Transforming Mind-sets of Product Design Students Towards Sustainable Product Service Systems:

The Case of the University Of Botswana

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Structure:

1. Introduction

2. Theoretical framework

3. Methodology

4. Results

5. Discussion

6. Conclusion

Introduction:

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┌─────────────────┐          ┌─────────────────┐          ┌─────────────────┐
│     Current     │  - - →   │    Increased     │  - - →   │     Energy,      │
│    Business     │          │   Consumption    │          │      Water       │
│     Models      │          │                  │          │        &         │
│                 │          │                  │          │    Materials     │
└─────────────────┘          └─────────────────┘          └─────────────────┘

┌─────────────────┐          ┌─────────────────┐          ┌─────────────────┐
│   Sustainable   │  - - →   │                  │  - - →   │   Distributed    │
│    Product-     │          │     Applied      │          │    Renewable     │
│    Service      │          │   Meaningful     │          │     Energy       │
│    Systems      │          │                  │          │     systems      │
│    (S.PSS)      │          │                  │          │      (DRE)       │
└─────────────────┘          └─────────────────┘          └─────────────────┘

┌─────────────────┐          ┌─────────────────┐          ┌─────────────────┐
│   Institutions  │  - - →   │      Must        │  - - →   │ Responsive & Proactive │
│   of Higher     │          │    produce       │          │ Global Sustainability  │
│   Learning      │          │    students      │          │        Crisis          │
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Research explored

S.PSS
applied to
DRE → **Taught & Learned
by
Design students** → **Enrolled
Traditional
Product Design Programs**

*Results/
Findings
inform* → **Pedagogy
&
Context** → **Interactive Resource
informing
Teaching & Learning**

WHERE?

