Integrating systematic design for sustainability in design education to stimulate sustainability awareness in developing countries: A case study in Rwanda

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Integrating systematic design for sustainability in design education to stimulate sustainability awareness in developing countries: A case study in Rwanda

by

Aziza Cyamani

A thesis submitted to the graduate faculty in partial fulfillment of the requirements for the degree of Master of Industrial Design

Major: Industrial Design (Industrial Design)

Program of Study Committee:
Verena Paepcke-Hjeltness, Major Professor
Tejas Dhadphale
Christopher Martin

The student author, whose presentation of the scholarship herein was approved by the program of study committee, is solely responsible for the content of this thesis. The Graduate College will ensure this thesis is globally accessible and will not permit alterations after a degree is conferred.

Iowa State University

Ames, Iowa

2018

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DEDICATION

This thesis is dedicated to everyone that has been and/or continues to be marginalized.
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ABSTRACT

It is a shared opinion that sustainability designers, regardless of their domain of specialization, need to reframe their traditional modus operandi to adapt practices that are less harmful. This is due to studies that continue to indicate that traditional design practices and outcomes greatly contribute to environmental, social, and economic degradation. Design for sustainability in itself is not a new concept; it has been extensively explored and a plethora of methods, tools, and approaches have emerged from its practice. Even more interesting is its integration in design education. Currently, methods of certifying, refining, and tracking the integration of sustainability in design education are increasing in the western world; however, studies that explore these concerns in other parts of the world are still scarce.

This research sought to explore the implications of sustainability in design education in developing countries with the intention of understanding fundamental dynamics that exist at the intersection of local design perceptions and sustainability. Capitalizing on the researcher’s background, the preliminary study was carried out in the Department of Creative Design program at the University of Rwanda. Using Participatory Action Research (PAR) methodology, design students were invited to take part in a design workshop that focused on using design for sustainability methods to address varying concerns in their surroundings. Data was collected at varying stages of the workshop using mixed methods and tools.

Analysis of the data collected during this study indicated that though the Department of Creative Design in Rwanda did not have systematic integration of aspects of sustainability in its curriculum, both students and instructors expressed positive perceptions and enthusiasm towards incorporating approaches of Design for Sustainability curriculum. Furthermore, direct structures including cultural, political, economic, geographical, and historical contexts were shown to play significant roles in participant’s awareness and definition of sustainability.
CHAPTER 1. INTRODUCTION

The need for integrating sustainable practices in education has and continues to be discussed at great length by a wide variety of scholars. In engineering, Davidson, Hendrickson, Matthews, Bridges, Allen, Murphy and Austin (2010) recognized it as a way of preparing sustainability-oriented engineers. In architecture, Altomonte, Rutherford, and Wilson (2007) recognized it as an imperative parallel to the growing sustainability relevance in the profession, in science Anastas and Warner (2000) pointed to its transformative nature, Sidiropoulos (2014) discussed its value in business education while O’Rafferty, Curtis, and O’Connor (2014) discussed its implication in design education. What is common in the literature that continues to pour out from different regions of the world is that there is a need for all professions to adapt sustainable practices as the best approach to ensuring a sustainable future.

In design disciplines that result in the creation of entities such as buildings in architecture, products in industrial design, prints in graphic design, or clothes in fashion design, it is easy to see the imprints of these disciplines on the surface of the earth. Victor Papenek, a major critic of lasting product imprints on the environment, was among the first to point to the massive dumping sites that were filled with discarded products in the United States. Since then, strategies, in the form of Design for Sustainability continue to be formulated and integrated in the design profession and education using different methods at varying stages.

To truly instill sustainability understanding and practice in design professionals, one needs to examine their training, especially the years that they spend at the university. Therefore, it is imperative to revisit the role that education (particularly higher education) plays in the dissemination of sustainability in future professionals. Ramirez (2007) mentioned
that it is imperative to train students to become stewards of the environment and to guide them in acknowledging social justice and equity in their practices.

**Statement of the Problem**

Though the integration of Design for Sustainability (D4S) continues to take hold in design education in developed countries, its integration in design curriculums in developing countries is still very low. There exists an opportunity to explore relevant strategies of integrating sustainability in design education in developing countries.

**Research Questions**

To formulate relevant methods of integrating sustainability in a design curriculum, this research set out to find answers to the following questions:

1. What is the current understanding of sustainability in design education in Rwanda?
2. What are the notable challenges of integrating Design for Sustainability in design education in Rwanda?
3. What are key aspects of the local context that might inform the integration of Design for Sustainability in design education in Rwanda?

**Purpose of the Study**

This study proposes that to integrate adequate sustainable design practices in design education in developing countries, we need to first understand the key aspects of the local context that inform the understanding, challenges, and opportunities of Design for Sustainability. It proposes approaches that could be of relevance in similarly developing countries; where through effective integration strategies, establishing relevant pedagogical techniques, and consideration of existing opportunities and challenges, design can play an effective role in sustainable development of developing countries.
CHAPTER 2. LITERATURE REVIEW

This literature review presents insights derived from different scientists and scholars. The section is arranged in a top-down structure presenting views of the concepts of sustainability in design starting with its definition, then exploring its application in the development and education contexts, and finally presenting an overview of the integration of sustainability in design education.

Defining Sustainability

With the persisting world concerns of environmental degradation, social inequality, population growth, and economic challenges (among others), the concept of sustainability continues to gain popularity. Though sustainability is a term that has recently been characterized by ubiquity, it also continues to be surrounded by discord (Vos, 2007). At the very least, the definition varies by scale and context of application; at the most, it varies by ideological constraints in its application according to (Gladwin & Kennelly, 1995). Whereas some critics refer to the failure to come to a general consensus on the definition of sustainability as an indication of its ‘uselessness’ (Costanza & Patten, 1995), Vos (2007) states that this very quality is in part what makes sustainability so valuable. Bryner (2001) agreed with that statement by stating that differing definitions of sustainability are useful because they foster a broader overview and assist in organizing for social change when tough choices are being confronted.

Toman (2006) and Vos (1997) both credit the origin of the concept of sustainability with biologists and ecologists who used it to refer to a harvesting regimen for reproducible natural resources that could be extracted or damaged by pollution without threatening the integrity of ecosystems. The term was also adapted in economics, where the maintenance of human’s living standards was the focus (Toman, 2006), and in other disciplines such as politics, business, design, and engineering (Vos, 2007). On one hand, its versatility has made
it possible to be integrated into the diverse disciplines but on the other hand, there continues to be a challenge with composing a definition that holds relevance in the various professions (Toman, 2006; Costanza & Patten, 1995; Mebratu, 1998; Vos, 1997). As a result, the concept is now more open to individual political and philosophical interpretations than to scientific definition (Robinson, 2004).

One aspect is clear though; the concept brings forward the concerns of temporality, balance, and longevity (Costanza & Patten, 1995). According to Toman (2006), the word sustainability connotes the concepts of preservation and nurturing overtime. This is in line with the Oxford English Dictionary, which defines ‘to sustain’ as ‘to keep a person or community, the mind, or spirit from failing or giving way’ or ‘to keep in a state of being; to cause to continue in a certain state; to keep or maintain a proper level or standard’ (Little et. al, 1992).

The criticism that exists around the concept of sustainability centers around: (1) Failure to reach consensus on what exactly it is that we want to last – is it a particular ecological system? Humans and/or all the species in the biodiversity? The current economic system? Or a particular culture (Costanza and Patten, 1995; Morelli, 2011). Scientists illustrated this argument by pointing out that human kind has consistently managed to avoid the specter of Malthusian scarcity through resource substitution and technical ingenuity (Toman, 2006); 2) it lacks scientific measurable spheres to which Costanza and Patten (1995) reasoned that it should be accounted in the range of interrelated time and space scales over which the concept must apply. Here, Costanza and Patten (1995) argue that the meaning of sustainability considered by some as ‘maintenance forever’ is both misleading and contradicting in itself; and (3) there are no accepted criteria with supporting test methods to measure it. Here, Moldan and Dahl (2007) propose the use of indicators of both quantitative and qualitative nature that contain values such as benchmarks, thresholds, baselines, and
targets that transform data into meaningful information. Ceschin & Gaziulusoy (2016) argue that our view on sustainability requires a process-based, multi-scale, and systemic approach to planning for sustainability guided by a target/vision instead of traditional goal-based optimization approaches.

**Sustainable Development**

Consequently, sustainability has been used in many contexts such as: *sustainable development, sustainable societies, sustainable communities, ecological sustainability, sustainable growth, and strategic sustainability*. Each use places a slight emphasis on one or another aspect of the concept (Vos, 2007) without addressing sustainability as a whole. Perhaps one of the leading and most commonly used definitions of sustainability emerged from the World Commission on Environment and Development (WCED) and was published in the Brundtland report of 1987 in the context of sustainable development as, “development that meets the needs of the present without comprising the ability of future generations to meet their own needs.” As discussed by Baker (2006), this commission whose proceeds were published in a report known as “Our Common Future or The Brundtland Report” linked dimensions of environmental concerns with the traditional economic and social goals of development. In addition to endorsing a more hollistic approach to development, *Our Common Future* prioritized meeting the needs of the World’s poor and working within the limitations of the planets abilities and inter-national cooperation (Baker, 2006). Whereas *The Brundtland Report* discussed the global causes of unsustainable development and put forward pathways for nations to integrate sustainability within the new development paradigm, as well as guidelines on how this can be done (Baker, 2006). It should be noted that the goals and objectives of sustainability are influenced heavily by regional, industrial, and cultural needs. Therefore, actual goals are usually formulated within particular realms preceded by extensive research of the domains’ impacts linked to the bigger goal of global sustainability.
Sustainable development proposes to approach this goal through the consideration of three domains that are believed to be the fundamental pillars of sustainable development also known as the Triple Bottom Line defined as: economic growth, social justice, and environmental stewardship (Mebratu, 1998). The economic realm refers to the ability to sustain a flow of goods and services and managing a government’s income and loans. The social realm denotes the fair distribution of equity and adequate social services among people, whereas the environmental aspect addresses the use of natural resources and managing other ecosystems not included in the previous definitions (Harris, 2000). These descriptions present challenges if regarded in the original definition in terms of balancing goals and assessing what would take precedence when objectives of one principle negatively impact the other (Harris, 2000). However, Giddings, Hopwood, and O'brien (2002) argue that these are not unified entities but rather should be considered as fractured and multi-layered aspects that can be considered at different spatial levels with connections and dependences with each other. Consequently, it is this stipulation that education of sustainability education has followed this model.

**Sustainability Education**

According to Cortese (2003), unsustainability problems that the world is facing are caused by the world’s highly literate. Cortese argues that the lack of sustainability education in higher education leads to graduates who do not care about environmental concerns and thus leading to decision-makers whose decisions are based solely on traditional development (Cortese, 2003). In Cortese’s “What is Education for?: Six Myths About the Foundations of Modern Education and Six New Principles to Replace Them.” Orr (1991) supported this statement by arguing that it is a matter of no small consequence that the only people who have lived sustainably on the planet for any length of time could not read or do not make a fetish of reading. He went on to argue that the goal of education is not mastery of subject
matter but of one’s person, which was supported by Cortese (2003) who mentioned that “all education must be environmental.”

All parts of the university system are critical to achieving a transformative change that can only occur by connecting head, heart, and hand. Furthermore, Orr (1991) mentions that knowledge carries with it the responsibility to see that it is well used in the world. In support of this statement, he points at the freedom to create vast and risky things that comes with acquiring knowledge by the cost having that the ability to use it responsibly. Additionally, he discusses the importance of the process of learning, which was supported by Cortese (2003) who attributed the shortcomings of the traditional learning environment as the stresses of higher education focusing on individual learning and competition, resulting in professionals who are ill prepared for cooperative efforts. He goes on to note, due to learning being fragmented, faculty responding to long-established incentives (e.g., tenure, research) and professional practices are often discouraged from extending their work into other disciplines or inviting interdisciplinary collaboration (Ibid). It cannot be said that something is known until the effects of this knowledge on real people and their communities is understood: business decisions can affect not just the economy of a place but the livelihood of the people who depend on it (Orr, 1991).

UNESCO (2004) notes that education for sustainability at all educational institutions including higher education, was to demonstrate a range of key features. It is to be interdisciplinary and holistic; so embedded across the whole curriculum with its values examined, debated, tested, and applied. It is to be built around critical thinking and problem solving and confidence building in the face of dilemmas and challenges of sustainable development. It is to be multi-methods and participatory, applying different pedagogies, and fostering cooperative learning and decision making between teachers and learners (Ibid). In addition to that, it is to be locally grounded in local languages and cultures (Sterling, 2010).
Higher education institutions are considered as key players in promoting sustainable development due to the part they play in educating future professionals and leaders (Garcia, 2010). However, to understand the preparation of graduates with sustainability knowledge, we should first seek to understand the approaches to sustainability education in higher learning environments. According to Cortese (2003), this is usually done by engagement of the four areas that form a student’s total experience (i.e., Education, Research, University Operations, and External Community). In education, Cortese (2003) argued that most disciplines should make sustainability the context for, or content of, learning. Furthermore, Orr (1991) argued that higher learning institutions should set goals of ecological literacy for all students. In research, Filho (2010) emphasizes the need for hiring trained staff and establishing a scholarship by developing robust research programs and strong publication profiles. In university operations, Orr (1991) suggests that universities should examine the flow of resources on their campuses by collectively finding ways to shift buying power to support better alternatives that do less environmental damage, lower carbon dioxide emissions, reduce use of toxic substances, promote energy efficiency and the use of solar energy, help to build a sustainable regional economy, cut low-term costs, and serve as an example to students and other institutions alike. As for engaging the external community, Cortese (2003) argues that taking the educational experience from a theoretical to a practical level will have an impact on the way the academy will interact with the external community. He attributes this responsibility to planners who must focus as much on the education and research being done in higher education as on the physical, operational, and external community functions of the university, and to do so in an integrated and interdependent manner. For example, Filho (2010) attributes the lack appointed personnel (custodians) to oversee its implementation, resources to justify it, lack of scientific basis, too much competition for funds for sustainability initiatives, and lack of practical examples to be some
of the challenges that affect the integration of sustainability in higher education. In the growing interest of integrating sustainability in higher education curricular, institutions are integrating sustainability into their missions, study plans and research projects as observed in the United States, England, Australia, and Canada (Rowe, 2007; Wigmore & Ruiz, 2010; Ralph and Stubbs, 2014), a process traced by the Association for the Advancement of Sustainability in Higher Education (AASHE) as shown in Figure 2.1.

