Resource guide for team projects

Created by: Engineering teaching methods – faculty learning community 2019-2020

This resource guide provides strategies and personal recommendations for different topics that are involved in creating and implementing team projects. The topics in this guide include:

Designing a team project

This purpose of designing a team project is to create a collaborative student experience in any course, not just design courses, that can promote technical and professional skills along with a way to offer a form of alternative assessment.

Strategies

1. Pick the specific learning objectives/goals that you want the students to accomplish through the completion of the project.
2. Find related engineering practice topics that are relevant to the course (not just cool topics) – can look to industry, the literature, or build on projects of other courses.

Recommendations

To create a successful team project:

- Start small! It does not need to be a big project at first.
- Align with the learning objectives and goals of the course (be able to apply the knowledge to a bigger project).
- The project must be big enough and challenging enough for the team size used. It needs to require collaboration and benefit from students bringing different skill sets.
- Include a real world application that connects the engineering components of the course to something they may see after they graduate.
- Ensure the project is unbiased and can appeal to all genders and ethnicities.

Common challenges

- Project is not broad enough to allow groups to have different approaches.
- Project is not challenging enough which allows one person in the group to successfully complete it individually.

Example

Elements of Electrical Engineering (Circuits): In a two-person team, design and build a creative invention utilizing your course Arduino Kit. Your invention must use 3 sensors, 3 actuators, incorporate a variable resistor and utilize pulse width modulation. You must build the device, record a video of it functioning, draw the related circuit diagram, and draw the flow diagram of device operation.

Engineering Design & Society (first-year makerspace design): Human-centered engineering design for a societal based project. In a student research team of four students, you have been hired to design a prototype based on one of the three following general Human-Centered User Design Prompts:

a) Children's Motor Skills Toy
b) Elderly Population Independent Living
c) Solar Power for the Powerless

You will need to design, build, and document a functioning prototype product that must:

1. Be a human-centered design
2. Fit within a 30-cm x 30-cm x 30-cm volume
3. Use an Arduino Uno microcontroller development board. It must be powered and controlled by no more than Two Arduino microprocessors.
4. Receive input from at least one sensor (soil, humidity, sunlight, temperature, etc.)
5. Control at least two actuators based on input from the sensor(s)

6. Incorporate at least one functional 3D printed component designed using OnShape software
7. Estimated print time of your 3D printed component when brought into Cura at standard quality should be 8 hours or less
8. Take into account aesthetics in your design (prototype should look complete and clean)
9. Stay within a budget of $40 per team
10. Must use programming between sensors and actuators through Arduino microprocessor.

Resources

Grand Challenges for Engineers: http://www.engineeringchallenges.org/

Creating teams

The purpose of these strategies are to create a team that is set up with an equitable opportunity to be successful in the project.

Strategies

1. Topic of Interest - list 10 project topics and have the students rank their top 5 topics and then sort the groups based on topics of interest.
2. Skill distribution - multi-disciplinary teams (e.g. put a person with programming experience on each team).
3. Grade distribution - put high and low performing students on each team or put similar performing students in the same team (allows a student from the low performing group to step-up).
4. Consider software for forming teams (like CATME) where they answer questions that help form the group

Recommendations

In order for teams to get to know each other and create a successful working environment:

- Instructor should form the teams (not let the students try to group up themselves).
- Allow each student to identify a person they want to work with and do not want work with.
- Do not leave minority students alone (e.g. put two females in a group).
- Provide an initial questionnaire about their interests, skills, and strengths for working in a team.
- Team size of 3-6 people is an ideal size, but the specific size would depend on the scope of the project.
- Observe the dynamics of the teams for a few periods to get a feel for how people work together.
- Create a classroom setting that allows for collaboration and working together.
- Provide them time to get to know each other (refer to *Orienting the team to each other*).
- Explain reasoning for how the teams are selected.