Non-Conventional Learning Spaces

Design Students

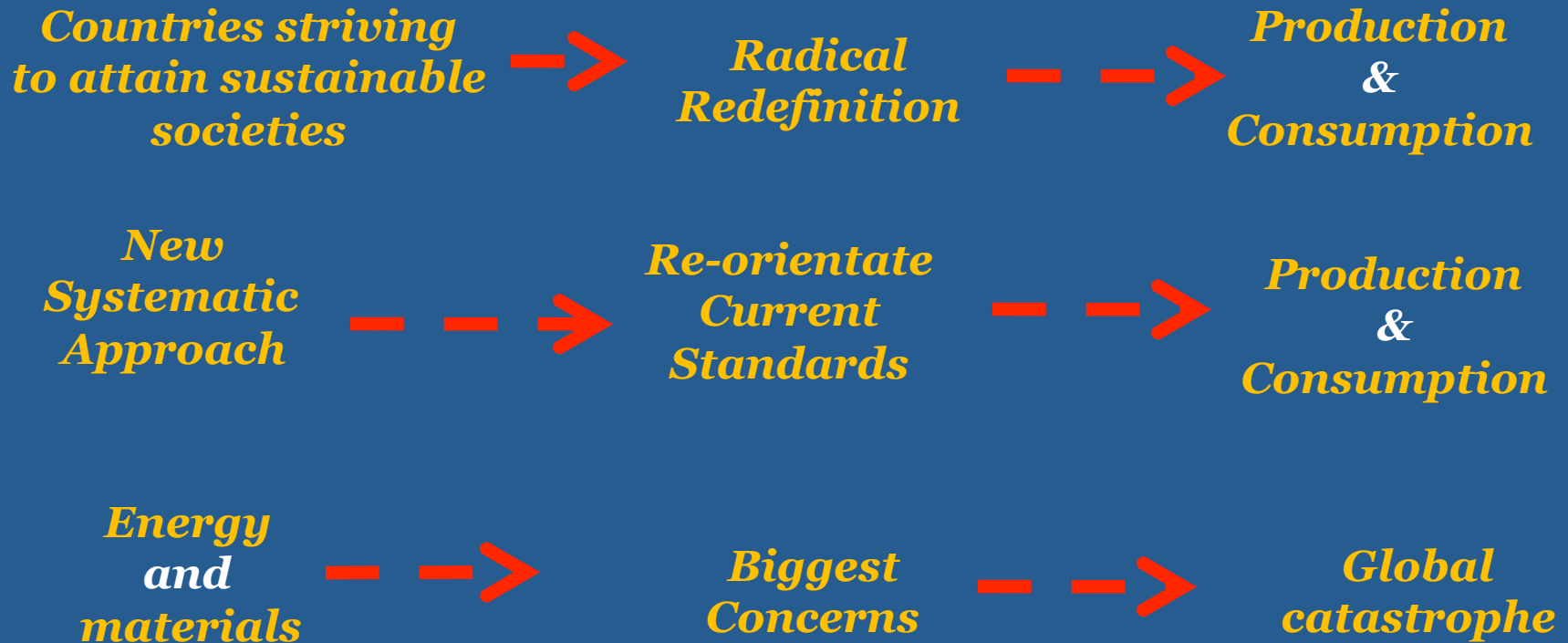↓

Design Challenges

↓

Product Service Systems
approach

↓

Positive Transition
Towards

↓

Service-Oriented Solutions
leading to
Sustainable Culture

Introduction

Countries striving to attain sustainable societies → **Radical Redefinition** --→ **Production & Consumption**

New Systematic Approach --→ **Re-orientate Current Standards** --→ **Production & Consumption**

Energy and materials --→ **Biggest Concerns** --→ **Global catastrophe**

"To combat the current global challenges, a sustainable PSS is a promising alternative"

(Manzini & Vezzoli, 2003; Valencia et al., 2015; Ceshin, 2013; Baines et al., 2007; Beuren, 2013)

Premise:

University of Botswana seeks ---> **Equip design students** ---> **S.PSS knowledge & Skills**

To contribute to Sustainable Industrial Development of their country

New Generation Designer ---> **Assist Botswana leapfrog** ---> **Avoid mistakes committed by other countries**

Aim is to inculcate the values of S.PSS in design students to mitigate economic, environmental and socio-ethical

Anticipated that new crop of designers will contribute towards a sustainable future and construct service-oriented strategies

Brief Definitions

PSS:

- *An **innovation strategy** that **shifts the business focus** from only designing and selling physical products.*

- *To **designing** and **selling** a competitive system of products and services which are jointly capable of fulfilling specific **client demands** with lower **environmental impacts***

- ***Selling the use** is more emphasised than **selling the product itself** (Pergande, 2012).*

- *A mix of **tangible products** and **intangible services** designed and **combined** so that they are both **capable of fulfilling customer needs** (Tischner, Verkuiji & Tukker, 2002; Baines et al., 2007)*

- *Designed to be more **competitive, satisfy customers** and **social demands** by **reducing consumption of material products** through **product service solutions** over **products ownership**.*

Theoretical framework

According : Fidler (2013) and Tukker (2004)

PSS categorised into **three areas**:

1. Product **oriented PSS:**

- **Ownership rights** of   product are **transferred to customer** & a **service arrangement** is provided to ensure **utility of the product over a given period of time**. Examples: **warranties** & **maintenance contracts**;

2. Use **oriented PSS:**

- **Ownership rights** of the product are **retained by the service provider**
- Customer purchases **use of the product** over a **given period of time** or **units of service**

3. Results **oriented PSS:**

- **Ownership rights** of the product are **retained by the service provider**, similar to **use oriented PSS**,
- **Customer** purchases the **utility as an outcome** and **not the use of a product over a given period of time**
- **Example**: Instead of **purchasing a washing machine**, the customer **purchases the service of clean clothes** delivered through a washing service.

- *Qiu (2010) posited that sustainability concerns have an impact on teaching approaches.*

- *What people learn, how they learn, and where they learn will radically change in future*

- *There is a need to make the transition towards a service economy and sustainable culture,*

- *It's imperative to inculcating the same values in the students because they are future leaders.*

- *Require Cultural shift to redefine customer needs away from product ownership (Manzini & Vezzoli, 2003).*

- *Ceschin (2013) advances that there is need to move from focus on product improvements only, towards a wider systematic approach (considerations new potential ways of satisfying the social demand of well-being)*

- *Advantages gained by implementing S.PSS and applying S.PSS to DRE*

- *Benefits relate to service providers, consumers, governments, the environment, and society at large since they are drivers of PSS in their different capacities (Boehm & Thomas, 2013; Emili et al, 2016).*

- *Major benefits of the PSS are focused on the continuous improvement of the business, innovation in quality, and the satisfaction of consumer demand*

- *Results in building long lasting relationships and fostering loyalty among consumers.*

Methodology:

UB students --→ Loose opportunity to learn --→ strategic design for sustainability

Since design for sustainability --→ Offered as optional courses

Reporting case study — Conducted with --→ Design students at UB

Case study Approach adopted

Why?