![Figure 2.1: A map showing sustainability education tracking around the world](image)

**Design for Sustainability (D4S)**

Design has been engaged with different aspects of sustainability practices since the mid-twentieth century thanks to pioneers such as Victor Papanek (Ceschin & Gaziulusoy, 2016). The most common practice of design that applies sustainability criteria known as Design for Sustainability (D4S) is one of the most convenient instruments in today’s design foundation. The D4S concept builds upon the work of eco-design and green design and outlines tools and methodologies for integrating sustainability concerns into product redesign, development, and creation (Clark, Kosoris, Hong, & Crul, 2009; Crul & Diehl, 2009). A review of the evolution of D4S Design for Sustainability by Ceschin and Gaziulusoy (2016) cited early examples of green design that focused on lowering environmental impacts through
redesigning individual product qualities to have resulted in unexpected outcomes leading to green consumerism. Consequently, eco-design was adapted as a more holistic approach taking into account environmental impacts at every stage of design from material sourcing to disposal. Eco-design included a wide range of design approaches to be employed at different stages of the product lifecycle to reduce the social and ecological impact of a product, service or system. The Okala ecodesign strategy wheel adapted by White, Pierre, and Belletire (2013) presents a comprehensive list of strategies and approaches that designers can incorporate in product development or improvement as shown in Figure 2.2.

![Okala Ecodesign Strategy Wheel](image)

**Figure 2.2: OKALA proposed strategies for eco-design**

Though the eco-design approach was considerably more ecologically friendly, it was quoted to lack contemplations for human-related impacts that cannot be accounted for in life-cycle assessments. Therefore, approaches such as emotionally durable design (extending emotional attachment between user and product), design for sustainable behavior (encouraging user to adopt sustainable behaviors), cradle to cradle (emphasis on closed-loop approaches), biomimicry design (using nature as model, measure and mentor), product-service systems (joint emphasis on product and service systems), social innovation (development and improvement for social impact), systems design (waste from one process is
uses as input for other processes), and design for the base of the pyramid came into fruition (Ceschin and Gaziulusoy, 2016).

The later approach, which focuses on improving the lives of people who live below a certain economic threshold, is of particular interest in this study. Two approaches in this category were proposed including ‘designing for’ and ‘design with’. However, the idea that designing products within the capabilities of Bottom of the Pyramid communities could bring prosperity continues to raise ethical criticism (Oosterlaken, 2008). Jagtap and Kandachar (2010) argue that the diverse needs of communities at the BoP oblige distinctive design approaches to those applied in industrialized countries to which Gomez, Diehl, and Brezet (2012) identified requirements of designing for BoP as desirability (user context), feasibility (technical capabilities), viability (financial capabilities), and sustainability (people, planet and profit). The adaption of Design for Sustainability (D4S) in the innovation process for countries at the BoP presents new opportunities including the reduction of environmental, social, and economic impacts in consumption and production of design products from the beginning, instead of incorporating these considerations at the end of the process as has been traditionally practiced (Clark et al., 2009). However, it is recognized that design for BoP is still a fairly under-explored arena; thus, comprehensive design methodologies that take into consideration user context, business development, sustainability, and innovation models are yet to be developed (Cruz & Diehl, 2009).

**Design for Sustainability (D4S) in Education**

In its conception, Design for Sustainability and its constituents were introduced as strategies that companies could employ to reduce the environmental impacts associated with their production processes (Clark et al., 2009). To this day, D4S continues to be integrated in private companies and even more interesting is its integration in design education. In this regard, Ramirez (2007) argues that design education should respond by developing ethical
designers. For the longest time, designers had been considered the root of the problems; they can also be seen as the source of the solutions (Yang & Giard, 2001).

Pioneering at the Delft University of Technology (TU Delft) in the Netherlands, pedagogy techniques and methods of the integration of sustainability in design education continue to be explored around the world. Two methods are commonly reported in the integration of sustainability in the curriculum of design schools; one extreme is where sustainability is incorporated in existing design practices and the other extreme is where design is viewed as a dimension of sustainability (Fletcher & Dewberry, 2002). To evaluate which method is more effective is outside the scope of this study. However, a review of programs that integrate sustainability in design education can present insightful implications on the differing methods. Notable programs include Design for Sustainability at Delft University of Technology (DUT-DFS), a research and education cluster in the faculty of engineering. The cluster focuses on integrating sustainability aspects in the front end of the design process considering the limited technological advances, enhancing sustainable lifestyles and life cycle assessment methods. Multiple modules in the curriculum include substantial aspects of sustainability and several Masters programs confer a Sustainable Development (SD) annotation certificate. Other notable programs include the Masters in Arts and Masters in Fine Arts degrees offered at Savannah College of Arts and Design; Masters of Sustainability leadership at Arizona State University; and an online Masters of Arts in Sustainable Design program offered at Minneapolis College of Art and Design. From the literature explored, it can be deduced that after a long time of estrangement between design education and sustainability, a gradual increase in Design for Sustainability programs continues to be observed around the world.
Rwanda Context

The lack of design solicitation in many countries that are still considered under-developed or on the path of development could be attributed to the fact that most of the countries in this category are still on the path of acquiring adequate basic needs for their citizens. However, in recent years, with an increase of internal stability and consistency of good governance, some countries are slowly breaking the mold and are now on a path of development. This newly found stability continues to bring about the need for strong public sectors, creation of jobs for the youth, expansion of knowledge, and most importantly a need for self-sufficiency. One of these notable countries is Rwanda.

Twenty-four years after the 1994 genocide that claimed more than 800,000 people’s lives and left the country in tragic economic standing, Rwanda is currently considered among the fastest growing nations in Africa. Rwanda’s vision is to become a middle-income country by 2020; therefore, efforts have been concentrated on methods that accelerate poverty reduction and sustainable economic development. The Vision 2020, a national conceptual framework that was adopted in 2008 and revised in 2012, outlined clear goals of achieving this ambitious vision. It identified the creation of macroeconomic stability and wealth to reduce aid dependency, structural economic transformation, the creation of a productive middle class, and job creation to be among the top priorities (Republic of Rwanda, 2012). The achievement of these goals is structured through short to long-term strategies operationalized through medium term (3 years) Economic Development and Poverty Reduction Strategies (EDPRS) at different country subdivisions. By the end of EDPRS I (2008-2012), Rwanda ranked among the ten fastest growing economies in the world with more than one million people elevated out of poverty (Republic of Rwanda, 2013). Ownership of EDPRS, homegrown solutions, community-based solutions, use of technology in different sectors, and institutional implementation were at the forefront of the milestones
achieved. Shortcomings of EDPRS I included insufficient coordination between entities, low private sector engagement, and inadequate linkages between issues and institutions. The EDPRS II (2012-2018) set out to remedy these issues by mainstreaming crosscutting issues, creating coherence in district and sectorial strategic plans, and implementing monitoring and evaluation strategies. To build upon the pillars of Vision 2020, EDPRS II also focused on four thematic strategies including economic transformation, rural development, accountability in governance, productivity, and youth employment (Republic of Rwanda, 2012). This last thematic focus was especially important as managing the pressure of the demographic expansion and the high demand of the job market for the equally rapidly growing working-age population continued to challenge the country’s poverty reduction and economic growth. The Rwanda National Employment Policy (RNEP) anticipates the need for at least 200,000 new jobs to be created each year to close this gap (MIFOTRA, 2014). With the majority of the national labor force involved in agrarian practices, a shift towards non-farming occupations, notably those that result in job creation, self-reliance, and place a strong focus on the youth be the breakthrough could bail Rwanda out of this conundrum. EDPRS II recognizes the reformation of education curriculum to promote skills development, technology mainstreaming, support for private sector driven innovation and entrepreneurial ventures, and labor market interventions to be driving factors for the achievement of a non-agrarian labor market. These initiatives are currently being implemented by the Rwanda Development Board (RDB), which continues to report an increase in new businesses with growth in the service sector. Among the jobs created in Rwanda, there are those that fall under the product and/or service provision sector where design has predominantly reigned. This is mainly evidenced in design graduates, among whom almost 70% have gone on to start entrepreneurial ventures in the country as discussed by the Head of Department of the only design school in Rwanda, Senior Lecturer, Henry Miheso. Miheso attributed this factor to be
a derivative of the marginal design jobs on the Rwandan market. “In a country that is rated number six on the World Bank list of “the easiest countries to start a business in,” it is not surprising that most graduates opt to starting their own businesses,” he mentioned. The Made in Rwanda policy that aims to promote products that are manufactured in Rwanda presents new opportunities for product, industrial designers, and innovators in general. So the question remains, are the design jobs and markets being created in Rwanda in line with the global and national sustainable development agenda?

**Environmental Education for Sustainable Development (EESD)**

On the national level, the integration of sustainability in the education system is mandated through the Environmental Education for Sustainable Development (EESD) strategy adopted by the Rwanda Environmental Management Authority (REMA). Specific objectives of the strategy include: education and awareness to increase public participation in sustainable development, capacity-build future leaders to have commitment, expertise, and leadership to ensure sustainable development; integrate environmental and sustainability issues in the school curriculum to improve the quality of learning and make it relevant to the needs of the society; capacity-build the media to report and communicate sustainable development challenges; and enhance the quality and relevance of technical and higher education to respond to local sustainable development challenges (Rwanda Environment Management Authority (REMA), 2010). This Education for Sustainable Development (ESD) framework was conceived in alignment with the national sustainable development initiatives including the Vision 2020 and the Economic Development and Poverty Reduction Strategy (EDPRS), as well as in compliance with international initiatives such as the Millennium Development Goals (MDGs) and the Decade of Education for Sustainable Development (DESD). The government of Rwanda has additionally taken steps in mainstreaming environmental management through policy formulation, advocacy and public awareness,
resource material development, research and innovations, capacity building, networking, partnerships, and vision-building (Rwanda Environment Management Authority (REMA), 2010). In the S.W.O.T (Strength, Weaknesses, Opportunities, and Threats) analysis performed by REMA, strengths in education for sustainable development were quoted to stem from the strong political will on environmental conservation and a high participation by civil society, whilst the weaknesses were centered upon inadequate implementation mechanisms and skilled labor, limited understanding, awareness and sharing of information, and the lack of adequate linkages between environment - development and sustainability. Poverty, conflict, and lack of resources were acknowledged as major threats to this initiative while the opportunities identified were mostly concentrated in the numerous strategic plans and policies drafted with consideration for integration of environmental concerns, economic development, and poverty reduction (Rwanda Environment Management Authority (REMA), 2010).

**Current Mandates Related to Sustainability in Design Education in Rwanda**

A major driver for integrating sustainability in the Creative Design program lies in its foundation that affirms to conform to the University of Rwanda’s vision, which is to be a leading University that develops highly enterprising graduates prepared and dedicated to building a more just and sustainable society locally, nationally and globally, with appropriate innovations that advance quality of life. Accounting for 40% of the total student population enrolled in all higher education institutions in Rwanda (University of Rwanda, 2017), the University of Rwanda (UR) is significantly positioned to impact Rwanda’s Vision 2020. In mandate with this vision, the University of Rwanda devised a 5-year (2018-2023) strategic plan aimed at increasing the production of relevant, high-quality scientific knowledge that would contribute to Rwanda becoming a knowledge-based economy (University of Rwanda, 2017). For this purpose, ten interdisciplinary research clusters were derived from emerging
national and sectorial priorities as well as the global Sustainable Development Goals (SDGs).

Though all the clusters incorporated crosscutting themes of environmental, social, technological, and innovation sensitivities, this study focused on clusters 2, 8, and 9 that addressed socio-economic transformation and sustainable development; sustainable energy and manufacturing; and transformative education, culture and creative arts respectively.

According to the University of Rwanda (2017), the socio-economic transformation and sustainable development cluster would focus on research that aimed to understand the drivers of structural transformation and social-economic effects on livelihoods, contributing to Sustainable Development Goals 8, 10, and 12 (decent work and economic growth; reduced inequalities; responsible consumption and production respectively). The University of Rwanda (UR) proposed to bridge the skill and capacity gaps in these fields by training UR staff in PHD programs in fields of economics, business and management, industrial organization, and creating related Masters programs such as Masters programs in innovation, creativity and entrepreneurship among others. The sustainable energy and manufacturing cluster addresses capacity and skill building in affordable, reliable, and sustainable energy for all, as well as the manufacturing sector in Rwanda. “Made in Rwanda,” a campaign aimed at promoting consumption of locally made items was referenced as a nationally supported and growing element in the manufacturing sector. In this regard, the university emphasized the significance of enhancing capabilities in engineering, industrial studies, quality assurance, automation, and the like to bridge the knowledge gap. The transformative education, culture, and creative arts cluster highlights the contribution of humanities and social sciences in the economic and societal transformation. This cluster particularly highlights the scarcity of research on the contribution of arts and culture in education in economic transformation and proposes capacity enhancement through homegrown initiatives that incorporate Rwandan core values that accelerate and sustain development.
CHAPTER 3. METHODOLOGY

The following chapter discusses the methodology that was employed in collecting data for this study. In regards to the nature of the social relationship that already existed between the researcher and the participants of this study, bias in this study was controlled by critical approaches to data collection. Kemmis (1991) describes critical methods as methodologies in which the researcher takes on both a subjective and objective stance, subject to treating oneself and one’s fellows both as subjects and as objects in the process of critical reflection and self-reflection. In this approach, the researcher aims to develop or improve people’s actions, understandings, and situations through collaborative research with the stance that the participants are both the products and producers of history, as they share circumstances which they can act together to challenge and to change (Kemmis, 1991). With these contemplations in mind, the following criteria were considered in the development of methods:

- Methods were collaborative
- Methods were able to target both primary and secondary participants to facilitate insider and outsider analysis.
- Methods were able to capture the diverse substance of the study and provide sufficient data on the questions under review.