Common challenges

- Making sure students that are in a team can find a common time
- Resistance to working together (refer to *Orienting the team to each other*)

Example(s)

Engineering Design & Society (first-year makerspace design): During the second week of classes, student are given a brief survey to help create successful first-year design teams.
Students are asked:

1. Favorite Movie (ice breaker question)
2. Major(s)
3. Level of Programming Experience
4. Level of Solid Modeling Experience
5. If there is Anyone in the Class They Want in their Group

The answers are screened to create groups to optimize the following, in order of importance.

1) If there are 2 students of the same minority in the engineering class (female, or same ethnic background, etc.) place those 2 students on the same team.
2) Ensure there is one team member on each team with some programming experience.

3) Spread out any students with solid modeling experience.
4) Accommodate student requests for friends on the same team.
5) Group by majors to help undecided engineering students meet someone in a major they are interested in or to create good multidisciplinary teams.

Resources

Team Based Learning Collaborative http://www.teambasedlearning.org/
CATME for team creation https://catme.org/login/index
UF Instructor Guide https://ufl.pb.unizin.org/instructorguide/

Orienting the team to each other

The purpose of orienting the team to each other prior and during a team project is to get the team to have a conversation and learn how to speak to each other. The goal is to get them to a level of comfort where they will want to share the ideas they have. This can be done through the use of meaningful ice breakers (topic related or not) to get them to interact. This is important for any team project to create a level of comfort so that everyone contributes and not just one team member takes control.

Strategies

1. Ice Breaker for the whole class (typically done during the first few days of class) to get comfortable talking, interacting, and being loud.
2. Ice Breakers amongst each team. These are mini activities that require all students to participate equally that are low stress/low stakes (not worth points).
3. Allow each team time to make a team name and logo.
4. Require each team to create a *team resume*. This includes all their skills for each resume section and offers them a way to get to know each other.
5. For design challenges/brainstorm sessions require each student to have their own notebook and first spend a few minutes individually doing their own work. Then each team member takes turns sharing their idea with the group. This gives each student time to come up and develop their own idea and allows everyone to have something to share.
6. Create a relevant mini quiz that is first done individually and then allow the teams to complete it together. This will allow all students to be more successful and demonstrates why the group is more valuable than the individual.
7. If team work is done in the class, the instructor should go around to each team and make sure everyone is engaging. This could include creating conversation if it is quiet.

Recommendations

In order for teams to get to know each other and create a successful working environment, it is important to:

- Provide adequate time (multiple days) in class to get to know each other.
- Provide a time and space that they can come together as a team.
- Point them towards the resources of how to book spaces/rooms for them to work together (Marston study rooms, other building spaces).
- Create ice breakers that are not just verbal, but include sketching, building, and other ways to contribute.
- Create the environment to feel low stakes and friendly.
- Provide small incentives (candy/little prizes) which can help if students are nervous or unsure of engaging.
- Reinforce the team mentality amongst themselves and show that the instructor/peer tutors are behind them and there to help.

Common challenges

- Quiet students (those that don't want to speak/interact)
  - This is why it is important to complete some of the strategies listed above to allow everyone an opportunity to interact in a way they are comfortable with
- Quiet groups or groups that cannot find things in common
  - This may require more intervention from the instructor at first (see Strategy 7).

Example(s)

1) After teams are formed, do a small ice breaker in class that requires each team to find 4 things that they all have in common with the other members of their team. After discussing this for 15 minutes, offer the teams an opportunity to share their answers. Have an incentive (small 3D printed keychain or candy) for the first group to volunteer their answers.
2) On the first day of class, set up a mini design challenge that is hands on. This challenge provides the class an opportunity to talk and start working together in an interactive environment. The design challenge can be based on the cards from “MockUps Game“. In this game they pick out a potential user and a constraint that they must design for using arts and crafts supplies.

Resources

MockUps https://engagetheirminds.com/2018/01/24/mockups/

Creating productive teams

The purpose of these strategies is to establish a culture of accountability and best practices that keep the teams progressing towards the end goal.