Source of Ideas about Behaviour	
Offers opportunities for Innovation	Resulting from New Service Development
Challenges theoretical assumptions	
Understanding /Explaining Links & pathways	

(Yin, 2009; Crowe et al., 2011).

Evidence for case study

Collected mainly

2-week workshop
involving
User research,

Brainstorming
Sessions

Exploring
Possible solutions

Structured
Presentation
to share **outcomes**

Research question was in part addressing aim *number three of the LeNSes project;*

"Delivering these curricula through an innovative teaching approach..." (Vezzoli, et al, 2015: 135).

Workshop participants consisted of *41 fourth year students from the Bachelor of Design (D & Technology Education)*

Experts from *research institutions* on *renewable energy, energy companies, government departments* and *academic experts* on DRE & S.PSS contributed

Sample was also on the verge of *undertaking* their *Major Design Project* course the following semester.

*Understanding **user needs** and **problems** with **teachers** at a **primary school** in Old Naledi Community*

*Workshop came at the right time to **equip participants** with sustainable **PSS & DRE knowledge** to further apply into their major Design Project*

*Workshop was structured to include **lectures, practical activities and field visits***

*Students were given lectures on **sustainable development, sustainable design, sustainable product service systems and distributed renewable energy systems**.*

*Followed by a **field trip** to facilitate **user research** on the launched design exercise*

*With a **pre-requisite knowledge** about **sustainability, PSS and distributed renewable energy systems**, the students were now able to undertake the **design exercise***

2 briefs for the design exercise.

Design exercise and final Expected Outcome	
Briefs	**Final expected outcome**
1. Design a **Product-Service System** to improve **safety of townships** by providing **light** and **security** to **public, passages** and **open spaces** which are not lit at night 2. Design a **Product-Service System** to assist students from **low-income** and **rural areas** to study at night	▪ **Summary** of **problem** and **user analysis** ▪ **Offering diagram** ▪ **Concept description** ▪ **Interaction storyboard** ▪ Details on the **energy system and 'energy using products'** ▪ **Details on services** ▪ Details on the **payment structure** ▪ **Stakeholder system map** ▪ **Sustainability potential**

Ability to develop Sustainable Product Service system solutions for distributed renewable energy systems formed the foundation provided by lectures

Summary of the Workshop Structure

Phase	Workshop activity
1	•Introduction of the workshop aim •Launch of the design exercise •Lectures
2	•Lectures •Field visit •User research and problem framing
3	•Lectures •Brainstorming - solution seeking
4	•Solution detailing and presentations

Qualitative data generated was handled using thematic analysis (Miles and Huberman, 1994).

Analytical question was:

How did students absorb new S.PSS & DRE knowledge & reflect it in their outcomes?

Results:

Experimentation with *teaching* and *learning* of *S.PSS applied to DRE* was conducted in a *workshop setting*.

Practical component of the *teaching and learning* was the *design exercise.*

Context as *Interactive Resource*

Understanding of the *local context* elicited important information on *users and their energy needs.*

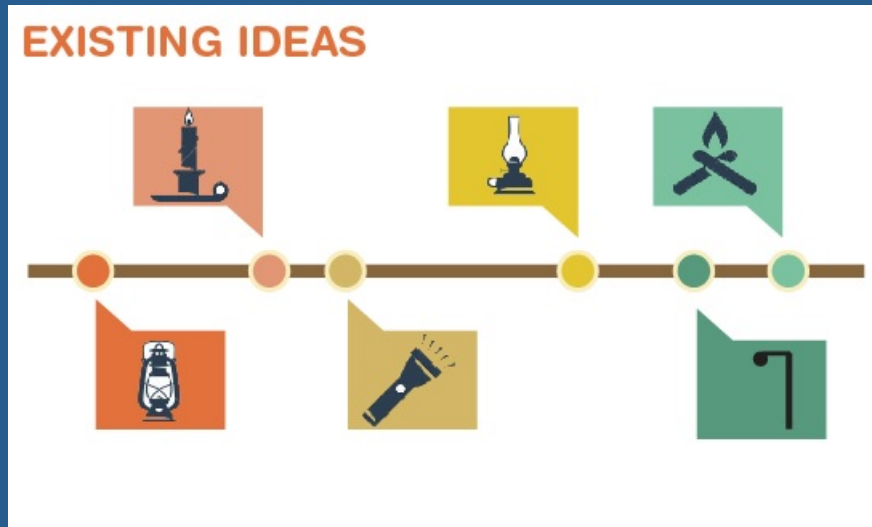*Groups* demonstrated themes by *profiling of users* as described *personas or a visual representation* .