Based on these criteria, a combination of qualitative, quantitative, and critical action research methods were selected for this study’s realization. Action research is a collaborative approach wherein participants work together to understand and improve their own practices (Altrichter, Kemmis, McTaggart, & Zuber-Skerritt, 2002). At the core of action research lays (1) working on an agreed thematic concern (McTaggart, 1991); (2) an overlapping process of action, reflection, and evaluation (Lewin, 1946); and (3) a group working together to change themselves individually or collectively (McTaggart, 1991). Groups can be any group of
participants with a shared concern such as students, parents, teachers, activists, or any other community member (Altrichter et al., 2002). Action research can be used as a means for professional development, improving curriculum, or problem solving in a variety of work situations (Berg, 2004).

Though the nature of Participatory Action Research (PAR) is often cited as a qualitative one (MacDonald, 2012), its versatility allows for the application of mixed methodologies and using diverse approaches in data collection. According to Creswell and Creswell (2017), combining qualitative and quantitative approaches allows researchers to explore topics pragmatically, using a wide range of tools, and accommodating the researcher’s function without the restrictions or biases of a single approach. Combining different types of methods and data collection techniques also provides an opportunity to triangulate and validate data (Jick, 1979).

In the context of this research, an action research study was set up at the University of Rwanda in the form of a workshop. The targeted group were third year students in the Department of Creative Design who were invited to participate in a workshop that aimed to explore the consideration of sustainability in design practices, identifying relevant challenges in their specific contextual setting, while reflecting on the process and knowledge acquired through daily journals and interviews. A study design such as this one has previously been used to explore innovation capacity in agricultural systems (Schut et al., 2015); to study the appropriateness of care workers as mentors for nursing students (Annear, Lea, & Robinson, 2014); and in design education such as Katoppo & Sudradjat (2015) exploration in combining Participatory Action Research (PAR) and Design Thinking (DT) as an alternative research method in architecture.
Setting

The study was initiated at the University of Rwanda, in the Department of Creative Design (CRD) located at Remera campus in Kigali City. The Creative Design department was established in 2010 with the core aim of supporting national growth and development through establishing and training vibrant, creative, and competent art and design industry and professionals. The program’s goal is to impart on students the knowledge and understanding of the theories of creative arts and design, develop their cognitive and intellectual facilities, train them in practical and communication skills, and equip them with general transferable skills. Students are awarded the Bachelors of Creative Design (BCD) with honors degree upon completion of the four-year program.

The program’s curriculum follows a module-based structure organized as follows: students take 22 core design modules distributed among four semesters in the first two years, after which they can pick an area of specialization. During their third year, students take 16 modules pertaining to their respective specialization alongside 4 general courses distributed in two semesters. In the fourth year, students are given the autonomy to conceptualize and explore a topic of their choice, of which, a written thesis and design project are created in the last two semesters, respectively. Table 3.1 demonstrates the curriculum structure of the Department of Creative Design.

Specializations

The Department of Creative design (CRD) at the University of Rwanda is equipped to offer specializations in Communication Design, Media design, and Environmental design with prospects of offering a Product Design specialization in the future.
Table 3.1: Curriculum of the Department of Creative Design

<table>
<thead>
<tr>
<th>Year</th>
<th>Specialization</th>
<th>Semester 1</th>
<th>Semester 2</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>n/a</td>
<td>Design theory I, Print techniques, Free hand drawing, 2D &amp; 3D studies</td>
<td>Design theory II, Design materials, Photography I, Free hand drawing II, Instrumental drawing</td>
<td>100</td>
</tr>
<tr>
<td>2</td>
<td>n/a</td>
<td>Interaction design, Method improvisation, Photography II, Design drawing, Painting, Modeling technology I</td>
<td>Design theory III, Digital imaging, Creative media, Environmental design, Modeling technology II, Applied &amp; Decorative design</td>
<td>120</td>
</tr>
<tr>
<td>3</td>
<td>Media Design</td>
<td>Model making, Sound, Digital media, Advertising</td>
<td>Event design, 3D animation, Film / Video, Web design</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Communication Design</td>
<td>Digital media, Advertising, Graphic design, Photography III</td>
<td>Innovation design, Creative entrepreneur</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Environmental Design</td>
<td>Landscape design, (Residential) Interior design, (Residential) Murals, Soft furnishing</td>
<td>Industrial attachment I</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Landscape design, (office/public) Interior design, (office/public) Sculpture, Furniture</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>All</td>
<td>Research project</td>
<td>Design studio</td>
<td>120</td>
</tr>
</tbody>
</table>

Population

At the time of implementation of this study, the Department of Creative Design had a total student body of 125 students across its four classifications: 35 students were reported to be in their first year, 30 students in the second year, 26 students in third year, and 18 students in the fourth year. The 2017-2018 academic year was a particularly unique year for the
department as no first-year students were admitted due to the department's administrative changes. The department had nine full-time faculty, one part-time faculty, and two Tutorial Assistants. Other personnel linked to the department included (in ascending hierarchical order): The Head of Department, the Dean of the School of Architecture and Built Environment, the Vice Rector of Academy, the Principle of the College of Science and Technology, the Chancellor of the University of Rwanda, and the Minister of Education. Students, faculty, and staff in the Department of Creative Design were chosen as the population to be studied. Furthermore, government officials in public offices and businesses that were relevant to the research topic were included in the study. The total population that was studied was 143.

**Participants**

Participants of the workshop were purposely selected as third year students pursuing a Bachelor’s degree in Creative Design – with specialization in Environmental Design and Communication Design. Participants were recruited on the basis of having completed the Innovation Design module before the workshop. This criterion was crucial for the study as the process of design that was employed during the workshop complimented the process taught in this course. Participants were recruited using posters and word of mouth. In total, 17 responses were recorded for the questionnaire of which 10 participated in the workshop and interviews. Participants’ classifications are presented in Figure 3.1 and participants’ specializations are presented in Figure 3.2.
In addition, faculty and staff were recruited through word of mouth, phone calls, and email. Five full-time instructors, one Head of Department, and one Dean of The School of Architecture participated in the study. The total number of participants in this portion of the study was 24.

**Data Collection Methods**

Data for this study was collected using questionnaires, semi structured interviews, journal entries, and secondary data. Table 3.2 elaborates the methodological framework of...
how the study was planned and conducted. It indicates the breakdown of the research questions; demonstrates the process of collecting data from different participants; the volume of data collected; and the methods of data analysis.

Table 3.2: *Data collection methods*

<table>
<thead>
<tr>
<th>Research question</th>
<th>Sub question</th>
<th>Methodology</th>
<th>Participants</th>
<th>Outcome</th>
<th>Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>What is the current understanding of Sustainability in design education in Rwanda?</strong></td>
<td>What is the students’ current understanding of Sustainability in design?</td>
<td>Questionnaire</td>
<td>Students</td>
<td>10-20 questionnaires</td>
<td><strong>Quantitative</strong>: Words that students commonly associate with D4S</td>
</tr>
<tr>
<td></td>
<td>What aspects of Design for Sustainability currently exist in the curriculum and how are they taught to students?</td>
<td>- Interviews</td>
<td>Instructors</td>
<td>5 interviews</td>
<td><strong>Qualitative</strong>: Discussion on instructors’ understanding, teaching, and assessment methods</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Secondary data</td>
<td>Department</td>
<td></td>
<td><strong>Qualitative</strong>: Review course outlines</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>What is the UR’s standing on sustainability education?</td>
<td>- Interviews</td>
<td>- Head of Department (CRD) - Dean of the School of Architecture and Built Environment SABE &amp; UR</td>
<td>2 Interviews</td>
<td><strong>Qualitative</strong>: Review of the program structure and discussion of the overview of the UR’s standing on sustainability</td>
</tr>
</tbody>
</table>
Table 3.2 (continued)

<table>
<thead>
<tr>
<th>What are the key challenges for implementing Design for Sustainability in design activities in Rwanda?</th>
<th>What challenges did students face in applying Design for Sustainability strategies in a design project?</th>
<th>- Workshop daily journal entries</th>
<th>- Post workshop Interviews</th>
<th>- Observations</th>
<th>Students</th>
<th>- 100-200 journal entries</th>
<th>- 10 interviews</th>
<th>- Field notes</th>
<th>Qualitative: - Discussion on critical inquiry towards applying sustainable methods</th>
</tr>
</thead>
<tbody>
<tr>
<td>Workshop daily journal entries</td>
<td>Workshop daily journal entries</td>
<td>- 100-200 journal entries</td>
<td>- 10 interviews</td>
<td>- Field notes</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Qualitative: - Discussion on critical inquiry towards applying sustainable methods</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>What key aspects of the local context might inform the integration of Design for Sustainability in design education in Rwanda?</td>
<td>What factors exist in Rwanda that may support or hinder the adoption of Design for Sustainability?</td>
<td>- Workshop daily journal entries</td>
<td>- Post workshop interviews</td>
<td>- Secondary data</td>
<td>Students</td>
<td>Instructors</td>
<td>- 100-200 journal entries</td>
<td>- 10 post-workshop interviews</td>
<td>- Literature review</td>
</tr>
<tr>
<td>Qualitative: - Discussion on students’ and instructors’ impressions. Discussion on federal involvement and existing resources</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Workshop

A collaborative workshop was conceptualized for exploring the integration of sustainability practices in CRD. The workshop aimed to guide participants through the theories and approaches pertaining to Design for Sustainability and their application design projects. Schut et., al (2014) suggest that a workshop such as this should be held in a language that all participants are able to understand and be facilitated by someone who is familiar with the cultural norms, has affinity with the problem, and understands the context of the country.
The researcher was the sole facilitator of the workshop. The researcher was responsible for planning, organizing, facilitating, and documenting the workshop’s daily activities as well as conducting data collection protocols. At the time of the workshop, the researcher was a third-year Masters student in Industrial Design at Iowa State University. The researcher had completed a bachelor’s degree in the Department of Creative Design with a specialization in Media Design.

To keep the workshop manageable, encourage an environment of interaction and debate, and maximize engagement and participation, the workshop was limited to 10 participants. Nine participants of the workshop were third year students and one participant was a Tutorial Assistant in the Department of Creative Design at the University of Rwanda. Eight participants were students in the specialization of Environmental Design and one participant was a student in the specialization of Communication Design. The Tutorial Assistant was a graduate of the Creative Design program with a specialization in Environmental Design.

The workshop was designed to take approximately 10-11 days including pre and post workshop data collection procedures. Table 3.3 illustrates the tools of data collection used before, during, and after the workshop.

Table 3.3: Data collection tools

<table>
<thead>
<tr>
<th></th>
<th>Before the workshop</th>
<th>During the workshop</th>
<th>After the workshop</th>
</tr>
</thead>
<tbody>
<tr>
<td>Questionnaires</td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Daily journal entries</td>
<td></td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Observations</td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interviews</td>
<td></td>
<td></td>
<td>x</td>
</tr>
</tbody>
</table>

**Questionnaires**

At beginning of the workshop, data was collected using a questionnaire with open-ended questions. The questionnaire aimed to gain insights on students’ understanding, their
source of knowledge, application, and perception of Design for Sustainability. The researcher administered the questionnaires in person on the first day of the workshop. Seventeen responses were collected using the questionnaire.

Reflections

A crucial element of the workshop was that participants were asked to answer daily journal questions that related to the topics discussed. The daily journals allowed students to reflect on the material that they were learning and relate it to pre-conceived knowledge as well as their immediate environment. This allowed the facilitator to track participants’ thoughts and follow up on topics of inquiry that emerged from the discussions. At the end of each session, participants were asked to reflect on 2-3 journal questions pertaining to the topics discussed, a question about what they had learned and a question about what they would like to know.

By recording the extent of what the participants had learned, and what inquiries it had sparked in them, the researcher was able to anticipate the key knowledge and technical skills needed to formulate a relevant curriculum.

Interviews

After the workshop, all participants of the workshops were invited for semi-structured interviews. Interviews addressed students experience in the workshop, their overall remarks on integrating elements of Design for Sustainability in design projects, and their reflection on its impact on design activities in Rwanda. The interviews focused on identifying key contextual factors that may support or hinder the integration of Design for Sustainability in design education and practices in Rwanda. Each interview took between 15-30 minutes. All interviews were conducted by the researcher, in person, recorded on an electronic device, and stored digitally in a secured folder.
Additional interviews were conducted with faculty and staff of the Department Creative Design to explore their understanding of Design for Sustainability, its teaching approaches, and assessment criteria. Sampling of participants among instructors was done according to convenience and availability. The interviewer followed a list of topics focusing on sustainability elements, their assessment criteria, and the key challenges that they had met or anticipated in integrating sustainability in the individual modules they taught. Interviews were conducted in person and recorded on an electronic device. Raw data was labeled and stored in a remote secured digital folder.

**Secondary Data**

Secondary data were written documents with relevancy to the integration of sustainability in education in Rwanda. The documents collected included the Department of Creative Design program structure, and course outlines; the ‘Research Capacity Development and Institutional Advancement’ at the University of Rwanda, detailing research endeavors including the ‘Green Cities’ agenda; and documents that detailed the Ministry of Education’s policy on the integration of sustainability in higher education. Furthermore, documents from the Ministry of Trade and Industries (MINICOM) websites were collected for the analysis of the existing resources and policies of integrating sustainability in education in Rwanda.

**Role of Researcher**

As quoted in Creswell’s ‘Research Design’ (Creswell & Creswell, 2017), in studies that involve a qualitative nature, the interviewer is the instrument. This alludes to the fact that the researcher’s background, experience, and beliefs may play a role in the outcome of the research. Since this research involved a diverse body of participants in different groups, the researcher acknowledges that the identity, experiences, beliefs, and knowledge or lack of may have had an influence on the interpretation of data during the study. However, careful
attention was employed in the analysis of the data collected to avoid any biased interpretation.

**Trustworthiness**

To ensure the validity and the reliability of the study, data was collected from different sources and using different tools, which were later triangulated. Furthermore, the final report was subjected to peer revision to ensure the accuracy of the findings.

