Recursive Water Balloon Drop

A Classroom Project on Creativity, Teamwork, and Design

This is an exercise that aims to teach creativity, teamwork, and learning from iterations. The exercise has similarities with a common egg drop activity where here students are challenged to create packaging that will prevent an egg from breaking during a designated test drop. However, in the egg drop activity each student is given only one egg, thus the exercise does not allow learning from iteration which is a key design principle. This recursive water balloon drop exercise was developed to increase the learning opportunities in the project. A key feature in this exercise is that teams will be given multiple water balloons that have been filled with the same amount of water. In addition, to increase learning opportunities from failures, each drop will be recorded with a high speed camera such as in the iPhone 5S (120fsp) or Casio EX camera line (more than 300 fps). The exercise is structured with both individual and team activities to also provide a teamwork learning opportunity.

Objectives of the Exercise

- Learn about what factors help creativity.
- Learn that teamwork can increase the range of concepts one develops, but also requires good communication, decision making, and buy-in to be successful.
- Learn that data driven trail and error helps one succeed; an important part of the design process.
- First hand experience with not-invented-here syndrome and if one can overcome it.
- Reflection on how one can improve teamwork and creativity in future projects.

Logistics and Packets

The project is structured as a multiple part activity, where the initial individual concept generation phase can be done as a homework assignment. This approach can save classroom time, and also ensures that each student fully participates in the idea generation phase. The water balloon drops are done during class time, and involve a teamwork and documentation process. There is also an individual reflection assignment that is done after the drop activity. The packets for the project are:

- Project introduction.
    - 1 hour if done with IDEO video, or 15 minutes if IDEO video is assigned as homework.
- Individual Concept Generation.
    - This is done as homework 1-7 days before the in-class drop activity.
- Team exercise during build and drop.
    - Estimated time is 3 hours
- Individual Reflection Homework.
- Teacher Notes

Project Introduction

Recursive Water Balloon Drop

This is a project on creativity, teamwork, and design. While there are many drop excercises this one is unique intaht you get to do it many times,a nd hopefully improve during the process. The rpoejct will start indivually, but then be impmented in teams. The goal of each team is to build a protection device in which you will place a “standardized” water balloon. The devie willb e dropped at increasing hight elvles,a nd the winning team is the one that drops their device fromt eh highest hight without breaking their balloon. To be fari, each water balloon will be filled with the saem amount of water using a syringe.

Effective Design Process
To learn about the

IDEO Video Assignment
Key things to note in the video are how a large number of concepts are generated,and the freqruent use of sketches,a nd the importance of teamwork.

Rules
The protection devices must be cleanly dropped, with their lowest part specifying the test height. A clean drop means that they cannot be spun or tossed in anyway. The devices cannot contact any object during the fall except the ground.

Material in Your Kit
- Megalobk building blocks (1 set)
- 10 ft. of blue (easy to remove) masking tape, pre-cut into 1 ft lengths
- 5 ft. of string
- 20 Rubber bands

If part of your kit is broken during a drop, it can be replaces with a new part. However, make sure to count your parts so the design does not violate the rules.

Assignments in this Project
- IDEO Video Assignment
- Individual Concept Generation
- Team Build and Drop calls activity.
- Individual Reflection Homework

Individual Concept Generation

Homework Assignment (duration 1 to 7 days)

As seen in the IDEO video an important aspect of the design process is to create a wide range of possible solutions. Each student is to develop 4 concepts for the water balloon drop. For each concept:

- Sketch and label your drawing as shown in the example below. Use a new page for each concept, and make your sketches large enough to fill the page and be easily understood. Give a name to each concept.
- Make a list of pros and cons for each concept.
- Try to include some crazy ideas that might spark some creative insights to build upon, as well as some safer ideas.