Provided *useful insights* through the *emphatic approach* adopted during the field trip to the *Old Naledi* community.

Interaction with the environment and the people, who live and work there, uncovered and shaped what should be investigated, how it should be investigated and possible configuration of the outcomes.
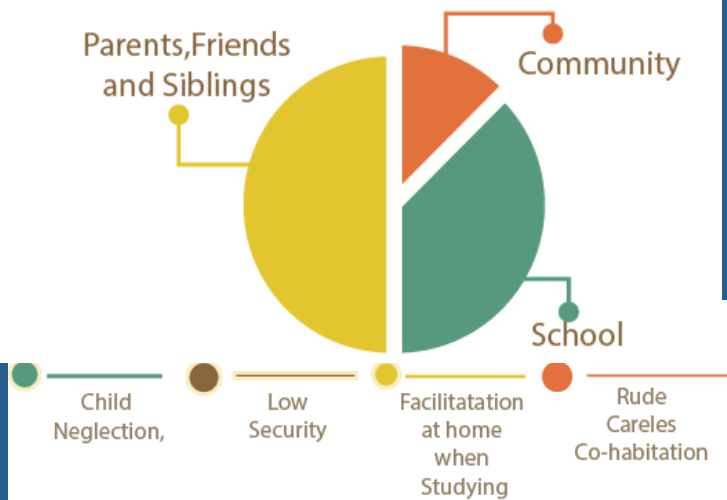
Different approach when compared to the classroom-based approach.

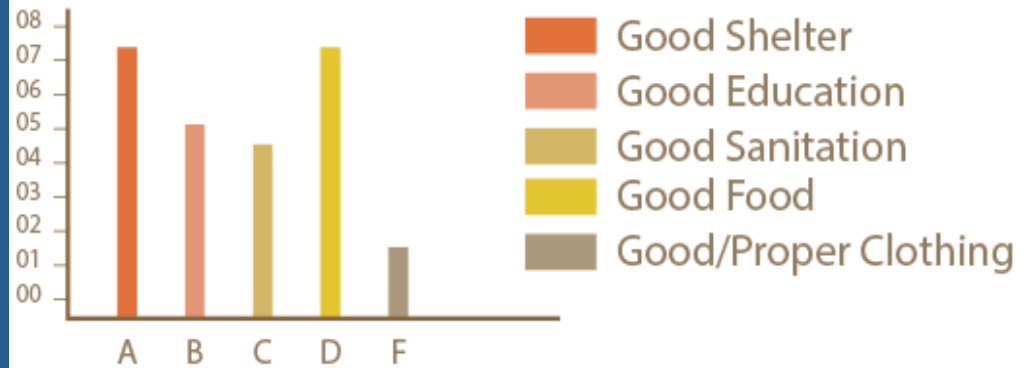*Classroom scenario, context is not explicitly planned into the learning activities to be a resource.*

Persona 1

Age : 30 - 60 years
Gender : Male & Female
Occupation : Old Naledi

Persona 2

Age : 11 - 12 years
Gender : Male & Female
Occupation : Tshwaragano Primary School(Old Naledi)

SOCIAL

Social Circle — Parents,Siblings and Friends

Income — Low Income

Location — Old Naledi

CULTURAL BACKGROUND

- Mixed/multi Cultural Place due to Imigration from Rural Areas
- Collection of Firewood for food preparation
- Traditional Doctors

EXISTING IDEAS

MOTIVATION

Parents, Friends and Siblings

Community

School

Child Neglection,

Low Security

Facilitatation at home when Studying

Rude Careles Co-habitation

NEEDS, DESIRES, GOALS

08	Good Shelter
07	Good Education
06	Good Sanitation
05	Good Food
04	Good/Proper Clothing
03	
02	
01	
00	

A B C D F

Non-Conventional New Learning Spaces

Facilitating the acquisition and assimilation of new knowledge meant that the new learning space had to be defined.