**Ethical considerations**

The following steps were followed to ensure ethical considerations

- Permission was obtained and the study adhered to the rules, regulations, and guidelines set by the Iowa State University Institutional Review Board.
- Participants’ rights, needs, values, and desires were honored to avoid obtrusion.
- Participants were clearly informed of the objectives of the study before the study and were permitted to opt out whenever they desired.
- Permission was obtained from participants for use and publication of data through signed consent forms.

**Limitations of the study**

The study’s primary limitation was the generalization of data collected from the sample as a representation of design programs in developing countries. It is possible that every design program is unique and would require equally unique consideration in developing a relevant curriculum. Secondly, due to the nature of the study being international, there was a limited response rate due to the timing and ongoing school schedule of participants.
CHAPTER 4. DATA ANALYSIS

Current Understanding and Knowledge of Design for Sustainability in the Department of Creative Design

The results from the questionnaires and interviews conducted during this study provided insight into the understanding and existing knowledge of aspects pertaining to Design for Sustainability in the Creative Design department.

Students’ Understanding of Design for Sustainability

Data collected through the open-ended questionnaire asking participants to state what they understood by the term ‘Sustainable Design’ implies that most of the participants linked sustainable design to the usability of a design. The main characteristics mentioned were that a sustainable design was one that could be used, maintained, and lasted a long time. Other definitions in this category touched upon the quality of the design, affordances, and satisfaction of the design in relation to the user, as well as need and solution-based designs. Other participants responses touched upon designs that prevented and reduced harm to the environment and the people. In this category, particular facets were mentioned included eco-friendliness, green, and recycling characteristics. This question was further complimented by an interview question asking participants to state characteristics they thought a “sustainable design” should possess. Table 4.1 summarizes the data collected in four thematic focuses.

Table 4.1: Thematic focuses of sustainable design characteristics

<table>
<thead>
<tr>
<th>Archetype</th>
<th>Users</th>
<th>Value</th>
<th>Environment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Long-lasting</td>
<td>Satisfies people’s needs</td>
<td>Low cost</td>
<td>Cannot cause negative effects on environment</td>
</tr>
<tr>
<td>Good semantics</td>
<td>Comfortable to the user</td>
<td>Innovative</td>
<td>Green</td>
</tr>
<tr>
<td>Durable</td>
<td>No harm to people</td>
<td>Expensive</td>
<td>Eco-friendly Recycling</td>
</tr>
<tr>
<td>Quality</td>
<td>Healthy</td>
<td>Guarantee</td>
<td>Growth Friendly to the ecosystem</td>
</tr>
<tr>
<td>Efficient</td>
<td></td>
<td>Value</td>
<td></td>
</tr>
<tr>
<td>Practical</td>
<td></td>
<td>Guarantee</td>
<td></td>
</tr>
<tr>
<td>Solution-based</td>
<td></td>
<td>Growth</td>
<td></td>
</tr>
<tr>
<td>Can be maintained</td>
<td></td>
<td>Development</td>
<td></td>
</tr>
<tr>
<td>Useful</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Comfortable</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Multifunctional</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
To further investigate the perception of the respondents’ knowledge about Design for Sustainability, participants were asked to provide examples of designs they considered to be sustainable. Table 4.2 presents examples of products and why participants thought that they were sustainable.

Table 4.2: *Examples of sustainable designs*

<table>
<thead>
<tr>
<th>Product</th>
<th>Attributes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Car</td>
<td>Used for long time</td>
</tr>
<tr>
<td></td>
<td>Functional</td>
</tr>
<tr>
<td>Electric cars</td>
<td>Environmentally friendly and still looks good</td>
</tr>
<tr>
<td>Gas cooker</td>
<td>Uses both gas and electricity</td>
</tr>
<tr>
<td>Sports shoes</td>
<td>Helps athlete run smoothly</td>
</tr>
<tr>
<td>Plastic water tanks</td>
<td>Durable</td>
</tr>
<tr>
<td>Solar panels</td>
<td>Source of power</td>
</tr>
<tr>
<td></td>
<td>Do not harm the environment</td>
</tr>
<tr>
<td></td>
<td>Renewable energy</td>
</tr>
<tr>
<td></td>
<td>Environmentally friendly</td>
</tr>
<tr>
<td></td>
<td>Long lasting</td>
</tr>
<tr>
<td>Laptop cover</td>
<td>Light</td>
</tr>
<tr>
<td></td>
<td>Protects laptop</td>
</tr>
<tr>
<td>Paper</td>
<td>Recycled into packaging</td>
</tr>
<tr>
<td>Pencil</td>
<td>Not harmful</td>
</tr>
<tr>
<td></td>
<td>Easy to use</td>
</tr>
<tr>
<td></td>
<td>Long lasting</td>
</tr>
<tr>
<td>Street light</td>
<td>Illuminates street</td>
</tr>
<tr>
<td></td>
<td>Contributes to street aesthetics</td>
</tr>
</tbody>
</table>
The understanding of Design for Sustainability of participants further exhibited a certain amount of ambiguity, which was evidenced in questions that examined participants’ perceived knowledge of sustainable design. Most respondents answered that they knew some, while others answered that they were not sure or that they did not know much about sustainable design as presented in Figure 4.1.

![Figure 4.1. Participants’ perceived knowledge of sustainability]

When participants were asked whether they had ever used any aspects of sustainable design in their design projects, the majority said they were not sure. Of those who said that they had used them, they credited attributes such as durability, usability, designing shelter for refugees, window sizes for interior design, and using natural materials in environmental design as the attributes they had integrated in their design projects. Figure 4.2 presents participants’ application of elements of Design for Sustainability.
Instructors’ Understanding of Design for Sustainability

The definition of sustainable design among instructors focused mainly on holistic principles of sustainable design practices, such as concentrating on tomorrow’s condition and long-lasting approaches. However, a clear diversity in perception could be observed. For example, one instructor’s definition focused on the investment in human capital aspect of design schools. He defined sustainable design as being able to impart students with the knowledge and skills that could be used outside of the classroom. He attributed the consideration of this aspect in the Creative design Department to be a leading factor in the high rate of entrepreneurial ventures that graduates of the department have undertaken after graduation. Another instructor credited understanding and consideration of design materials as being important when it comes to sustainable design. Repetition and consistency are other facets that were emphasized by some instructors. In this regard, they credited the ability to care about the future as well as the possibilities of carrying out the same design practices and using the same materials anywhere in the world as being major factors of sustainable design. Longevity and continuation in terms of design and materials are other facets that were
mentioned by instructors as factors that characterize sustainability in design. From this data, the main themes of sustainable design among instructors could be deduced to design that is continuous, long-lasting, empowering, future-focused, and environmentally conscious.

**Education of Design for Sustainability in the Department of Creative Design**

The questionnaire and interviews provided insight into how participants had acquired knowledge about Design for Sustainability and the current practices and integration of aspects pertaining to Design for Sustainability in the Creative Design Department.

The questionnaire asked participants to outline how they had learned about sustainable design. Participants were presented with a set of options and asked to select all the answers that applied. The majority of the respondents answered they had learned about it in school; some answered they had learned about it on the Internet, TV, or Radio; and some answered they had learned about it from elsewhere. Those who answered that they had learned about it in school were asked to specify, and all of them answered that they had learned about it in CRD. Figure 4.3 presents participants’ methods of learning about Design for Sustainability.

![Figure 4.3: Participants’ methods of learning about Design for Sustainability](image)

**Figure 4.3: Participants’ methods of learning about Design for Sustainability**
Participants were further asked to elaborate on their previous knowledge on sustainability pertaining to design and they quoted having learned about it during one of the modules taught in the second year. One participant elaborated that in the ‘Environmental design studio module,’ they had been tasked with designing a house that was eco-friendly using materials that were friendly to the environment. Of those who mentioned that they had learned about sustainability in “other” ways, they were asked to specify and most of them mentioned that they had learned about it at Nyundo School of Art. The impact of primary and secondary school education was evident in this study as Nyundo School of Arts is one of the secondary schools in Rwanda. Other respondents also referenced their previous education mentioning that they had heard about recycling in science subjects in the health and sanitary context. Others mentioned that they had experienced aspects of sustainability such as separating trash for composting purposes at home. Others mentioned that they had separated trash because there were people willing to buy plastic water bottles and metal scraps. Some respondents mentioned that they had learned about sustainability on the radio, television, or the Internet. The investigation of these mediums was outside the scope of this study, however, their contribution to the dissemination of information to the general public cannot be denied and should be investigated further.

**Sustainability in the Creative Design Curriculum**

A review of the modules offered in the Creative Design department provided insight on the integration of Design for Sustainability in the curriculum and its teaching strategies. Among the 48 modules taught, five modules were found to feature an element of sustainability in its description. The following are the modules that were selected in regards to their mention of keywords that pertain to aspects of Design for Sustainability derived from participants’ understanding in section one of this data analysis. These keywords included sustainable, sustainability, eco, green, harm, long, environmentally friendly, recycling, and
renewable. Modules are arranged in ascending format according to when they were offered in the department.

**Module I: Environmental Design  Type: Studio**

Description: The brief of the Environmental Design module states that it is an introduction to the environmental aspects of architectural design and analysis of the form that landscapes take and the processes and ideals leading to those forms. This module’s indicative content section states that “*the content of the module will reflect current intellectual debates and materials on i) environmental concepts and influences on design; ii) sustainable development; iii) embodied energy, climatic influences and microclimates; and iv) passive heating, passive cooling and carbon neutral design basics.*”

Learning and teaching strategy: This course consists of a combination of theory and practical learning and teaching methods, which are supported by lectures, visual demonstrations, field trips, reading, and field assignments.

**Module II: Innovation Design  Type: Theory**

A brief description of the Innovation Design module states that it encourages design thinking and innovation among students. It gives the students a deeper understanding of how design business operates, by learning each of the processes first hand. Students from any trade can be exposed to other disciplines like architecture and engineering, thus giving them ability to apply design thinking in all aspects of the design industry. Its mention of sustainability appears in the indicative content section, which outlines *Design for Sustainability* as one of the topics to be covered.

Learning and teaching strategy: There is strong emphasis on self-directed learning, based on research topics related to the lecture program. Traditionally delivered in a lecture atmosphere, complimented with practical assignments and report writing on some topics. All
exercises or projects require the students to undertake some investigation of their own, hence developing their own unique interpretation of the task assigned.

**Module III: Interior Design  Type: Studio**

The brief of the Interior Design module states that it aims to introduce students to advanced knowledge and skills in Interior Design (lighting specifications) and a focus on non-Western architecture and design history and styles and decorative arts (cultural design concepts, furniture motifs, color applications and vocabulary). Among its learning outcomes is an objective that states “*having successfully completed the module; students should demonstrate knowledge and understanding of the use of lighting, sustainable interior design, and application of non-western designs.*” In its indicative content section, it also features *students’ research on sustainable interior design concepts.*

Learning and teaching strategy: This is a practical course, which is supported by theoretical tutorials and field trips. It is delivered through studio-based lectures backed up by demonstration, exercises, small in-class projects, and presentations. Students work individually or in small groups to learn the development of concepts by applying their knowledge gained in theory exercises and self-directed studies. Experts are invited (where necessary) to give guest lectures and/or demonstration to students.

**Module IV: Furniture  Type: Studio**

The brief of the Furniture module states that it aims to give students a basic understanding in furniture design theory, construction joinery methods, materials and specifications. Students will learn to create concepts and designs that balance innovative design, functional requirements and aesthetic appeal, as well as selecting suitable materials, which might include wood, metal, plastic, and textiles. This module’s indicative content section touches upon *students’ research on sustainable furniture concepts/designs and structures.*
Learning and teaching strategy: This is a practical course, which is supported by theoretical tutorials and field trips. It is delivered through studio-based lectures supplemented by demonstration, exercises, small in-class projects, and presentations. Students work individually or in small groups to learn the development of concepts by applying their knowledge gained in theory exercises and self-directed studies. Experts are invited (where necessary) to give guest lectures and/or demonstration to students.

Module V: Design Practice and Management  Type: Theory

A brief description of the Design Practice and Management module states that it aims to introduce students to Management Principles, functions of management in relation to design practice, management process in design practice, and management techniques. This course references ‘The Integrative Design Guide to Green Building: Redefining the Practice of Sustainability (Sustainability Design), 7 group Bill Reed, Wiley Books, 2009’ as an indicative resource.

Learning and teaching strategy: This module consists of a combination of Theory and Practical teaching methods, which are supported by lectures, visual demonstrations, field trips, reading, and field assignments. Teaching and learning for this module utilizes lectures that raise specific ideas, principles, or practices. Students are given weekly assignments and they are expected to be able to communicate their ideas and thoughts to their peers.
Asked about the integration of sustainability in the curriculum, the Head of Department of the Creative Design department mentioned that the curriculum did not holistically address aspects of Design for Sustainability but instead, those elements were embedded in individual modules and that their exploration depended on the module’s leading instructor’s teaching methods. Some instructors mentioned that they indirectly integrated aspects of Design for Sustainability in their courses. For example, one instructor who had taught ‘Modeling Technology’ (a course offered in the first semester of level two focusing on media and material applications) mentioned that during his tenure, he encouraged students to reuse materials they had used in their previous projects, sometimes spanning to materials used in previous semesters. He quoted that this practice allowed students to develop their ideas further and created continuity in modules. Another instructor mentioned he had indirectly integrated Design for Sustainability in the module by asking students to use materials that were readily available in the environment such as discarded cardboard. He quoted that this approach allowed students to understand the materials better and also facilitated gauging standards of understanding since students were using a similar material. Other examples that were provided correlated with the individual instructors’ perception of sustainability, for example; an instructor in the Graphic Design specialization quoted his outlook on integrating sustainability in his modules as equipping students with the aptitude and skills to start entrepreneurship ventures. Asked whether any of the aspects of Design for Sustainability were considered in module assessment, all instructors mentioned that there was no quantifiable assessment of the elements of Design for Sustainability in students’ projects beyond appreciation.
Attitudes Towards Design for Sustainability in Creative Design

The study also aimed to understand the existing attitude towards Design for Sustainability among students and instructors in the Creative Design department. Data for this section was collected during the post workshop interviews after participants had learned and applied elements of Design for Sustainability in design projects.

