Seeding energy sustainability through transformative teaching: any way forward for sub-Saharan Africa?

Kant E Kanyarusoke

Cape Peninsula University of Technology, Cape Town – South Africa
HIGHLIGHTS

• MEETING SOME SSA HOME ENERGY NEEDS SUSTAINABLY

• SEEDING SUSTAINABILITY THROUGH PRACADEMIA

• TRANSFORMATIVE TEACHING

• PrBL EXAMPLES TO MEET SSA ENERGY & EE CHALLENGES
SUB-SAHARAN AFRICA – ENERGY PROBLEM

http://solarjourneyusa.com/solarvsgas.php

SOLAR HOURS DISTRIBUTION

(≈ 4781 - SA; 150 - others cf. 10 000 for DEVELOPED WORLD)
ENERGY CHALLENGES

• ENGINEERING
  o GENERATION & TRANSMISSION
  o MAINTENANCE

• ECONOMICS
  o FINANCING
  o DISTRIBUTION
  o LOW INDUSTRIALISATION
ENG. EDUC. CHALLENGES

FROM LITERATURE

- FUNDING (Owolabi & Rafiu 2010, etc.)
- CURRICULA (Falade 2007, etc.)
- STUDENT COHORTS (Oryem-Origa 2010, etc.)
- SOCIETY EXPECTATIONS (Akintola 2002)

ADD

- PREVAILING SOCIETY BELIEFS
- ATTITUDINAL ISSUES
THE PROBLEM

Within limitations of an engineering academic, what can be done to sensitize and activate students’ actions on SSA’s Energy problems?
THE PRACADEMIC FOCUSES HIS/HER TEACHING (T) AND RESEARCH (R) ON SOLVING SOCIETY’S PROBLEMS (S)
Finley (2015)

- Constructivist Learning Experiences
- Arts and Science in teaching
- Symphonic teaching
- Facilitating Productive struggle
METHODOLGY—Transformative Teaching using PrBL

PrBL PEDAGOGY (Baş, 2011, Uziak, 2016 etc)

• Most Energy Eng. Work is Project based
• Transition from Eng. Sc. to Eng. Design (Savage, 2007)

USED IN EACH OF 4 JOB ELEMENTS OF TEACHING ‘T’
TRANSFORMATIVE TEACHING FOR SUSTAINABLE ENERGY - EXAMPLE 1: WATER HEATING

INITIAL DESIGN: 2012; 100 L; $C = \text{ZAR } 1000; T_{\text{max}} = 40.1^\circ C$

MAINTAINED, REDESIGNED 2013-15; 30 L; $C = \text{ZAR } 1200-1700; T_{\text{max}} = 52-67^\circ C$
TRANSFORMATIVE TEACHING FOR SUSTAINABLE ENERGY - EXAMPLE 2: RURAL WATER PURIFICATION

MODEL WATER PURIFIER: DIPLOMA STUDENTS 2014

PROTOTYPE WATER PURIFIER: MASTERS STUDENT 2014-15
TRANSFORMATIVE TEACHING FOR SUSTAINABLE ENERGY - EXAMPLE 3: RURAL CROP DRYING

INITIAL CONCEPT FROM LECTURER’S R&D REJECTED COMPONENTS - 2013

IMPROVED CONCEPT TO EXTRACT WATER AS WELL – 2014

FURTHER IMPROVED TO REDUCE DRYING TIME – 2015
COSTS & PERFORMANCE OF STUDENT SOLAR SYPHONS AND OFF SHELF UNITS

Pathogen growth stops
Pathogens die instantly
Pathogen reproduction stops

EFFICIENCY % or TEMPERATURE (°C)

MODEL
- Capital cost (US$)
- Tmax (°C)
TRANSFORMATIVE TEACHING FOR SUSTAINABLE ENERGY – DID STUDENTS LEARN BETTER? - EVIDENCE

**MED 300S: MACHINE DESIGN 3 RESULTS (SEMESTER 2, 2015)**

<table>
<thead>
<tr>
<th>Type of Assessment</th>
<th>Marks (%)</th>
<th>Ratio Standard Deviation to Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Summative 1</td>
<td>40</td>
<td></td>
</tr>
<tr>
<td>Summative 2</td>
<td>30</td>
<td></td>
</tr>
<tr>
<td>Project</td>
<td>70</td>
<td></td>
</tr>
<tr>
<td>Formative</td>
<td>60</td>
<td></td>
</tr>
<tr>
<td>Total Evaluation</td>
<td>45</td>
<td></td>
</tr>
</tbody>
</table>

**Type of Assessment Colors**

- **Mean**
- **stdv/mean**

**Graph Legend**

- **Summative 1**: Red Bar
- **Summative 2**: Red Bar
- **Project**: Red Bar
- **Formative**: Red Bar
- **Total Evaluation**: Red Bar
CONCLUSIONS

• DISTRIBUTED SOLAR ENERGY HARNESSING HAS POTENTIAL TO OVERCOME MANY ENERGY CHALLENGES AT HOME LEVEL IN SSA

• MAKING A START IN HOME SOLAR ENERGY HARNESSING NEEDS *NEITHER* ‘LOTS’ OF MONEY *NOR* IMPORTED TECHNOLOGIES

• PrBL COULD BE USED AS A TRANSFORMATIVE TEACHING TOOL
If China can, SSA should do it better – but probably through her young generation: This is the beauty of Transformative university teaching in SSA today!!
ASANTENI SANA; DANKIE; ENKOSI; ESE GAN; KE A LEOunda; NA GODE; THANK YOU;
kanyarusokek@cput.ac.za