Framework was developed.

Treating both energy issues (DRE) and business model issues (S.PSS) at the same time were evident in the students' work

New concept in a non-conventional learning way prescribed new learning spaces for learning S.PSS and DRE

Dynamic learning environment were evident where students constantly consulted various experts

Defining parameters of this new learning space was the flexibility to consult academics, industry experts and members of the community within a manageable space of time

Expert consultation going on at the same time

Integrated Use Of Enabling Tools

Socio-Technical rigour of S.PSS and the Technical Perspective of DRE required that students use tools

To effectively communicate both Qualitative and Quantitative data

Qualitative tools often allowed for exploring holistic systemic issues, defining actors and their roles, products and possible services,

what a DRE- S.PSS offer could look like in various models, customers and their roles as well as payment modalities and system benefits.

Idea generation map allowed students to build narratives and express situations in the local context.

Quantitative tools such as the system information tool provided technical rigour in student solutions.

Learning & Problem Solving through Networking

Diversity of human capital involved in the workshop provided students with opportunities for networking and having access to new knowledge from various people

Experts from research institutions, energy companies, government departments and members of the Old Naledi community

Between PSS and DRE was linked through bringing experts on PSS and DRE and energy systems together under one roof

Created a platform for cross-pollination of ideas, thus defining how PSS can be practically applied to DRE in Botswana

Participants networking with stakeholders in Old Naledi Community

Process Reflective *Outcomes*

Outcomes from all the *ten groups* were a reflection of the *integration of principles* explored through the *design exercise* and *lecture structures of the workshop*

Offering diagrams from the students reflected *local community structures* such as the *Village Development Committee*, *local manufacturers/providers* and *payment modalities* that are applicable in the *local context*

Understanding of who the *stakeholders* are and what their *roles* will be, a *stakeholder system map*

How they will *relate* to each in a *system win-win scenario*,

Customer meets their *needs* and the *providers make profits* at *no or minimal cost* to the environment.

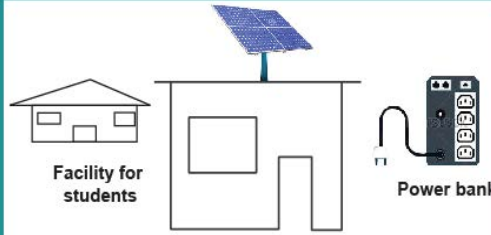**Village Development Commitee**
Buys equipment from Technology and manufacture

Selling Products

Technology Manufacture
(supplies charging station equipment e.g Power bank)

