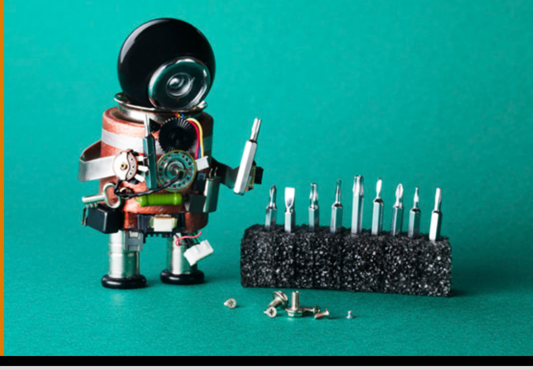
Krista M. Rundiks OILS-546-002 (Fall 2019)
ID Case Summary

Establishing a Virtual Makerspace for an Online Graduate Course: A Design Case



Case Summary:

Who: *Two professors* of Learning Design and Technology and *1 doctoral candidate* in the Department of Teacher Education and Learning Sciences from North Carolina State University set out to create an effective online makerspace for *6 graduate students* and eventually more *online distance learners*.

What: A makerspace is a learning environment most typically conducted in a physical location utilizing face-to-face communication, facilitated learner support, peer-to-peer collaboration, and real-time feedback. In a makerspace, leaners have access to materials, tools, and guidance so they can *design, create, and build projects* that pertain to robotics, 3-D printing, electrical engineering, computers, and coding.

When/Where: To launch this idea, *in 2016* the professors *developed an online course* for graduate students called "Technology and Informal Learning Environments" with an objective to teach those who will serve in technology leadership roles for schools, non-profits, higher education, and businesses how to achieve an effective online makerspace environment.

Why: The professors realized the need to provide an *opportunity for distance learners* who would not otherwise partake in a makerspace in person due to geographical constraints, lack of community resources, lack of learner support, or other impending cultural restraints.

Issues: The main issues that encompass this design problem are *how to establish a virtual makerspace* when these spaces and their supports are typically physically sited and *how educators can support makers* in sharing their work and giving and receiving feedback in online environments.

Design Decisions: After 18 months of evaluating makerspace projects from another successful massively open online course held in San Francisco, the professors *selected 6 projects* pertaining to circuitry, robotics, and physical computing and fabrication. They felt these were best suited towards an online learning environment as well as selected the *best strategies to document* a student's design processes as they worked on the projects.

Resources: The professors selected makerspace projects that could be *easily packaged and mailed* to students, were *cost-effective* when purchased in bulk and re-distributed, as well as they *applied for additional funding* to offset other costs outside of regular semester tuition which includes an Education Technology Fee (ETF). Students only paid an additional $45.22 kit fee. Common household items like glue or tape were not included in the kits, but students didn't find this to be an issue.

Context: Project one consisted of *conductive poetry*. Project two was an *LED greeting card*. Project 3 was a *soft-circuit wearable brooch*. Project 4 was the creation of a *spinbot or scribing machine*. Project 5 involved the creation of a simple *computer program* that reacts to external inputs. The final project allowed learners to create their own *3D design* for printing.

Instructional Design Approach & Traditional Learning Theories Applied:

The 6 projects designed for students included a *scaffolding* approach to build upon a level of difficulty. The course was modeled after a *constructionist approach* to STEM learning. Criteria for the 6 projects would need to satisfy the *adult learner* and *self-directed learning* in order to provide flexibility to customize projects and pursue personal interests. Instructors didn't want projects to be too easy, but rather engage learners to solve and trouble shoot problems on their own and collaboratively thus taking a *social cognitive, constructivism, and socio-cultural* approach to learning.

Solutions: A *learning management system* was utilized as the platform for the online course and included a *wiki* for each project. Students were given a *syllabus* with guidelines for using VoiceThread. *VoiceThread* was a major technology component used to document student designs by creating a video or still photos with written or narrated annotations to share processes and obtain feedback. For 3D printing the students used a software program called *TinkerCad* and an *AutoDesk Project Ignite website* provided step-by-step guides. Google Hangouts was suggested as a synchronous option but was not used.