Insert sample figure here (rocket ship landing module)
Pros. Looks cool and would have a soft landing
Cons. Hard to build, especially with kit parts

STOP

THIS IS AN INDIVUDAL PART OF THE PROJECT. DO NOT SHARE YOUR INDIVUDAL CONCEPTS BEFORE CLASSTIME. DO NOT USE THE INTERNET OR OTHER RESOURCES TO COME UP WITH DESIGN IDEAS

Team Build and Drop (3 hours)

In Teams of 3-4 Students

- Have each team member share his or her 4 design concepts with the rest of the team (2-4 minutes per team member).
- The team must select one design concept to build for the first iteration. This can be one of initial suggestion or a combination of ideas. In future iterations other ideas can be tried, but the whole team must work on only one idea at a time (5 minutes for team to choose idea).
- Team builds device from kit parts (10 minutes).
- Prepare Pre-Drop Documentation
    - Photo of device with labels (apps like Skitch can be helpful).
    - List of predictions from each team member:
        - Maximum drop height before water balloon pop
        - Failure mode, i.e. what causes the pop
- Practice filming drop with a non-protected water balloon.
    - Play with frame rate, lighting, and angle to get the best view.
    - Protect camera form water and potential flying debris.
- Drop the device starting from 2 ft., and moving up in 2 ft. increments until the balloon pops. Above 10 ft. higher increments can be used.
    - It is important to start low; you will be able to see the impact dynamics much better from lower height drops.
    - Device can be repaired in between drops.
    - Increasing the height until failure allows the team to identify the weakest link and the critical failure mode.
- Prepare Post-Drop Documentation
    - Make table of video filename and drop heights.
    - Record maximum height before balloon pop.
    - Describe failure mode.
    - Summarize what was learned.
- Team decides what device to build next. It can be a brand new concept or a variation on what was already built. Repeat the process above making sure to include the Pre and Post Documentation each time.
- Iterate till time is up, and record maximum successful drop height of each team in class.
- Turn in documentation.
- Clean up and thank teacher.

Individual Reflection Homework

Write a paragraph for each of the numbered items below. Address the items in the sub-bullets when relevant. Total length of reflection should be 2-3 typed pages.

1. How well did you communicate your initial design concepts to the rest of the team?
    - Did you teammates listen intently to you?
    - Were your drawings easy to understand?
    - Was your oral explanation easy to follow?
    - Did it bother you if a teammate was not listening? What about questions or comments about your design, did they bother you or did you like them and why?
2. How well did you understand the initial design concepts of your teammates?
    - Did you pay attention and listen intently while your teammates where talking, or were there things that distracted you? What were the distractions? What was the effect of you or others not listening intently?
    - Do did you ask helpful questions when your teammates were presenting?
    - Did you successfully hold back criticism at this stage? Is this hard to do?
3. How did the team make the choice for the first device built and the following devices?
    - Did everybody get a chance to voice his or her opinion?
    - In retrospect were the reasons raised about the pros and cons of the device correct? If not, do you think members in your team had inklings of possible failure modes, but did not voice them?
4. How involved was each team member during the build phase?
    - Were the team members whose ideas were not chosen as involved in the building as the other team members?
    - In retrospect is there any thing that could have been done to increase participation by all team embers?
    - Was there any team member (you included) who initially was not very involved in building, but became so further along during the project? If yes, what were they keys to increased involvement? Also consider the case for decreased involvement as the project continued.
5. What were effective design process methods?
    - Was there a best balance between iterating quickly vs. taking time to learn from the experiment? Cite instances where the iterations happened too quickly without learning, and cases with too much discussion and not enough building.
    - Were you able to properly identify the reasons for failure and design to avoid them? Cite cases where a refined design did not solve the problems of the old design and why this happened.
6. What helped creativity and what hindered it?
    - Did anybody borrow ideas from other teams (this can be a good thing in design, but often it is hard to adopt ideas from others and improve upon them)?
    - Were there any examples of building on crazy ideas?
    - Where there examples of good ideas arising from discussions among teammates with different viewpoints?
    - Did understanding the failure modes lead to new creative designs?