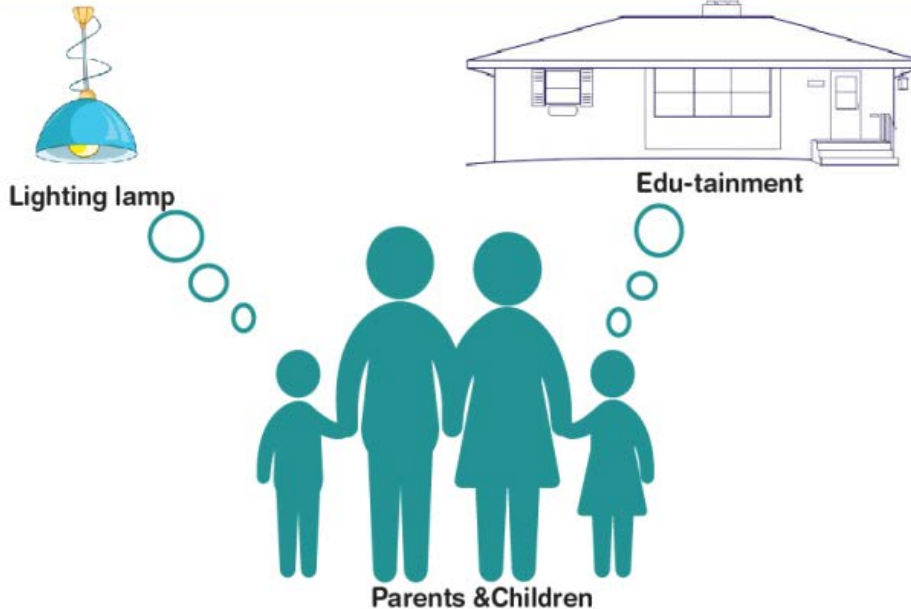Facility for students

Power bank

VDC
- provide studying + edutainment facility for the children
- lease power bank to parents on contract (e.g mascom lease phone to use and charge only airtime money every month)
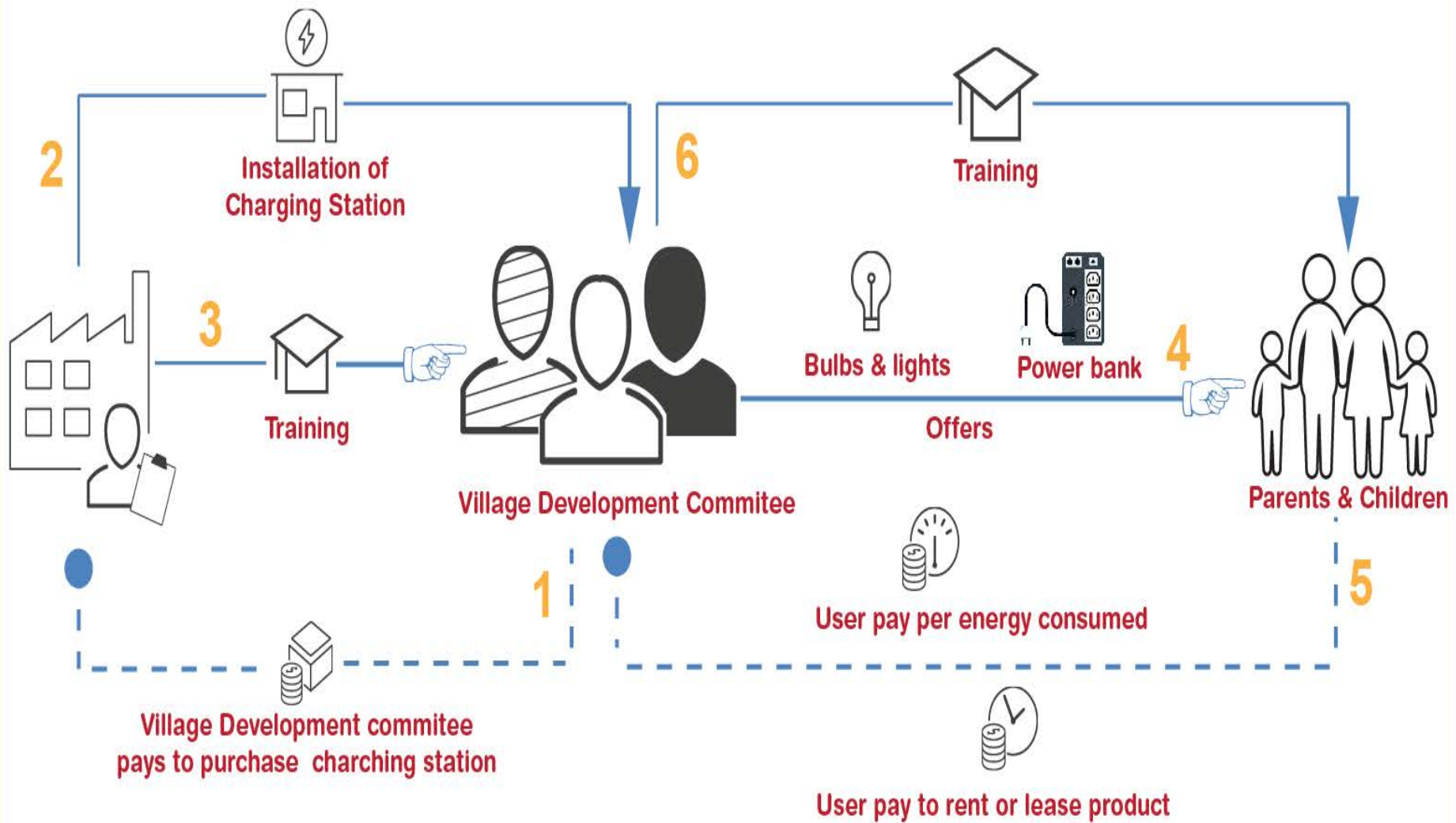- Manage the Facility