Iteration: After 2 courses, instructors received and used *a mini-grant* to purchase a 3-D printer to produce a print of the students .stl files and mail them a physical copy of their 3-D design. Instructors were able to purchase a *mini tripod* to capture time lapse video of the 3D object being printed. *Materials were culled down* after evaluations to eliminate material waste and save in costs. The second iteration of the *class increased to 11* students from 6. Since the class emphasizes problem solving, the instructors didn't want to include tips on problem incidents found from their evaluation. After the second class *two optional frameworks* (engineering design thinking and computational thinking) are being considered to enable student reflection.

Problems: The main problems reported from students were *lack of real-time feedback* on project designs, project tutorials *left out certain steps that were assumed* as prior knowledge of student, and students needed *help in remembering* to document their projects earlier on and throughout.

Evaluation: Validation from the *local college of education computing and technology committee* approved the 6 projects. *Critical incident analysis* was used to identify scenarios where a problem was encountered and had to be resolved. This was done by creating multiple spreadsheets that recorded data on each student, per project, and then cross-referenced the data to find where students expressed similar difficulties. Through evaluation students expressed difficulties in following tutorials that left out steps or made assumptions. Further *effectiveness was determined by students* who attempted to make projects with their own children and teach their own makers class.

Interpretation: I believe the professors did their due diligence in pre-evaluation of other makerspace courses, provided appropriate technology to students to facilitate an effective online class, kept learner costs outside of tuition to a minimum, and did an impeccable job using critical incident analysis in their evaluations. *I agree with the modifications they made to the course,* but would have *implemented one synchronous group session per project* earlier on or midway through to answer any problem incidents in real-time.

Reference:

Oliver, K., Moore, R., & Evans, M. (2017). Establishing a Virtual Makerspace for an Online Graduate Course: A Design Case. *International Journal of Designs for Learning*, 8(1). https://doi.org/10.14434/ijdl.v8i1.22573

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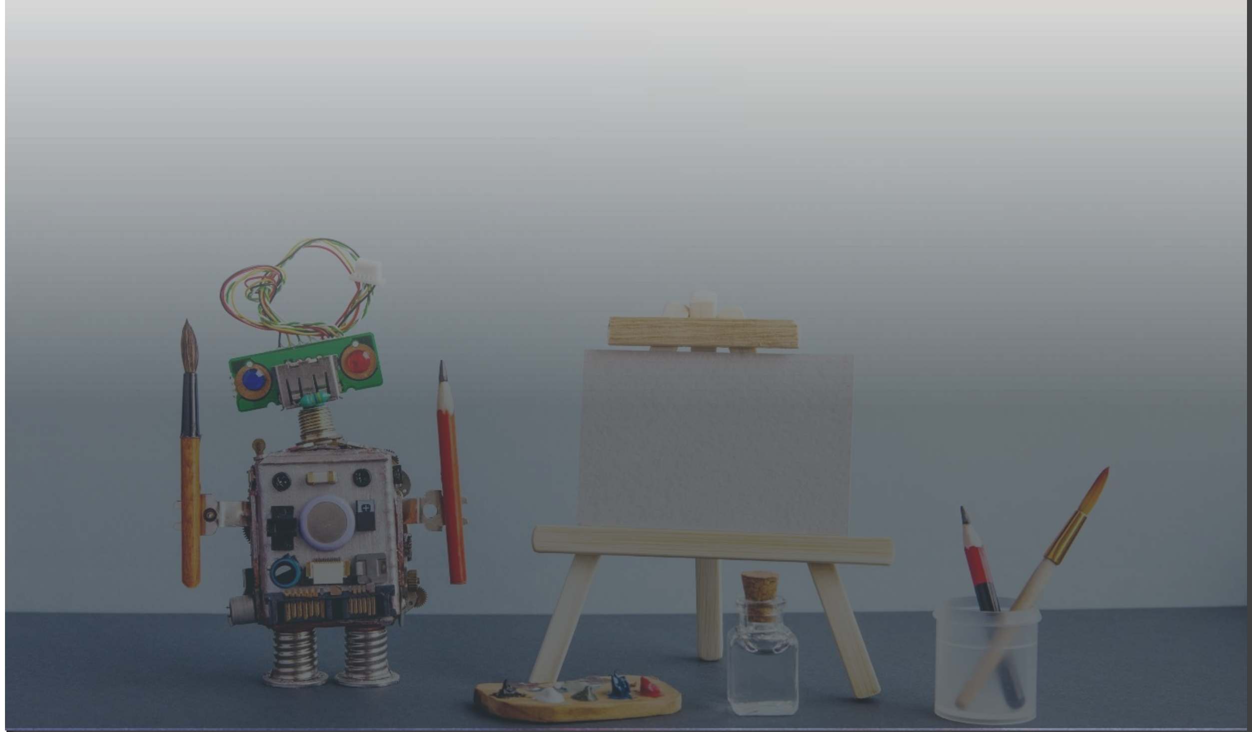
OILS-546-002 (Fall 2019)