Students’ Attitudes Towards Design for Sustainability

Using a Likert scale, participants were asked to state how much they thought design affected the environment, people, and economic conditions. They were also asked to explain why and provide examples in support of their answers. Figure 4.4 diagram illustrates participants’ inclinations.

![Figure 4.4. Participants’ perception on impacts of sustainability](image)

As shown in the figure above, the diagram implies that the majority of the participants thought that design affected the three elements of sustainability ‘very much’. However, prominence was given to the economic conditions. Among the reasons participants provided for this were that it was an influential factor in the country’s development. They credited design to be a leading factor in innovation practices contributing to the economy and the creation of jobs for designers and credited well-designed products to lead to increase in sales.
and user satisfaction. In regards to the environment, participants emphasized regulating land use in relation to the population size, preserving and elevating natural beauty, regulating population growth, and the effect of harmful materials and substances on the environment. Furthermore, some participants touched upon people in this category, stating that barriers to understanding of design can affect people’s livelihood. In case of the effect of design on people, participants quoted the effectiveness of a design’s usability factors in relation to user’s needs as the main effect. They also touched upon the effect of design trends on user consumption trends, emotional effects of design on users, job creation, avoiding harmful substances, culture, and purpose.

After the workshop, most participants expressed the desire to learn more about Design for Sustainability. Some mentioned they believed that aspects of Design for Sustainability should be taught early in all disciplines while others mentioned they should be integrated in the brief of design projects to ensure entities that were conceptualized were friendly to the environment.

“maybe this process should be [taught] early to all disciplines especially the design world to achieve sustainable results” participant 1.

“this was a great session a lot of learning. I hope we can all use sustainable design in our concepts” participant 2.

Others mentioned that they believed that it should be integrated in base education starting at home in families. Some participants also stated that they thought it was important to provide sustainability training to all and bring awareness of issues and concerns to the general public.

**Instructors’ Attitudes Towards Design for Sustainability**

Data collected from educators in the Creative Design department indicated that most educators were pro-integrating aspects of Design for Sustainability in their modules. Some
mentioned that since aspects of Design for Sustainability already manifested themselves in students’ projects, integrating it in the curriculum and dissipating the knowledge and skills seemed to be the next natural step. Other instructors mentioned that since Sustainable Design was a growing global trend with significant popularity, integrating it in every module would create relevance and encourage innovation in a growing niche. Other instructors credited the incorporation of Design for Sustainability endeavors to support the conservation of precious materials through identification and appropriate use. They emphasized the innovative use of available materials for non-traditional purposes to bridge the gap of material scarcity used in student learning. While most instructors supported full integration of Design for Sustainability in modules, some were inclined to its partial integration in form of faculty-led initiatives and for research purposes. The head of department also mentioned that integrating sustainability would require leadership and that faculty voluntary undertaking would be encouraged.

“we need trained people to spearhead our sustainability practices. Mentors to guide us in adopting the best practices and partners who can help us fast-track our goals,” participant 3.
Application of Design for Sustainability in Design Activities

The Innovation Design course taught in the third year in the Department of Creative Design at the University of Rwanda features a process that employs a systematic sequence of steps in developing solutions to design problems. This process, commonly known as the Design Process, involves methods that alternate between converging and diverging processes that help to break down large projects into manageable chunks and allow problem-solvers to track their thought process in the form of a roadmap. Such segmentation allows problem-solvers to access specific tasks and thoughts instead of the entire process being perceived as one unit. Therefore, this process has been extensively used in creative fields such as engineering, architecture, sciences, and others. Though there is no one universally recognized sequence in which the steps are followed in this process, Figure 4.5 illustrates the seven steps that are most commonly employed and used in the following progression:

![The design process](image)

Figure 4.5. The design process
The design process employed in the workshop involved an iterative process that was comprised of approaches innuendo to the cognitive theories in Design Thinking. The theory of convergent and divergent thinking is centered on the belief that the ability to engage ones’ brain in the creative process is characterized by broadening one’s perspective to explore a multiplicity of information or solutions, and narrowing it down to focus on specific concepts. Its application in this workshop allowed participants to follow a systematic approach as presented in Figure 4.6.

![Figure 4.6. Convergence and Divergence theories of design thinking](#)

Since participants were already familiar with this process from the Innovation Design course, the workshop followed a similar progression in its approach to the design steps. However, due to limited time, the workshop’s design projects stopped at the fourth step - selecting the best solution. This allowed both the researcher and the participants to spend enough time and resources on finding the problem and generating ideas for the solution. Since the goal of the workshop was to acquaint participants with theory of Design for Sustainability and to explore participants’ perceptions towards applying it in design projects, evaluating the results of the design exercises was outside the scope of the study.
Figure 4.5. Workshop participants working in teams
Table 4.3. Workshop schedule and agenda

<table>
<thead>
<tr>
<th>Themes</th>
<th>Sessions (1hr – 1hr 30 minutes)</th>
<th>Activities</th>
<th>Objective</th>
</tr>
</thead>
</table>
| Introduction                   | 1. Opening the workshop         | ✓ Introduction to the study  
  o Consent forms  
  o Questionnaires  
  ✓ Facilitator-led discussions:  
  o Definition of design  
  o The design process | To align participants’ expectations with the workshop’s agenda                |
| Understanding Design for sustainability (D4S) | 2. Product life-cycle mapping | ✓ Whole class activity  
  o Participants map out a product’s life-cycle  
  ✓ Participants form groups  
  o Participants identify problems that arise in the product life-cycle  
  ✓ Whole class discussion  
  o Problems in the product life-cycle | To gain insight on participants’ perceptions on the role of design/designers in the product life cycle |
| 3. Introduction to Design for Sustainability (D4S) | | ✓ Whole class activity  
  o Participants find solutions to the problems identified in the product life cycle  
  ✓ Lecture  
  o Design for sustainability (D4S)  
  o Eco-design strategies  
  ✓ Assignment  
  o Participants to think about relevant sustainability problems that arise in the ‘disposal’ stage that exist in their own surroundings | To align participants’ knowledge of D4S with established theories  
 To gather participants’ inquiries on D4S |
<table>
<thead>
<tr>
<th>Table 4.3 (continued)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Identifying key entry points in the integration of Design for Sustainability in design education in Rwanda</strong></td>
</tr>
</tbody>
</table>
| 4. Defining the problem | ✓ Group activities  
  o Discuss problems identified and narrow down to one  
  o Ax4 analysis and user journey maps  
  o Define criteria  
  o Reframe the problem | To gain insights on participants’ viewpoints on sustainability issues in relation to their contextual setting |
| 5. Field trip – Nduba landfill | Participants and facilitator take a field trip to the visit a landfill | To identify existing opportunities in the disposal stage of products |
| 6. Ideation | ✓ Whole class discussion  
  o Landfill visit  
  ✓ Group activities  
  o Brainstorming (individual & group)  
  o Pick 3 concepts | To identify the key factors that may inform D4S in design education in Rwanda |
| 7. Finding solutions | ✓ Group activities  
  o Brainstorming on the 3 concepts  
  o Pick 1 concept | To explore proficiencies required for D4S in design education in Rwanda |
| 8. Finding solutions | ✓ Group activities  
  o Develop the final concept  
  o Research ‘materials’ | To gain insight in participants’ perception on integrating D4S in design education in Rwanda |
| 9. Evaluating solution | ✓ Group activities  
  o Evaluate and refine the solution in regards to the criteria | To gain general insights in integrating D4S in design education in Rwanda |
| 10. Preparing presentation | ✓ Group activities  
  o Create presentation materials | |
| 11. Presentation | Participant’s presentations on proposed solutions | |
Prior to beginning the design projects, students were given lectures that addressed product journey maps, sustainability and its implication in design practices and took a field trip to the Kigali City landfill in Nduba. Figure 4.8 presents lectures and discussion notes on Design for Sustainability.

Figure 4.6. Lecture notes and discussions on Design for Sustainability
**Step 1: Identifying Problems**

Participants were asked to form groups of three and to identify problems existing in their immediate surroundings that could be addressed through design. To limit the scope of the problems, participants were asked to find problems that occurred only in the disposal phase of the product journey map (Figure 4.9).

![Diagram of identified problems](image)

*Figure 4.7. Problems in the disposal stage of the product life cycle*
Step 2: Research and Problem Identification

Participants were guided through the process of conducting research, narrowing down the problems, individual and group idea generation exercises, and then selecting the best solutions. Participants were encouraged to do a stakeholder (AX4 analysis) and market analysis to guide them in decision making and to narrow down the stage of intervention.

Figure 4.10 presents notes from reframing of the problem.
Step 3: Idea Generation

Figure 4.9: Participants’ idea generation process
**Step 4: Possible solutions**

At the end of the workshop, each team had conceptualized a solution for their design problem (Figure 4.11).

Team 1, which was exploring the design problem “*how might we establish a culture for disposal separation in Remera Campus*” designed a trashcan with different compartments for different kinds of trash. They created three specific compartments in the trashcan that could be identified by color and labels. The integration of design semantics was intended to guide users in which compartment to throw the different kinds of recyclable trash (Figure 4.12). In the end, the group made an assessment of the environmental, social, and economic impacts of the trashcan on the university community.

![Team 1's proposed solution](image)

Figure 4.10. *Team one's proposed solution*
Team 2, which was exploring the design problem “how might we create packaging solutions that are affordable by consumers on small scale markets?” designed a closed-loop system around used papers for packaging. They suggested that paper that was generated in classrooms could be collected by recycling companies, taken to paper factories, and could be recycled into paper products that could be sold in the market (Figure 4.13). The solution attempted to create new jobs and industries for paper recycling.

Figure 4.11. Team two's proposed solution
Key Insights

Throughout the workshop, a number of key observations were made as well as deduced from the data that was provided by participants through daily reflections and post workshop interviews. These reflections portray the contemplations of participants in an attempt to embed sustainability in design projects in Rwanda, creating a glance into students’ perceptions and challenges (and consequently) deriving entry points for the conception of a curriculum that integrates Sustainability in design education.

Design as a Function

Respondents recognized that design is a key player in ensuring that the practice of Design for Sustainability (D4S) was done effectively. In this regard, participants’ responses touched upon two main themes addressing ‘design considerations’ and ‘the position of designers’ in regards to D4S. According to the respondents, these two themes were connected as ‘parent and child’. However, variances were made between the two as respondents credited design considerations to be made up of a set of criteria; whereas, they expounded on the position of designers through the practices employed, skills possessed, and distinct discernments.

Attributes to be Considered in Employing Design for Sustainability

In this study, the resulting entity of a process that employed any aspect of Design for Sustainability was referred to as ‘a sustainable solution.’ Respondents provided insights into characteristics, or things, that should be taken into consideration when designing a sustainable solution. Responses to these questions touched mainly on the following five thematic focuses presented in Table 4.4.
Table 4.4. Sustainable design characteristics

<table>
<thead>
<tr>
<th>Physical</th>
<th>Tangible attributes that a sustainable solution should possess including its function, use, affordances, durability, maintenance, aesthetics, and ergonomics of the product.</th>
</tr>
</thead>
<tbody>
<tr>
<td>User</td>
<td>Focus on the users, considering their age, preference, needs, culture, context, solving problems, interaction, capabilities, experience and health.</td>
</tr>
<tr>
<td>Environment</td>
<td>Ensuring solutions that were not harmful, friendly, conserved the natural environment, disposal-friendly, and took into consideration the contextual location of were the solution was to be used.</td>
</tr>
<tr>
<td>Materials</td>
<td>Focus on the materials used, taking into account their availability, properties, affordability, impact on health, sourcing, eco-friendliness, durability, disposal, recyclability, and degradability.</td>
</tr>
<tr>
<td>Value</td>
<td>Focus on the ability of the solution to generate money, affordability and availability on the market, accessibility, and cost of production.</td>
</tr>
</tbody>
</table>

Designers as Instruments in Design for Sustainability

Most respondents recognized themselves as ‘designers’ and answered questions pertaining to designers through first person narratives. They also recognized designers to be instrumental in the process of designing sustainable solutions. The following thematic focuses were derived from the responses that participants provided:

The role of designers

Whereas most respondents mentioned that the task of designers was to ‘think’ during the conception stage of the solution, others referred to designers as being instrumental in other roles such as ensuring quality workmanship of the solution, choosing materials, following up with the users for future improvements, influencing user perceptions, supervising the whole process, as well as being involved in the processes of manufacturing, distribution, retail, and disposal.
**Designer aptitudes**

Respondents mentioned that it was important to possess the necessary skills to be able to carry out projects that aimed to create sustainable products. Some of the skills that were considered to be important included the knowledge of materials and manufacturing techniques. They mentioned that knowledge of material properties could help them in the selection of materials and to innovate around the manufacturing capabilities available in Rwanda. Additionally, they noted the ability to apply design thinking and creativity to projects, and to think innovatively to be important in meeting the expectations of the market and users.

**Design Methods for Design for Sustainability**

Respondents cited different practices that designers could apply in conceiving sustainable solutions. They mentioned that new practices and processes could be introduced or the existing practices be optimized. Their responses touched upon processes in different stages such as innovation, creative thinking and research during conception, processes in the production phase, the use of resources, and evaluation at the end of the design process. The majority of the respondents mentioned that in order for designers to design sustainable solutions, they should focus on:

**Innovation thinking**

Respondents mentioned that designers should identify opportunities and engage in thinking about the problem and the solution at hand by employing different innovation and creative thinking methods. These methods include identifying problems that already exist in that environment through observation and solving them using effective methods. Respondents mentioned the designer should explore the problem deeply and define the problem to ensure that the solution meets the right criteria and needs of the users. In addition
to that, they mentioned designers should develop multiple solutions, and test them with users to ensure that the solution balances the problem.

**Research**

Respondents focused on the need for designers to understand the external stakeholders through conducting research on the design and/or the business. They mentioned that the designer should gather information on the user of the solution, their environment, financial capabilities, and also information on how the solution is going to make money. Furthermore, respondents mentioned that the designer should gather information on existing models in the environment such as transportation, federal regulations and manufacturing capabilities.