Strategies

- Team charter
  - Each team creates their own charter and sign it. Provide the students with an outline of each aspect they need to include. It should contain: when they will meet, goals for the team, contact information, availability, roles and responsibility, team name/logo, timeline for the project (set the minimum number of deliverables and allow them to choose when and what those are), team rules (e.g. if one member is 10 minutes late they must bring candy for the team), how they will deal with conflict, and mission statement (team purpose).
- Role identification
  - If you want them to have defined roles specific to the project, then give a brief description for each role (like a project manager or programmer).
  - TRELLO – online app to assign roles and due dates so students can check off as things get done. It sends reminders to the students as due dates are coming up.
  - Assign a person to the role of format checker to make sure final product is consistent.
- Group decision making
  - Should be discussed as part of the team charter, but remind them to come to you if an issue comes up.
  - Recommend the use of a decision matrix that can include weight of importance of factors to come up with a score to help them make decisions.
- Monitor team progress
  - Require intermediate deliverables (allow the students to pick the timeline).
  - Provide timely feedback on the deliverables (can be written or in person).
  - Have an intermediate peer evaluation to know how the group is working and make sure students are doing their assigned roles.
  - Make the deliverables part of the final project grade so final grade is not all based on one project.
  - Informally check in with each team verbally during class to make sure everyone is on track and do not need help.

Recommendations

- Provide time in class to work on some aspects of the project.
- Provide class time to check in with each group.
- Provide each team with the peer evaluation rubric at the start of the project (see *Designing a Peer Evaluation* topic). Remind them that they will be evaluated by their peers at the end of the project and provide them time to reflect.
- Allow time to reflect on their contributions and where they are at in the project and how their group is working.
- Remind the teams about use of consistent formatting for professionalism and communication.
- Remind the team that they are a team and if someone is missing for several meetings to let you know in case the student is having issues that need more attention.

Common challenges

- Personality conflicts – if issues come up the instructor can reference the discussion back to the team charter and remind students to keep it professional.

- Team members not completing their portion of the work successfully or at all – again refer back to team charter and role identification.

Example(s)

Engineering Design & Society (first-year makerspace design): The teams are required to make a charter to use as a tool to link the team goal to the activities to be performed as a team and the strategies to work in the team. The teams are asked for the minimum items to be listed in the charter: team name and logo, communication plan, contact information, team purpose or goal, preferred meeting times and place to work outside class, team norms about to deal conflicts, deadlines, division of labor, member roles, and any additional information/agreement you consider will help making the teamwork more successful. This exercise has helped less experienced team members or teams composed of members who have not worked together regularly benefit from both the process of developing a team charter and using it to guide their operations.

Resources

TRELLO https://trello.com/en-US

Designing a peer evaluation rubric

The purpose of a peer evaluation rubric is to assess individual participation in team projects, to allow students to identify the input from other members, and to identify areas of improvement for individual team members. The evaluation can be used to foster a team climate, allow for conflict resolution, and provide accountability for team members.

Strategies

1. Align rubric with project goals.
2. Evaluate both participation and quality.
3. Create a document on etiquette for evaluating each other constructively.
4. Include professional conduct evaluation to foster diversity.
5. Peer evaluation could be anonymous or not depending on its use.
6. Use the peer evaluation as formative feedback to improve the group dynamic.
7. Groups should create their own forms of evaluation as well (could be part of Team Charter see *Creating Productive Teams*).

Recommendations

- Go over the peer evaluation rubric as a class at the start of the project assignment.
- The instructions need to be clear and objective for students to effectively evaluate their peers.
- Do not create an opportunity to incentivize the peer evaluation (e.g. evaluate relative contribution of each group member out of 100%)
- For long-term projects allow for intermediate evaluations to allow for corrective actions.
- Apply a common scale for all evaluations (e.g., 1-5 poor to excellent) with space to include comments.
- Consider the length of the project as the rubric could be different for a short term project or a long term project.

Common challenges

- Create an evaluation so students won't rate each other all the same in all areas.
- Allow the peer feedback to be used constructively amongst group members without upsetting each other.

Resources

Example peer evaluation: https://www.doctemplates.net/peer-evaluation-form-sample/