# **Supplementary material**

**Adapted Business Model Canvas Template and Primary Market Research for Project-Based Learning on Management of Slurry**

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**Fig. S.1.** Lean BMC templated filled for the LabreGando project.

**Table. S.1.** Rubric for assessing the artifact developed in the PBL (Make it happen!). Elaborated with Rubistar (ALTEC at University of Kansas, 2008). (1/3)

| **CATEGORY** | **4** | **3** | **2** | **1** |
| --- | --- | --- | --- | --- |
| **Modification/Testing: Modifications applied to the prototype.** | Clear evidence of troubleshooting, testing, and refinements based on data or scientific principles. | Clear evidence of troubleshooting, testing and refinements. | Some evidence of troubleshooting, testing and refinements. | Little evidence of troubleshooting, testing or refinement. |
| **Function: Justification for all the components of the artifact.** | Structure functions extraordinarily well, holding up under atypical stresses. | Structure functions well, holding up under typical stresses. | Structure functions pretty well but deteriorates under typical stresses. | Fatal flaws in function with complete failure under typical stresses. |
| **Scientific Knowledge: Based on the content of the curriculum.** | Explanations by all group members indicate a clear and accurate understanding of scientific principles underlying the construction and modifications. | Explanations by all group members indicate a relatively accurate understanding of scientific principles underlying the construction and modifications. | Explanations by most group members indicate relatively accurate understanding of scientific principles underlying the construction and modifications. | Explanations by several members of the group do not illustrate much understanding of scientific principles underlying the construction and modifications. |

**Table. S.1.** Rubric for assessing the artifact developed in the PBL (Make it happen!). Elaborated with Rubistar (ALTEC at University of Kansas, 2008). (2/3)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **CATEGORY** | **4** | **3** | **2** | **1** |
| **Information Gathering: Primary Market Research.** | Accurate information taken from several sources in a systematic manner. | Accurate information taken from a couple of sources in a systematic manner. | Accurate information taken from a couple of sources but not systematically. | Information taken from only one source and/or information not accurate. |
| **Plan: Adapted BMC Template (both paper-based and online).** | Plan is neat with clear measurements and labeling for all components. | Plan is neat with clear measurements and labeling for most components. | Plan provides clear measurements and labeling for most components. | Plan does not show measurements clearly or is otherwise inadequately labeled. |
| **Data Collection: Throughout the whole PBL.** | Data taken several times in a careful, reliable manner. | Data taken twice in a careful, reliable manner. | Data taken once in a careful, reliable manner. | Data not taken carefully OR not taken in a reliable manner. |
| **Construction -Materials: Request for special components.** | Appropriate materials were selected and creatively modified in ways that made them even better. | Appropriate materials were selected and there was an attempt at creative modification to make them even better. | Appropriate materials were selected. | Inappropriate materials were selected and contributed to a product that performed poorly. |

**Table. S.1.** Rubric for assessing the artifact developed in the PBL (Make it happen!). Elaborated with Rubistar (ALTEC at University of Kansas, 2008). (3/3)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **CATEGORY** | **4** | **3** | **2** | **1** |
| **Construction - Care Taken: Request for special consumables.** | Great care taken in construction process so that the structure is neat, attractive and follows plans accurately. | Construction was careful and accurate for the most part, but 1-2 details could have been refined for a more attractive product. | Construction accurately followed the plans, but 3-4 details could have been refined for a more attractive product. | Construction appears careless or haphazard. Many details need refinement for a strong or attractive product. |
| **Journal/Log - Content: Student's notebook.** | Journal provides a complete record of planning, construction, testing, modifications, reasons for modifications, and some reflection about the strategies used and the results. | Journal provides a complete record of planning, construction, testing, modifications, and reasons for modifications. | Journal provides quite a bit of detail about planning, construction, testing, modifications, and reasons for modifications. | Journal provides very little detail about several aspects of the planning, construction, and testing process. |
| **Journal/Log - Appearance: Student's notebook.** | Several entries made and all are dated and neatly. | Several entries are made and most of the entries are dated and neatly entered. | Several entries are made and most of the entries are dated and legible. | Few entries are made AND/OR many entries are not dated or very difficult to read. |



**Fig. S.2.** Process flow diagram for the commercialization of the technology on improving the management of organic slurry.

## **Reference**

ALTEC at University of Kansas, 2008. Create Rubrics for your Project-Based Learning Activities [WWW Document]. Rubistar. URL http://rubistar.4teachers.org/index.php?screen=CustomizeTemplate&bank\_rubric\_id=6&section\_id=4& (accessed 2.26.23).