**Production**

Respondents mentioned that designers should take implementation methods into account. They cited the use of green methods in production such as using renewable and solar energy. Furthermore, they mentioned the use of technology in production to ensure effectiveness and constantly assessing the process to find opportunities for improvement and increase efficiency. Respondents also cited optimizing the existing manufacturing and transportation processes.

**Resources**

Respondents focused on the use of resources. They mentioned that designers should consider using locally available resources to influence user’s perception on the materials. Additionally, they mentioned that designers should consider recycling or reusing materials to create new entities and reduce material impact on the environment. Respondents also cited the efficiency in using materials as well as establishing recycling industries.
Collaboration
Respondents pointed out the importance of collaborating with scientists and engineers. They credited the importance of sharing knowledge with professionals in other fields to develop processes and methods that are sustainable.

Follow up
Respondents mentioned that in order to design sustainable solutions, designers should consider testing products for harmful substances that may affect people or the environment. They mentioned that designers should also prescribe catalogues and labels for users to ensure proper use of the solution and avoid confusion. Furthermore, they mentioned that designers should evaluate the impacts of the solutions and follow up on future improvements of the solution to ensure durability and elect maintenance processes.

Drivers for Design for Sustainability
Participants conveyed different drivers for why they thought that sustainability should be integrated in design projects.

Ethical drivers
Respondents cited ethics as being one of the drivers as to why designers should adapt practices of Design for Sustainability. They mentioned that since the main goals of design and innovation are financial gains, designers should consider the impacts of their practices on the livelihoods of people because it is the right thing to do.

Prevention and protection
Respondents expressed their concerns on design methods that could harm the environment and the people. They mentioned that sometimes, a designer could choose to use materials that are potentially harmful to the users or the environment. Some respondents pointed to the fact that they never cared about where the products they designed went as long
as their clients were happy. Now that they had had discussions on sustainability, they cared more about disposal and protecting the environment.

*Future-orientation*

Respondents expressed their consideration for Design for Sustainability as a future centric subject. They mentioned that there is a need for designers to consider whether the resources that designers are using now will be available in the future.

*Raising awareness and advocacy*

Respondents mentioned that incorporating eco-design strategies in design projects could contribute to bringing awareness of sustainability to clients as well as other designers.

**Challenges in Practicing Design for Sustainability**

When asked what challenges they met in the design process, respondents mentioned that most challenges were mainly organizational.

*Design aptitude*

Respondents mentioned that one of the challenges was that they were not confident in their design skills such as creativity, design thinking, and idea generation. Furthermore, respondents mentioned that they struggled to select appropriate materials. They also mentioned that they did not know how to make the product nor whether it was possible to be made in Rwanda.

*Scope of the projects*

Respondents mentioned that in the process of conceiving solutions for the design problems, they realized considering sustainability in design projects placed a lot of constraints on their choices. They mentioned that there were a lot of limits as to what materials they could use. Additionally, they mentioned trying to balance all three aspects of the triple bottom line was a challenge since they wanted to make the solutions affordable to
the local population. Furthermore, they perceived the goal of designing a completely sustainable solution to be almost unattainable. They credited this to being unable to control user behavior, for example, if they wanted to design a solution that used recycled materials, they could not stop the user from throwing the product in the trash thus resulting in waste.

**Time constraints**

Most respondents mentioned that the time allotted in the workshop was not enough to develop with a solution. They mentioned that they needed more time to familiarize themselves with the theory of sustainability, to understand what it was and its role in design or vice versa. Some respondents expressed concerns as to whether learning about sustainability was for everyone as some participants were more involved than others, which affected the overall process of design and the resulting outcomes.

**Financing**

Respondents cited that one of the biggest challenges was the lack of funding they encountered or the lack of knowledge on where funding for their project would come from.

**Access to learning facilities, tools and materials**

Respondents expressed their concern about not being able to access some learning facilities, materials, and tools. A good example is in the fact that most materials are imported in Rwanda. Another is whether or not participants were able to acquire permission from authorities to access certain government-controlled places such as the Nduba dumping site.

**People’s perceptions**

Some respondents expressed concern regarding response from the general public. They mentioned that they were worried about what people would think about their design solutions especially in the cases were participants were addressing problems that dealt with culture and behaviors.
Anticipated Challenges in Teaching Design for Sustainability in Creative Design

When asked about the challenges they had observed or anticipated in teaching Design for Sustainability, instructors referenced challenges that were administrative and contextual in nature. The need to import most resources that they used in teaching was considered a big challenge. They mentioned that some of the materials that could not be found in Rwanda had to be imported from neighboring countries, which created a financial burden both for students and the department. Furthermore, they cited that without proper knowledge of their use, students could be wasteful of those resources. Another challenge mentioned was the scarcity of trained faculty that could spearhead, advise, and mentor the department towards the integration of the best practices of Design for Sustainability in the curriculum. Other instructors mentioned that the mentality that “new is better” in the society was a challenge to be reckoned with. This was credited to inhibit designers from applying some practices of Design for Sustainability such as recycling, up-cycling, and/or renewing of old materials. In addition to that, it was mentioned that the cultural beliefs sometimes interfered with student learning. An example provided in this regard was of the use of clay for modeling purposes. It was mentioned that since pottery was linked to an art form practiced by a certain ethnic group in Rwanda, some students did not embrace its use in some material education practices. Other challenges included the volatile nature of the department’s structural organization in terms of administration. At the time of this study’s implementation, the department was undergoing a major curriculum change whilst in the process of being reassigned from the School of Architecture and Built Environment (SABE) in the College of Science and Technology to a College that was yet to be determined.
CHAPTER 5. DISCUSSION

Utilizing participatory approaches such as those presented in this study allowed the researcher to establish a needs-analysis of integrating sustainability in the Department of Creative Design at the University of Rwanda by focusing on the students’ interests, reflections and recording their challenges during application, the study was able to provide a bottom-up framework of integrating strategies of the Design for Sustainability in the Creative Design curriculum. The following are the main lessons learned.

Convergence and Divergence in the Meaning of Sustainability

Often times, the global definition of sustainability in the development context is perceived as an all-encompassing concept that can be adapted in any context. The shortcomings of one universal meaning of sustainability or sustainable development as is commonly interpreted continues to be the focus in many social science research discussions, which argue that the focus on moderation in favor of future generations, as presented in the 1987 Brundtland report, might not be applicable in environments where immediate survival is of higher priority. Many argue that in places such as Rwanda where fulfilling basic needs is still a major priority, a global perception is not only misconstrued but can overshadow the needs and livelihood systems of diverse cultures. Therefore, the adaptation of the meaning of sustainability needs to be relevant and rooted in local values, needs, and experiences of diverse communities.

From the data collected in this study, few participants could articulate some elements of sustainability whereas most expressed that they were not familiar with the full definition of sustainability. This was further expressed in the examples of designs that they considered to be sustainable. Some considered cars that were made to last a long time to be sustainable
were as others mentioned attributes such as lightweight products to be sustainable. These discrepancies could be attributed to the lack of adequate integration of sustainability in the design curriculum, but they could equally be the result of lack in mainstream of sustainability in the customary lifestyle of Rwandans in general. Convenient ways to solve this issue would be the assimilation of the concepts of sustainability in linguistic and cultural aspects. This would include communicating the concepts and ideals of sustainability through relevant and appropriate methods that enhance understanding, appreciation, and critical engagement of these conceptual implications in learner’s everyday lives, such as the use of Kinyarwanda (the local language in teaching).

The current translation of sustainability in Kinyarwanda is “kuramba.” In English, Kuramba translates to “ever-existing,” “long-living,” or “durable.” In the development context, sustainable development would translate to “durable or long-lasting development” in Kinyarwanda whereas in the design context, it could translate to “durable design.” The influence of this direct translation could be observed in students’ associations of sustainable design to usability and durability attributes in design entities. Furthermore, during the workshop, participants continuously asked the researcher to explain some of the concepts of sustainability in Kinyarwanda and to relate them to examples of products, companies or entities with which they were familiar. By connecting the newly acquired knowledge of sustainability to the local language, participants were able to form connections and construct new meanings to the knowledge both on a cognitive and analytical level. These connections are supported by pedagogical theories such as experiential learning introduced by John Dewey (1859-1952), cognitive development by Jean Piaget (1896-1980), and social development by Lev Vygotsky (1896-1934) that emphasize the importance of learner’s
engagement with knowledge through critical reasoning and contextual associations. However, the mere translation of sustainability and relating paradigms is not enough, rather, the need to develop a broad range of vocabulary and resources that pertain to social, economic, environmental, and cultural perspectives is necessary without the linguistic stock to bridge the gap, the connection between classroom practices and the community might prove arduous. As Sillitoe (1998) claims, ‘it is increasingly recognized that development initiatives that pay attention to local perceptions and ways are more likely to be relevant to people’s needs and to generate sustainable interventions’.

The definition of sustainability among instructors featured attributes that focused on broad and all-encompassing concepts such as the condition of the future, ensuring long lasting, continuing, consistent, repeatable and capacity-building practices, and the consideration of design practices and materials. This divergence in perception is important to counter-balance the contextual focus on sustainability with universality. However, since the design department in Rwanda is mainly composed of expatriate staff, the limited local epistemology among instructors should carefully be taken into consideration when devising pedagogical strategies for integrating sustainability in the Creative Design curriculum.
Summarizing Key Components of the Encompassing Context

Key components of the local context are the values, needs, experiences, capabilities, challenges, motivations, and conditions shared by communities that exist in a given environment. Analysis of data collected for this study provided insight into the key concepts that might influence the integration of sustainability in the design program in Rwanda.

Among the key contextual aspects observed was the high political drive in the adoption of sustainable development strategies on the national level. National initiatives, such as the EDPRS II, that aims to reduce poverty and ensure prosperity and sustainability in the Rwandan community touch upon economic transformation, rural development, proficient governance, and youth empowerment. With a clear optimization and effective implementation, the Vision 2020 goal to transform Rwanda into a middle-income nation might become a reality. Although other challenges exist in the implementation of vision 2020, at the core of education lies the creation of effective linkages between the interdependent institutions such as academe, private sector, non-governmental and governmental institutions still persists. There is an opportunity in this realm for the design department to tap into these merging areas.

Another major component that was observed in Rwanda was the low proficiency in resource generation and production capabilities. Rwanda’s trade deficit has always been high due to its geographic location and economic standing. In design education, instructors lamented on the department’s heavy reliance on imported materials for teaching and learning practices. This aspect was credited to cause financial burdens on the department and the students and to create limitations in the breadth of material exploration techniques that could be investigated in design. Furthermore, it was mentioned that the low manufacturing capacity in Rwanda inhibited the ability for the department to foster majors such as product
design. However, the design department is in a unique position to turn these challenges into opportunities. The adaption of material optimization methods and low fabrication techniques in teaching and learning practices can be beneficial not only for the department but for the country at large. In addition to this, EDPRS II mentions the importance of fostering homegrown solutions to alleviate poverty. This is an undertaking that the Department of Creative Design can spearhead. Through holistic understanding the Rwandan technical and financial capabilities, the department can adopt design approaches and techniques that are prosperous, using available resources in the Rwandan environment. The versatility of such approaches could render them viable to be practiced in different environments including rural areas to compliment the agrarian industry.

Additionally, to effectively integrate sustainability in the design department in Rwanda, there is a need to understand the Rwandan society’s culture. The culture, including perceptions, values, and experiences of the Rwandan society were perceived to be a challenge for designers in adapting strategies for Design for Sustainability. Certain participants mentioned that there is a lack of appreciation for design practices and products made in Rwanda; that some people tend to perceive products made outside of the country to be of higher quality and value that those made in Rwanda; some people also perceived products made of recycled materials to be of lower quality. Without a well-established design industry, it is up to the Department of Creative Design to ensure the assimilation of systematic intervention practices in the community and to do so with cultural-sensitivity that enhances societal appreciation and engagement. Sensitivities in this realm could be the application of innovative practices around traditionally marginalized materials and practices in Rwanda.
An additional key component that might play a role in the integration of sustainability in the design program might be the current standing of the Department of Creative Design in the University of Rwanda. The department is new and still in the process of establishing its roots and core values in the university. This aspect does not only allow for flexibility but presents opportunities for the department to integrate up-to-date concepts in the curriculum that are in line with the national agenda and global trends. With a clear understanding of the Rwandan design market and professional needs, the department can develop ethical graduates with appropriate knowledge, skills, and motivation to contribute to the sustainable development agenda.

Notable challenges for integrating sustainability in the design department at the University of Rwanda were observed to be rooted in the administrative, organizational, and competency realms. Only five out of the currently offered forty-eight modules in the department proved to feature an element of sustainability in their description. Of the courses in which it was mentioned, it was presented with ambiguity that laid the foundation for instructors’ individual interpretation. This lack of strategic consideration proved to significantly impact the priority with which sustainability was considered in the courses witnessed in the lack of assessment criteria. Expectations of voluntary championing of Design for Sustainability by the teaching staff as mentioned by the head of Department may not have been the most effective method of integrating sustainability. A number of reasons in this regard should be considered including (1) an observable lack of experienced teaching staff with expertise in sustainability in relation to design practices and (2) the department is made up of majority staff with limited local epistemology.
A Proposed Design for Sustainability Curriculum Integration Framework

Design can be a facilitation and administration tool in mainstreaming and upholding the sustainability agenda in everyday life. Utilizing participatory approaches, as in this study, to provide a bottom-up perspective of applying strategies of the Design for Sustainability whereas theoretical and empirical insights provided top-down guidance for the design program in Rwanda to integrate sustainability in its curriculum. An important consideration in the integration of sustainability in the Creative Design department in Rwanda would be in the alignment of the student leaning objectives, teaching and strategies, and assessment and evaluation methods and criteria. In order to achieve this goal, there needs to be a broader consideration of the core knowledge base that fosters the understanding of sustainability, establishment of the appropriate competencies and adaption of relevant pedagogical approaches that enhance the learning and practice of Design for Sustainability. It is therefore with these considerations that the following framework was adapted.