Payment Modality

*Parents pay-per energy consumption / charged to power bank
*Through cellphone or cash credit
*Studying facility is paid through monthly subscription

Social and Development Commitee will be paying for venerable kids

Lighting lamp

Edu-tainment

Parents &Children

Sample Offering Diagram from one of the groups

2 Installation of Charging Station

6

Training

3 Training

Village Development Commitee

Bulbs & lights

Power bank

4

Offers

Parents & Children

1

User pay per energy consumed

5

Village Development commitee pays to purchase charching station

User pay to rent or lease product

Sample Stakeholder System Map

Discussion:

For students to develop these solutions, they had to **overcome a dominant** and **established cultural barrier** of designing products for **ownership** as opposed to designing solutions based on **sharing and access**.

Knowledge imparted through a **series of lectures** and the **design exercise** regarding **S.PSS and DRE** assisted students to overcome that **cultural barrier** and facilitated the **design of solutions based on S.PSS in a systemic landscape**

Could be argued to be an **innovative teaching approach** given that it took place outside the **conventional lecture room environment**, but diffrectly informed the **students'design skills** base

Conducting user research and building familiarity with the **context** during **S.PSS and DRE teaching and learning** could help develop valuable solutions which are **systemic in nature and appropriate** for the users in the given context

To *build awareness on resources* available in the *physical environment* and how *fragile they are*, so that *social and economic development issues* are cautious of a *rebound effect*

Constant interaction with the *community, experts and knowledge of the energy situation* in Botswana by students who participated in the workshop is an example of this measure.

What people learn, *how* they learn, and *where* they learn will *radically change in future*.

Need to make the transition towards a *service economy* and *sustainable culture*,

It's *imperative* to start inculcating the same values in the *students* because they are the *future leaders*. This requires a *cultural shift* to *redefine customer needs* away from *product ownership*

*Students projects show a **transition from a product-orientated solution to a S.PSS approach**.*

*UB sees **S.PSS knowledge** and **skills** vital to their design students so that they can **contribute to addressing issues of national concern** in their country*

Dynamic teaching** and **learning environment** could also **promote self-directed learning** especially where students see the **practical value of acquiring new knowledge and skills

*Through **constant networking** and **direct interaction** with **real people, real needs** and the **real environment**, values of transfer of **academic concepts** into the **real world** are made simpler.*

*The **S.PSS approach** advances the **strategic position of design in sustainability**, which requires a retrofit of the **teaching and learning environment** in universities such that **communication of the service component** to student designers in a product design undergraduate programme is not an **alien abstraction**.*

Conclusion:

Case study approach offered an opportunity to explore two issues

Firstly,

- *To conduct teaching and learning of sustainable product service systems in a localised context where systemic problems were identified*

After identifying the problem, students used a system thinking approach to develop the solutions.

That is, using a set of synergistic analytic skills used to improve the capability of identifying common elements and understanding their interconnection, predicting their behaviours, and devising modifications to them in order to produce the desired effects and viewing systems as a whole rather than as parts.

Secondly,

These activities took place in the usual environment of teaching and learning for these students.

Conclude that learning sustainable product service systems in existing structures of product design require a change in pedagogy over a period of time

This process should be supported by local and social settings in terms of learning resources and examples that can demonstrate the practicability of PSS.

The findings indicate that there was a trajectory through which student designers developed a mind-set change after being introduced to product service systems and DRE.

Though S.PSS is still a new business concept in new emerging economies, it has proved to have the potential to address economic, socio-ethical and environmental challenges facing the society such as exploitation of renewable energy systems in developing contexts.

A recommendation for future scaling up of this initiative could be to work closely with education ministries so that the concept is trickled down to lower levels in the education system, as opposed to end of pipe approaches currently being implemented only at university and corporate levels.