Case Overview Will Include:



01: Case Summary

Who

- 2 Professors
- 1 Doctoral Candidate
- 6 Graduate Students (1st iteration)
- 11 Graduate Students (2nd iteration)

What

- A makerspace for graduate students
- To design, create, & build
- Robotics, 3-D design & printing, circuitry, computers, and coding

When/Where

- North Carolina State University
- First iteration in 2016
- An online collaborative course

Why

- For distance learners
- To teach those who will serve in technology leadership roles.

02: Main Issues

- How to *establish a virtual makerspace.*
- How *educators* can support makers in *sharing work online*.
- How educators and students can *give and receive feedback.*

02: Design Decision

- Professors spent *18 months evaluating.*
- Selected *6 projects.*
- Selected *best strategies to document* a student's design processes.

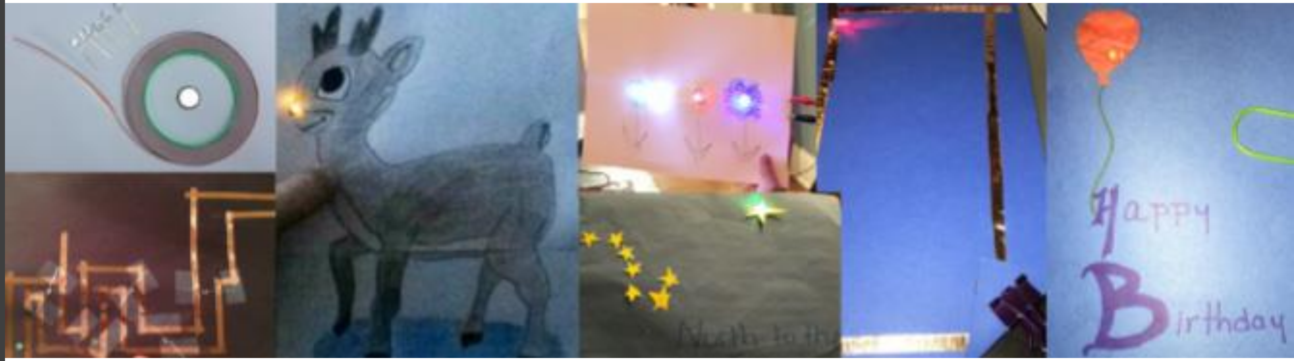
03: Resources

- Projects *easily packaged and mailed*.
- *Cost-effective materials*.
- *Additional funding* to offset costs.
- *$45.22 kit fee* over class tuition.
- *Household items* like glue or tape were not included in the kits.

03: Context

- Project 1: *Conductive poetry.*
- Project 2: *LED greeting card.*
- Project 3: *Soft-circuit wearable brooch.*
- Project 4: *Spinbot or scribing machine.*
- Project 5: *Simple computer program that reacts to external inputs.*
- Project 6: *3-D design for printing.*

Example of Project 1: Conductive poetry.



Example of Project 2: LED Greeting Card.

Example of Project 3: Soft-circuit wearable brooch.