Fundamentals of Design for Sustainability

Sustainability is believed to be so fundamental to design that it inherently manifests itself in both the education and practice of design. This can easily be observed in the Department of Creative Design were certain aspects of Design for Sustainability are noticeable in some modules and even furthermore substantiated in some students’ final projects. It is therefore imperative that the integration of the concept of sustainability in the design program aims to build students’ literacy on the fundamentals of sustainability both in the local and global context. Students will need to be guided in developing analytical skills about global perspectives through extrapolating and processing of information from various sources. Students will also need to be guided through developing awareness of cultural implications in the realm of appropriate design practices pertaining to their society’s values,
needs and experiences. Furthermore, they will need to be guided through defining their roles as designers in upholding the sustainability agenda to develop self-motivation and build enthusiasm for change. A great starting point would be the integration of fundamentals of sustainability in the core modules in the first and second years of the program. At this stage, the author proposes learning goals that intend to expose students to the meanings and awareness of contextual-specific and global theories, methods, tools, and approaches of Design for Sustainability be included in at least every course outline of the first and second years of the curriculum. Learning objectives at this stage are presented in Table 5.1.

Table 5.1. *Constrictive alignment for first year*

<table>
<thead>
<tr>
<th>Year</th>
<th>Skills</th>
<th>Learning goal</th>
<th>Learning objectives</th>
<th>Teaching approach</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Sustainability literacy</td>
<td>Upon completion, students should be able to exhibit the understanding of the fundamentals of Design for Sustainability on the global and local scale.</td>
<td>Ability to define Design for Sustainability in own perspective</td>
<td>Theory-based learning</td>
</tr>
<tr>
<td></td>
<td>Culture awareness and attention</td>
<td></td>
<td>Ability to exhibit understanding of cross-cultural contexts</td>
<td>Critical thinking exercises</td>
</tr>
<tr>
<td></td>
<td>Motivation to facilitate change</td>
<td></td>
<td>Ability to list aspects of Design for Sustainability</td>
<td>In class discussions</td>
</tr>
<tr>
<td></td>
<td>Role of designer in sustainability agenda</td>
<td></td>
<td>Ability to identify sustainability issues through research</td>
<td>Small group projects</td>
</tr>
<tr>
<td></td>
<td>Conduct research</td>
<td></td>
<td>Ability to classify materials by environmental, economic and social impacts</td>
<td></td>
</tr>
</tbody>
</table>
**Students’ Technical Skills**

To supplement the foundation knowledge and skills, students will need to have technical literacy that will help them in the implementation of Design for Sustainability projects. Such skills include analytical skills such as identifying problems and employing appropriate methods to solving them. Furthermore, they will need to be trained to use appropriate methods in understanding users' behaviors and ethnographic orientations as well as have the critical thinking capacities to realize interconnections between different dimensions and anticipate future needs. Students will also need to be trained to think creatively, innovatively, and to have a well-rounded grip on the various thinking systems and managerial approaches. These skills are to be complimented by technical skills that will allow students to methodically generate, analyze, communicate, and evaluate ideas such as material literacy, manufacturing techniques, modeling and visualization techniques, and tools that facilitate the assessment of the impacts of these aspects. Furthermore, students are to be acquainted with organizational skills such as collaboration, communications, and management that will allow them to engage in real-world learning opportunities and in multidisciplinary environments.
## Table 5.2. Constructive course alignment for second year

<table>
<thead>
<tr>
<th>Year</th>
<th>Skills</th>
<th>Learning goal</th>
<th>Learning objectives</th>
<th>Teaching approach</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Idea generation</td>
<td>Upon completion, students should be able to demonstrate the ability to apply and make decisions on methods and materials that pertain to sustainability in design projects</td>
<td>Ability to generate ideas that consider environmental, social, and economic impacts</td>
<td>Theory-based learning</td>
</tr>
<tr>
<td></td>
<td>Techniques that blend creativity, innovation, and sustainability</td>
<td>Strategies of Design for Sustainability</td>
<td>Knowledge of materials and manufacturing techniques and impacts</td>
<td>Ability to demonstrate creative and innovation thinking for improving environmental, social, and economic performance of designs</td>
</tr>
<tr>
<td></td>
<td>Awareness of local capacities and limitations in the design realm</td>
<td>Collaboration</td>
<td>Modeling and visualization</td>
<td>Ability to develop sustainable solutions through appropriate techniques</td>
</tr>
<tr>
<td></td>
<td>Ability to use and manipulate sustainable materials in model making</td>
<td>Ability to choose appropriate materials and method for design implementation</td>
<td>Ability to visually represent aspects of Sustainability in design projects</td>
<td>Problem solving exercises</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Group projects</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Field trips</td>
</tr>
</tbody>
</table>
Real World Problem-Based Learning

Throughout their education, students are typically trained to apply acquired skills to solve conceptual or textbook problems. Sometimes the methods applied in such contexts may become moot when applied to real-world problems as they are faced with barriers that are not only restrictive but also multidimensional. Therefore, it is important that at the upper levels of the Department of Creative Design, integration of sustainability in the curriculum focus on real world problem-solving practices that require students to engage with issues in their environment and take ownership of the problem-solving process, to which instructors can take the role of cognitive coaching. This pedagogical method is well engrained in the literatures of cognitive apprenticeship that supports students’ skill development through problem-based learning. In addition to the design skills developed in this practice, students also acquire professional skills such as working independently and in collaborative environments. They learn to seek out information from various sources, analyze, assess, and assimilate the new knowledge in and outside traditional design settings while enhancing their cognitive skills as they learn to navigate constraints of multifaceted problems and determine appropriate actions. To ensure student motivation, the problems should be adapted from real-world situations preferably, from settings that students have access to. This aspect would allow students to fully explore the extent of the problem by applying relevant exploration methodologies while synthesizing relevant solutions through creative and innovative thinking. Additionally, it would allow students to work directly with users, decision-makers, stakeholders, and the public in general. This in turn could generate the much-needed acclimation of the Creative Design department into the Rwandan society. Learning objectives for this approach could focus on the constructive course alignment presented in Table 5.3.
### Table 5.3. Constructive course alignment for third year

<table>
<thead>
<tr>
<th>Year</th>
<th>Skills</th>
<th>Learning goal</th>
<th>Learning objectives</th>
<th>Teaching approach</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>Problem-solving</td>
<td>Upon completion, students should be able to identify problems in their</td>
<td>Ability to identify problems</td>
<td>Individual and group projects</td>
</tr>
<tr>
<td></td>
<td>Understanding of user behavior and</td>
<td>environment and engage with the community using appropriate methods to solve</td>
<td>Ability to analyze, and rationalize complex data into usable information</td>
<td>Practice-based learning in collaboration</td>
</tr>
<tr>
<td></td>
<td>ethnomography</td>
<td>them</td>
<td></td>
<td>with the community</td>
</tr>
<tr>
<td></td>
<td>Stakeholder management</td>
<td></td>
<td>Ability to engage stakeholders in the design process</td>
<td>Problem solving exercises</td>
</tr>
<tr>
<td></td>
<td>Communication skills</td>
<td></td>
<td>Ability to choose appropriate methods</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Independent and collaborative work</td>
<td></td>
<td>Ability to communicate design thoughts and process in a structured and understandable manner</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Ability to work independently and collaboratively</td>
<td></td>
</tr>
</tbody>
</table>
Embracing Multidisciplinary Pedagogical Structures

It was observed during the workshop that to solve challenges with the aim of creating entities that support economic development while enhancing social wellbeing without negatively affecting the environment, participants were required to continuously cross normal design discipline boundaries into other fields such as engineering, business, environmental studies, and many others. Projects explored in the third and fourth year of the Creative Design department could be specific to specializations however; the author proposes that the department considers projects that call for collaborations across specializations to further capitalize on the limited resources. Furthermore, since sustainability is a multisystem concept that requires skills that expand far outside the scope of skills taught in design schools, it is imperative that the design department views the integration of sustainability in the curriculum from not only an ambiguous focus, but also as an opportunity to adapt pedagogical approaches that endorse collaboration with other departments. The design field is customary positioned to navigate the technical literacy of science and engineering majors while keeping social and humanities aspects in consideration. Therefore, the author proposes interdisciplinary and multidisciplinary group projects that are composed of students from other faculties such as Engineering, Social Sciences, Humanities, and Science. Students could champion the projects and instructors take on coaching, mentoring, and/or supervision roles. Learning objectives and approaches could focus on the constructive course alignment presented in Table 5.4.
Table 5.4. *Constructive course alignment for third and fourth year*

<table>
<thead>
<tr>
<th>Year</th>
<th>Skills</th>
<th>Learning goal</th>
<th>Learning objectives</th>
<th>Teaching approach</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>Multidisciplinary collaboration and communication, Goal orientation, Systems thinking, Managing non-linear processes, Impacts analysis</td>
<td>Upon completion, students should be able to create and evaluate design solutions that are environmentally, socially and economically viable</td>
<td>Ability to contribute to a collaborative environment, Ability to define problems and follow a structured process to find solutions, Ability to manage multi-faceted design problems, Ability to assess a design's environmental, social, and economic impacts</td>
<td>Multidisciplinary and interdisciplinary group projects, Practice-based learning, Experiential projects in collaboration with the public and/or private entities</td>
</tr>
</tbody>
</table>

Table 5.4 (continued)

**Capacity Building and Enhancing Expertise for Staff**

To be able to meet the needs of integrating sustainability in design education in Rwanda, the Department of Creative Design will need to foster a knowledgeable teaching staff in the subject of sustainability. Currently, the Creative Design department does not have staff with expertise in sustainability and will need to grow its staff base, and/or provide existing staff with continued professional development through capacity building programs, and/or provide resources to carry out research in Design for Sustainability-related realms, and/or provide incentives to integrate sustainability in the courses. Teaching staff can take advantage of the free knowledge, tools, and frameworks for sustainability literacy available on open sources.
Directive Approach to Integrating Sustainability in the Creative Design Curriculum

Secondary data analysis demonstrates a lack of directive approaches in the integration of sustainability in courses in the Creative Design department. Without proper departmental strategies of integration of sustainability in the curriculum, it was observed that instructors’ personal awareness and interpretation of sustainability could influence the way it is presented to the learners and/or whether it is mentioned in the course at all. Therefore, the department will need to adapt strategies for the integration of sustainability in the curriculum employing pedagogical approaches that are relevant to enhancing learning experiences and assessment models and evaluation methods of aspects of sustainability to assess learning outcomes.

Institutional Approaches to Integrating Sustainability in Higher Education

Secondary data analysis also demonstrated high institutional drive in integrating sustainability in higher education in Rwanda. The University of Rwanda presented clear objectives in its 5-year strategic plan but limited substantial approaches were observed when it came to the creative arts and design fields. It is important that the integration of sustainability in the design program stems from the institutional level. The advantage of such a top-down approach is in its capability to set broader goals and elect resources for custodianship. These goals can act as a bridge between the individual program’s goals and the national sustainable development goals.
CHAPTER 6. CONCLUSION

This study effectively presented the need for thoroughly investigating the needs, values, experiences, and capabilities of a community in order to formulate relevant pedagogical frameworks for integrating sustainability in the design curriculum. It presented the need to employ teaching and learning approaches that are relevant to the local community's cultural, social, environmental, and economic realities to create connections and empower students to facilitate change. Furthermore, through bottom-up approaches, this study presented insights into students and instructors’ attitudes and suitable competencies in regards to integrating sustainability in design education. Through systematic inquiry, this study was able to answer the research questions and demonstrate that investigation of key contextual aspects of a community can inform development of relevant pedagogical methods for integrating sustainability in a design curriculum.

The framework presented in this study does not advocate for complete transformation of the already existing Creative Design curriculum but instead presents methods and approaches for interjecting sustainability at different levels in the design program. The main goal of the framework is to give relevance to matters of sustainability in design education and to ensure that they are given as much priority as other subjects in the curriculum. For this framework to work, the integration of sustainability in design education in Rwanda not only requires a new paradigm adaption but will also necessitate systematic reform. There is a need to invest commitment and resources in supporting linkages between education practices and national sustainability goals to respond to relevant challenges in the community. Students trained under such a program can be expected to possess the critical, analytical, and technical aptitudes to contribute to their community's sustainable development goals.
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APPENDIX A. PLAN OF ACTION FOR VISION 2020

Figure 1A: Plan of Action for Vision 2020
# APPENDIX B. PROPOSED CURRICULUM FRAMEWORK

