discussion and active learning. I believe I have been able to achieve effective active learning opportunities even in a distance learning environment. However, my learnings and suggestions may not be applicable in all contexts, and I recommend that IS educators explore alternative forms of active learning, including problem-based learning (MacVaugh & Norton, 2012). I also encourage other colleagues to share their experiences in sustainability teaching and learning by presenting papers at IS conferences and publishing cases or other pedagodical materials in journals, such as the Communications of the Association for Information Systems, which has a department dedicated to IS Education.

Second, there remains an open question regarding interdisciplinarity in IS sustainability education, not so much about the need for interdisciplinarity, but how to effectively achieve it. In my course I attempt to bring in readings and perspectives from different disciplines, but can a single person, even one open to multiple perspectives, truly achieve an interdisciplinary approach? In addition, there are institutional constraints to university-level education to which we are bound, such as accreditation requirements, course ownership, and teaching loads. Although there are some exceptions, institutional and structural changes are required to facilitate cross-departmental collaboration in many universities (Moore, 2005; Toland et al., 2021). Finally, are our IS students 'ready' to engage in interdisciplinary learning? Students may experience cognitive dissonance, become confused or be reluctant to leave their comfort zone when faced with interdisciplinary teaching approaches (Toland et al., 2021). My experience suggests this is a skill that requires time and practice to develop, something that needs to be rethought from the beginning of post-secondary education with more research devoted to transformational and alternative pedagogies and new organizational and evaluative structures (Moore, 2005).

There is general agreement within the IS discipline that we can and should do more to advance sustainability and contribute to societal and planetary well-being. Education of current and future IS practitioners and managers is one of the most important levers we possess. However, teaching and learning related to sustainability is different and comes with its own set of challenges. This paper contributes to enhancing our collective knowledge and toolkit for sustainability education in IS by reflecting

upon my experiences over the past ten years and providing insights and recommendations to others involved in similar activities. As Moore (2005, p. 327) argues:

> *Sustainability is a **concept**, a **goal**, and a **strategy**. The **concept** speaks to the reconciliation of social justice, ecological integrity and the well being of all living systems on the planet. The **goal** is to create an ecologically and socially just world within the means of nature without compromising future generations. Sustainability also refers to the process or **strategy** of moving towards a sustainable future.*

As educators, we need to keep these three elements in mind and provide a suitable integrating framework to allow students to make sense of sustainability, act on what they learn, and become effective agents for change.

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