04: Instructional Design Approach

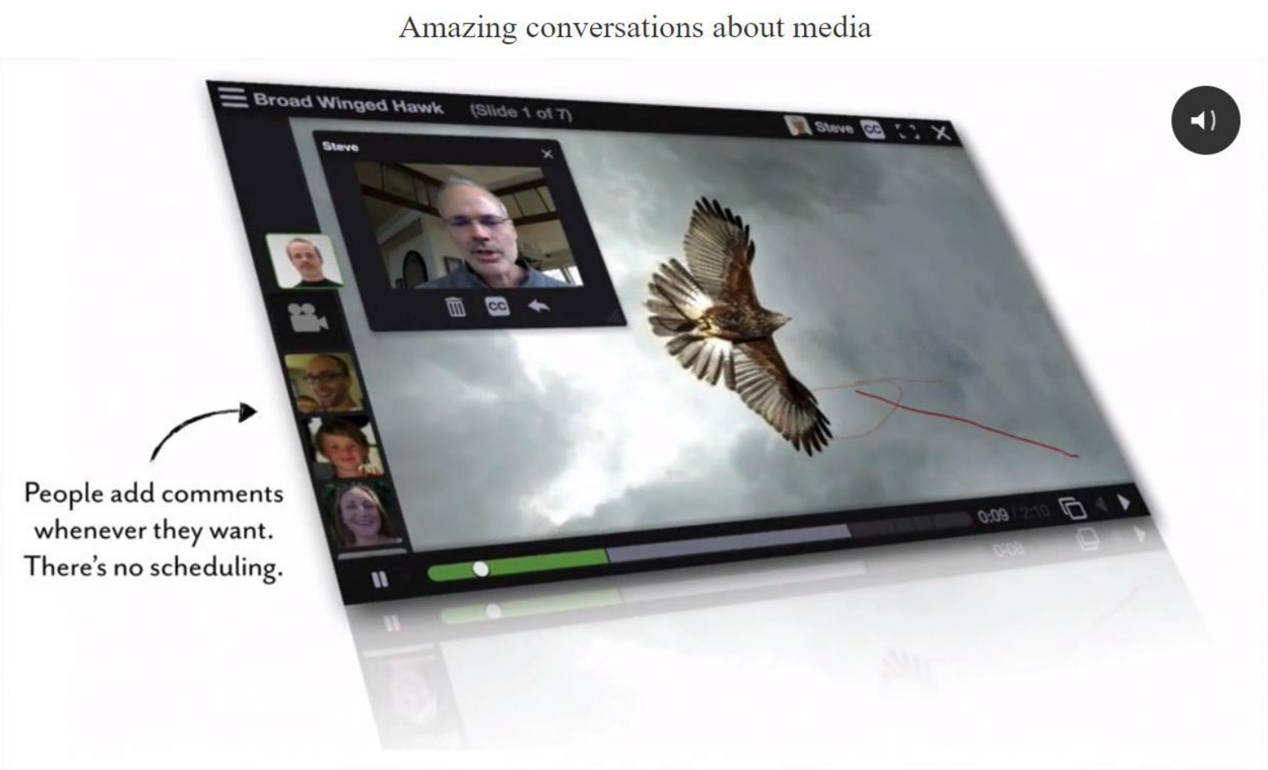
- *Scaffolding* to build on level of difficulty.
- *Constructionist approach* to STEM learning.
- *Engineering design thinking* and *Computational thinking* frameworks.

04: Traditional Learning Theories

- *The adult learner* and *self-directed learning.*
- *Social cognitive*, *constructivism*, and *socio-cultural* learning theories.

05: Solutions

- *Learning management system (LMS)* was utilized.
- *A wiki* for each project.
- A course *syllabus*.
- *VoiceThread* to document student designs.
- *Guidelines* for using VoiceThread.
- *TinkerCad* software for 3D printing.
- *AutoDesk Project Ignite website* provided step-by-step guides.
- *Google Hangouts for* synchronous meetings.