## Curriculum

<table>
<thead>
<tr>
<th>Existing Modules</th>
<th>Learning Outcomes</th>
<th>Learning Objectives</th>
<th>Teaching Approaches</th>
<th>Skills</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>First Year</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Design theory I</td>
<td>Upon completion, students should be able to exhibit the understanding of the fundamentals of Design for Sustainability on the global and local scale.</td>
<td>• Ability to define Design for Sustainability in own perspective&lt;br&gt;• Ability to exhibit understanding of cross-cultural contexts&lt;br&gt;• Ability to define designer’s role in the sustainability agenda&lt;br&gt;• Ability to analyze and synthesize a broad range of information related to sustainability&lt;br&gt;• Ability to show enthusiasm in sustainability-related concerns</td>
<td>Theory-based learning&lt;br&gt;Critical thinking exercises&lt;br&gt;In-class discussions&lt;br&gt;Small group research projects</td>
<td>Sustainability literacy&lt;br&gt;Cross-culture awareness&lt;br&gt;Role of designer&lt;br&gt;Research&lt;br&gt;Motivation for change</td>
</tr>
<tr>
<td>Print techniques</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Free hand drawing I</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>2D &amp; 3D studies</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Design theory II</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Design materials</td>
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<td></td>
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</tr>
<tr>
<td>Photography I</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Free hand drawing II</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Instrumental drawing</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| **Second Year**   |                   |                     |                     |        |
| Interaction design | Upon completion, students should be able to demonstrate the ability to apply and make decisions on methods and materials that pertain to sustainability in design projects | • Ability to generate ideas that consider environmental, social, and economic impacts<br>• Ability to develop sustainable solutions using appropriate techniques<br>• Ability to choose appropriate materials and method for design implementation<br>• Ability to demonstrate understanding of local capabilities<br>• Ability to demonstrate innovation thinking for improving sustainability performance of designs<br>• Ability to visually represent aspects of sustainability in design projects | Theory-based learning<br>Practical exercises<br>Active self-directed learning<br>Group projects<br>Field trips | Idea generation<br>Design for Sustainability<br>Materials and Fabrication<br>Awareness of local capabilities<br>Innovation<br>Modeling and Visualization |
| Method improvisation |                 |                     |                     |        |
| Photography II    |                   |                     |                     |        |
| Design drawing    |                   |                     |                     |        |
| Painting          |                   |                     |                     |        |
| Modeling technology I |              |                     |                     |        |
| Design theory III |                   |                     |                     |        |
| Digital imaging   |                   |                     |                     |        |
| Creative media    |                   |                     |                     |        |
| Environmental design |             |                     |                     |        |
| Modeling technology II |            |                     |                     |        |
| Applied & Decorative design |       |                     |                     |        |

| **Third and Fourth Year** | Upon completion, students should be able to identify problems in their environment and engage with the community applying appropriate methods to solve them. | • Ability to identify problems and use appropriate methods to solve them<br>• Ability to analyze, and rationalize complex data into usable information<br>• Ability to engage stakeholders in the design process<br>• Ability to communicate design thoughts and process in a structured and understandable manner<br>• Ability to work independently and collaboratively | Individual and group projects<br>Practice-based learning<br>Community collaborations<br>Problem-solving exercises | Problem solving<br>User behavior and ethnography<br>Stakeholder management<br>Communication<br>Collaboration |
| Model making       |                   |                     |                     |        |
| Sound              |                   |                     |                     |        |
| Digital media      |                   |                     |                     |        |
| Advertising        |                   |                     |                     |        |
| Event design       |                   |                     |                     |        |
| 3D animation       |                   |                     |                     |        |
| Film / Video       |                   |                     |                     |        |
| Web design         |                   |                     |                     |        |
| Digital media      |                   |                     |                     |        |
| Advertising        |                   |                     |                     |        |
| Graphic design     |                   |                     |                     |        |
| Photography II     |                   |                     |                     |        |
| Film / Video       |                   |                     |                     |        |
| Web design         |                   |                     |                     |        |
| 2D animation       |                   |                     |                     |        |
| Illustration       |                   |                     |                     |        |
| Landscape design (Residential) |   |                     |                     |        |
| Interior design (Residential) |   |                     |                     |        |
| Murals             |                   |                     |                     |        |
| Soft furnishing    |                   |                     |                     |        |
| Landscape design (office/public) |    |                     |                     |        |
| Interior design (office/public) |   |                     |                     |        |
| Sculpture          |                   |                     |                     |        |
| Innovation design  |                   |                     |                     |        |
| Creative entrepreneur |             |                     |                     |        |
| Industrial attachment I |         |                     |                     |        |
| Design practice and management |               |                     |                     |        |
| Research methods for designers |               |                     |                     |        |
| Industrial attachment II |            |                     |                     |        |

| Upon completion, students should be able to create and evaluate design solutions that are environmentally, socially and economically usable. | • Ability to contribute ideas and work in a collaborative environment<br>• Ability to define problems and follow a structured process to find solutions<br>• Ability to analyze and rationalize complex systems<br>• Ability to manage multi-faceted design problems<br>• Ability to assess a design’s environmental, social, and economic impacts | Interdisciplinary and Multidisciplinary projects<br>Practice-based learning<br>Experiential projects with public | Multidisciplinary collaboration<br>Goal orientation<br>Systems thinking<br>Managing non-linear process<br>Impacts analysis | |
| Upon completion, students should be able to exhibit the understanding of the fundamentals of Design for Sustainability on the global and local scale. | • Ability to define Design for Sustainability in own perspective<br>• Ability to exhibit understanding of cross-cultural contexts<br>• Ability to define designer’s role in the sustainability agenda<br>• Ability to analyze and synthesize a broad range of information related to sustainability<br>• Ability to show enthusiasm in sustainability-related concerns | Theory-based learning<br>Critical thinking exercises<br>In-class discussions<br>Small group research projects | Sustainability literacy<br>Cross-culture awareness<br>Role of designer<br>Research<br>Motivation for change | |
| Upon completion, students should be able to demonstrate the ability to apply and make decisions on methods and materials that pertain to sustainability in design projects | • Ability to generate ideas that consider environmental, social, and economic impacts<br>• Ability to develop sustainable solutions using appropriate techniques<br>• Ability to choose appropriate materials and method for design implementation<br>• Ability to demonstrate understanding of local capabilities<br>• Ability to demonstrate innovation thinking for improving sustainability performance of designs<br>• Ability to visually represent aspects of sustainability in design projects | Theory-based learning<br>Practical exercises<br>Active self-directed learning<br>Group projects<br>Field trips | Idea generation<br>Design for Sustainability<br>Materials and Fabrication<br>Awareness of local capabilities<br>Innovation<br>Modeling and Visualization | |

Figure B1: Proposed curriculum
APPENDIX C. INSTITUTIONAL REVIEW BOARD

Institutional Review Board
Office for Responsible Research
Vice President for Research
2420 Lincoln Way, Suite 202
Ames, Iowa 50014
515 294-4566

DATE: 11/3/2017

To: Aziza Cyamani
146 College of Design

CC: Dr. Verena Paepcke-Hjeltness
158 Design

From: Office for Responsible Research

Title: Sustainability in Product Design in Developing Countries

IRB ID: 17-417

Study Review Date: 11/3/2017

The project referenced above has been declared exempt from the requirements of the human subject protections regulations as described in 45 CFR 46.101(b) because it meets the following federal requirements for exemption:

1. Research conducted in established or commonly accepted education settings involving normal education practices, such as:
   - Research on regular and special education instructional strategies; or
   - Research on the effectiveness of, or the comparison among, instructional techniques, curricula, or classroom management methods.

2. Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey or interview procedures with adults or observation of public behavior where:
   - Information obtained is recorded in such a manner that human subjects cannot be identified directly or through identifiers linked to the subjects; or
   - Any disclosure of the human subjects' responses outside the research could not reasonably place the subject at risk of criminal or civil liability or be damaging to their financial standing, employability, or reputation.

The determination of exemption means that:

1. You do not need to submit an application for annual continuing review.

2. You must carry out the research as described in the IRB application. Review by IRB staff is required prior to implementing modifications that may change the exempt status of the research. In general, review is required for any modifications to the research procedures (e.g., method of data collection, nature or scope of information to be collected, changes in confidentiality measures, etc.), modifications that result in the inclusion of participants from vulnerable populations, and/or any change that may increase the risk or discomfort to participants. Changes to key personnel must also be approved. The purpose of review is to determine if the project still meets the federal criteria for exemption.

Non-exempt research is subject to many regulatory requirements that must be addressed prior to implementation of the study. Conducting non-exempt research without IRB review and approval may constitute non-compliance with federal regulations and/or academic misconduct according to ISU policy.

Detailed information about requirements for submission of modifications can be found on the Exempt Study Modification Form. A Personnel Change Form may be submitted when the only modification involves changes in study staff. If it is determined that exemption is no longer warranted, then an Application for Approval of Research Involving Humans Form will need to be submitted and approved before proceeding with data collection.

Please note that you must submit all research involving human participants for review. Only the IRB or designees may make the determination of exemption, even if you conduct a study in the future that is exactly like this study.

Please be aware that approval from other entities may also be needed. For example, access to data from private records (e.g.
APPENDIX D. INFORMED CONSENT

Title of Study: Integrating systematic eco-design strategies in design education to stimulate sustainability awareness in developing countries. Case study: A design course in Rwanda.

Investigators: Aziza Cyamani

This form describes a research project. It has information to help you decide whether or not you wish to participate. Research studies include only people who choose to take part—your participation is completely voluntary. Please discuss any questions you have about the study or about this form with the researcher before deciding to participate.

Introduction
The objective of this study will be to introduce eco-design strategies to design students and explore factors that may influence their adaptation in design education in Rwanda. This research will focus on exploring understanding of eco-design strategies, and identifying opportunities and constraints of integrating eco-design strategies in design education in Rwanda.

You are being invited to participate in this study because of your experience in the subjects of design education in Rwanda. You should not participate if you are under the age of 18 years.

Description of Procedures
If you agree to participate, you will be asked to answer a questionnaire, daily journals for 10 days, and participate in a semi-structured interview ranging from 10 minutes to 30 minutes. Through these tools, you will be asked to explain, give insights or describe your understanding of sustainability in design and also provide clarification (if required) on your application and challenges on the subject.

Risks or Discomforts
Participating in this study will cause no harm or discomfort to you physically, emotionally, psychologically, legally, painfully, inconveniently or privately. Please remember that this is neither a test nor a graded exercise that will contribute to your academic scores. There are no right or wrong answers.

Benefits
There are no direct benefits from this study. Your participation will provide me with insights into how co-design strategies can be adapted in design education in Rwanda. It is hoped that the information gained in this study will benefit the knowledge on the subject mentioned above.

Cost and Compensation
You will not have any costs associated with participating in this study and neither will you be compensated for participating in this study.

**Participant Rights**
Participating in this study is completely voluntary. You may choose not to take part in the study or to stop participating at any time, for any reason, without penalty or negative consequences. You can skip any questions that you do not wish to answer. Your choice of whether or not to participate will have no adverse impact on you as a student in any way.

If you have any questions about the rights of research subjects or research-related injury, please contact the IRB Administrator, (515) 294-4566, IRB@iastate.edu, or Director, (515) 294-3115, Office for Responsible Research, Iowa State University, Ames, Iowa 50011.

**Confidentiality**
Records identifying participants will be kept confidential to the extent permitted by applicable laws and regulations and will not be made publicly available. However, federal government regulatory agencies, auditing departments of Iowa State University, and the Institutional Review Board (a committee that reviews and approves human subject research studies) may inspect and/or copy study records for quality assurance and data analysis. These records may contain private information.

To ensure confidentiality to the extent permitted by law, the following measures will be taken: the coding of data will be done by the researcher, who will replace participant information with ID codes. Identifiers and data will be kept confidential, stored in password protected computer files and/or in locked cabinet files. If the results are published, your identity will remain confidential.

**Questions**
You are encouraged to ask questions at any time during this study. For further information about the study, please contact Aziza Cyamani or Verena Paepcke-Hjeltness.

**Consent and Authorization Provisions**
Your signature indicates that you voluntarily agree to participate in this study, that the study has been explained to you, that you have been given the time to read the document, and that your questions have been satisfactorily answered. You will receive a copy of the written informed consent prior to your participation in the study.

Participant’s Name (printed) __________________________

______________________________ __________________________
Participant’s Signature Date
APPENDIX E. QUESTIONNAIRE

Please answer the following questionnaire to the best of your knowledge.

What is your name?
........................................................................................................................................

What is your Classification?
  Third year student
  Fourth year student

Gender
  Male
  Female

What is your specialization?
  Environmental design
  Communication design

1. What do you understand by the term sustainable design?
........................................................................................................................................
........................................................................................................................................
........................................................................................................................................

2. How did you learn about sustainable design? (Choose all that apply)
   TV/Radio
   Internet
   Friends or Family
   In school (Please specify): ...........................................................
   Other (Please specify): ..............................................................

3. Have you ever used any aspects of sustainable design in your design projects? (Tick one)
   No
   Not sure
   Yes (Please specify which aspect and how you applied it): ...........................................................

4. How much do you think that design affects economic development? (Tick one)
   Does not affect it at all
   Somewhat doesn’t affect it
   Neutral
   Somewhat affects it
   Affects it very much
5. How much do you think that design affects the environment? (Tick one)

- Does not affect it at all
- Somewhat doesn’t affect it
- Neutral
- Somewhat affects it
- Affects it very much

Please explain why or give example

........................................................................................................................................
........................................................................................................................................
........................................................................................................................................

6. How much do you think that design affects people? (Tick one)

- Does not affect them at all
- Somewhat doesn’t affect them
- Neutral
- Somewhat affects them
- Affects them very much

Please explain why or give example

........................................................................................................................................
........................................................................................................................................
........................................................................................................................................

7. Give one example of a sustainable design. And please elaborate.

........................................................................................................................................
........................................................................................................................................

8. How much do you know about sustainable design? (Tick one)

- Do not know anything
- Do not know much
- Not sure
- know some
- Know very much
9. What words, aspects or characteristics would you associate with sustainable design? (Write in the bubbles)

10. Is there anything else that you would like to add?

........................................................................................................................................
........................................................................................................................................
........................................................................................................................................

Thank you!!!
APPENDIX F. DAILY JOURNAL TEMPLATE

Feedback on today’s module – Day 4

Name: ........................................................................................................................................
Year: ........................................................................................................................................
Concentration: ...........................................................................................................................
Date: ........................................................................................................................................

1. What do you think are major sustainability problems in Rwanda pertaining to

1.1 Economy

........................................................................................................................................

1.2 Environment

........................................................................................................................................
1.3 Social

2. What do you think are causes of sustainability problems in Rwanda?
3. What did you learn today that impacted you most?

5. Is there anything else you would like to discuss that was not asked here?

Thank you!!
APPENDIX G. POST WORKSHOP INTERVIEW PROTOCOL

1. How would you define sustainable design?

2. What kind of characteristics do you think a sustainably designed solution should have?

3. What things do you think are important to consider when you are trying to design products that are sustainable?

4. Why do you think sustainable practices are important?

5. How effective do you think some of the sustainable design practices we discussed in class are applicable here in Rwanda?

6. We discussed some sort of eco-design strategies in the workshop. Which ones do you think were familiar to you before the workshop?

7. What kind of challenges did you face when you went into designing the product?

8. In using sustainable design practice, did you meet any challenges? What are they?

9. What impact did participating in the workshop have on you?

10. How can we improve the workshop?

11. Is there anything you would like to add?
APPENDIX H. INSTRUCTORS INTERVIEW PROTOCOL

1. How do you define sustainable design?
2. What sustainable design practices are you aware of?
3. Have you ever taught any practices of sustainability in the courses that you teach?
4. What are the motivations for these practices in your classes?
5. Have you ever assessed students about sustainable design practices?
6. Have you met any challenges in teaching?
7. What aspects of sustainable design do you think are important to teach students in Rwanda?
8. Are there any aspects you think that are more relatable to the Rwandan context?
9. Do you teach any particular area of specialization?
10. Do you have any questions?