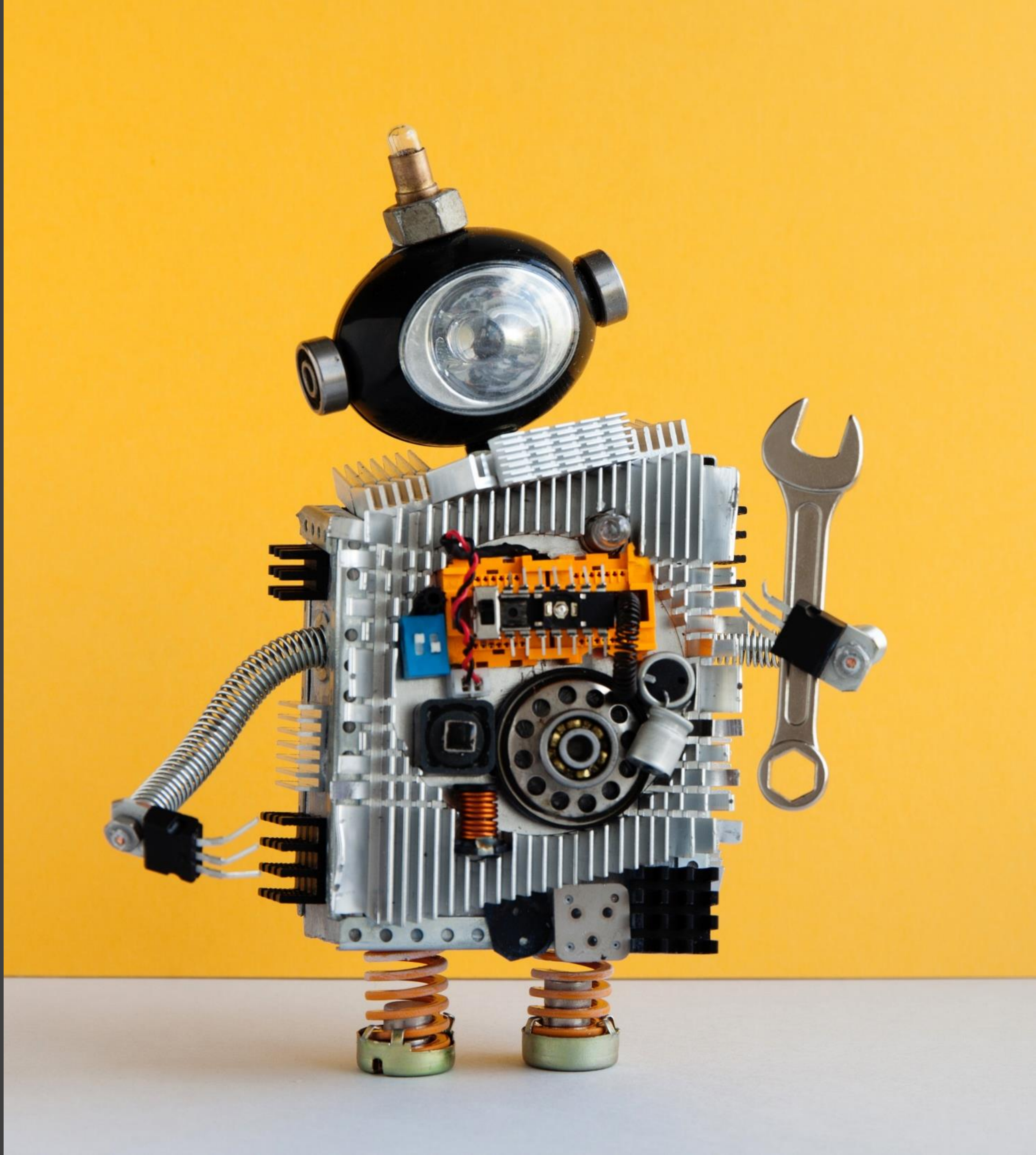


06: Iteration

- A *mini-grant* to purchase a 3-D printer & mini-tripod.
- *Materials* were culled down.
- An increase from *6 to 11 students*.
- *2 additional frameworks.*
- *Revision of project tutorials.*
- *Better guidelines* for using VoiceThread.
- Implementation of a *discussion forum.*

06: Problems

- *Delayed project advice* through VoiceThread.
- *Assumptions of a student's prior knowledge made* in step-by-step tutorials.



07: Evaluation

- *Local college of education computing and technology committee* approved the 6 class projects.
- *Critical incident analysis* used to identify problem scenarios.
- *Student evaluations* expressed were difficulties occurred.
- *Further effectiveness* was determined by student actions.

08: Interpretation

- *Pre-evaluation* was well researched.
- Course provided *appropriate technology* for online learning.
- Considerations of *student costs* were kept to a minimum.
- *Appropriate learning theories* for knowledge transfer, motivation, and possibly transformational learning.
- *Critical incident analysis* for evaluations was effective.
- *Modifications* made to the course enhanced learning.
- Implement *one synchronous group session* per project.

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09: Reference

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Thank You