2019 National Engineering Design Challenge

Judges Training: Technical Presentation and Interview

Thank You!

Thank you for volunteering to score technical presentations and interviews!

We created this slide deck to provide some information about scoring. Thanks for taking the time to review it!

Agenda

- What is MESA?
- Things to keep in mind
- About the competition
- Rubric scale
- Rubric parts
- Logistics of scoring

Pro Tip:
Have a copy of the rubric in front of you while going through slide deck.

Technical Interview & Presentation Rubric

Technical Presentation & Interview Overview

Entire Competition Rules

What is MESA USA?

- Mathematics Engineering Science Achievement
- Classroom and After School programs
- Human Centered Design & STEM
- 10 States
- Focuses on students underrepresented in STEM
- Over 49,000 K-12 and college students are served annually

Why Training?

1. Inter-rater reliability
   - The degree of agreement among raters.
   - Common understanding of expectation for each part of rubric.
2. Consistency among MESA states.
3. Context of the Technical Presentation and Interview within the scope of the entire National Competition.
4. Familiarity with specifications and the scoring sheet.
5. Provide information about MESA students. Set expectations.

About the Competition

- Teams of 3-4 students.
- Device must be designed around the needs of a client.
- An Arduino microcontroller must be part of the solution.
- Students will:
  - Write a Project Report
  - Give a Prototype Pitch
  - Give a Technical Presentation and have an Interview
  - Create a Poster

Competition Components

- Project Report - 100 points
- Prototype Pitch - 100 points
- Technical Presentation and Interview - 100 points
- Poster Symposium - 50 points

Total: 350 points

Rubric Scale for Scoring

No half points!

(5) Exceptional - Exceeds all aspects of the standard when possible.

(4) Excellent - Meets all aspects of the standard very effectively.

(3) Met Criteria - Meets all aspects of the standard but no more.

(2) Fair - Almost meets the standard. May be inaccurate or unclear.

(1) Poor/Lacking - Attempts to meet the standard but provides information which is irrelevant or unnecessary.

(0) Not Present - No attempt appears to have been made to meet this standard.

Pro Tip: Judges may not award half points. Whole points only!

The Technical Presentation and Interview

Objective:
Teams will:

- provide an overview of the development of the design;
- provide specific information about the technical aspects (e.g., mechanical operation, software, hardware/software integration, etc.); and
- demonstrate the functionality of their design.

A technical presentation has a different focus than a pitch, and therefore, this presentation should be different than the Prototype Pitch Presentation.

Total time for both the Presentation and Interview will not exceed 20 minutes.

See the rules document for a full set of rules and guidelines.

Presentation & Interview Etiquette:

It is very important that judges follow proper etiquette when listening to the presentation and participating in the interview. General Instructions:

- Please do not interrupt teams. *Allow them to finish their presentation and demonstration before asking questions. They will indicate to you when they are finished. When they are answering questions. Allow them to finish their response to the question without interrupting.*
- Teams are allowed to have judges participate in their demonstration. *But, refrain from asking questions at this time, as the demonstration is part of their max 10 minute presentation time. They should give all needed instructions if they choose to have you try it out. Table any questions for the interview time.*
- Please do not give suggestions or lead their answers. *Questions should be direct questions where the students give direct answers. You might have lots of input and suggestions. If you do, add them to the score sheet in the comments section to avoid suggestive questioning and assistance.*
- Questions should pertain to the topic areas only or be limited to what is presented. *This is what teams should be prepared to respond to.*

Technical Presentation Portion

This is a summary of the major topics that will be addressed during the technical presentation:

- Project Objective
- Description of Design
- Engineering Design Process
- Conclusions and Recommendations
- Prototype Demonstration

The Technical Presentation portion should be no longer than 10 minutes, including the demonstration.
Pro Tip: Judges should notify teams when there is one minute remaining for the presentation (i.e., at the 9 minute mark).

During this time, only students should be speaking. Save questions for the interview section.

Technical Interview Portion

Judges will use the remaining time in the session to ask follow-up questions. Potential topics of questions include, but are not limit to:

- Usability
- Team Objective
- Engineering Design Process
- Materials & Technology
- Data
- Conclusions & Recommendation
- Support Materials-Including Demonstration

The total time of the Technical Presentation and Interview session should not exceed 20 minutes.

Pro Tip: Judges should notify the team when there is 3 minutes and 1 minute remaining in the total time (i.e., at the 17 minute and 19 minute marks).

For competition, judges will be provided a sample set of questions that can/should be used.

Overall Quality of Presentation

The factors listed below affect the overall quality of the presentation and should be considered when scoring:

- Verbal and non-verbal presentation skills
- Project knowledge and ownership
- Response to questions: quality of responses and equal participation of team members
- Focus on all content areas related to the project

The Rubric - Project Description

Design Overview: The client is well defined and the design meets all of the requirements and the needs of client.
Design Knowledge: Team demonstrates adequate knowledge of project. All design elements are intentional and thought out.
Usability: The team can adequately articulate prototype instructions and purpose. Judges can understand how the prototype is used by the client.
Prototype Demonstration: During the presentation time, the prototype is working and can be demonstrated effectively and with ease.
Project Impact: The presentation, without additional clarifying questions, increases judges' understanding of the importance of project and future impact.

Examples - Project Description

This is the general description of the project and prototype design. The prototype needs to be a device that is tailored towards the client(s), is simple and practical, and can easily be used.

Example Client Need: The client need an alternative to a car to get him and his colleagues to work...

Example solution:

Example - Project Description

While there is sophistication in the design, it is not well thought out for the client. They designed it as a modernization to a regular bike, but did not consider personal needs. It is not simple or practical. A scale model was brought, but it is not working. They would receive a:

- 1 in Design Overview: They did not meet the needs of the client.
- 3 in Design Knowledge: They thought about all the design elements and intentionally built it this way. They have great knowledge of the project. They answer every question, but do not elaborate on most.
- 2 in Usability: Although they know a lot of the project, they can't articulate well.
- 1 in Prototype Demonstration: They attempt to talk through their model but it is not working.
- 2 in Project Impact: The judges understand their project, but are unclear on the impact and importance for the client.

The Rubric - Materials & Technology

Materials: All materials are appropriate for design and for use by the client. Team is logical in material usage and budget consideration. Team can articulate and is knowledgeable about the rationale and purpose for materials used.
Mechanical Design: The team can articulate and is knowledgeable about details, reasoning, and purpose for the mechanical components of the design.
Technology Usage: Sensors, Wiring, Breadboard, Etc. Technology is appropriate for the design. The team can articulate and is knowledgeable about all technology used. The use of Arduino hardware and sensors is innovative, effective, and relevant to project. Rationale for selection of hardware components used is conveyed adequately.
Arduino Usage: Programming Logic Flow The team's Arduino code is logical and team can explain, with adequate detail, their coding choices, modifications, and programming logic.

Example - Materials & Mechanical Design

The team needs to use appropriate materials and technology in their prototype. They need to have well thought out and researched reasons for the choices that they made. Arduino must be the main component of the prototype design and coding.

Example: We decided to use aluminum for our bicycle because we felt that it was light and strong. This would allow for easier use by the client. The wheels are galvanized rubber that did add extra cost but we felt that a stronger rubber would lessen the wear and tear on the tires. We chose the design for balance so the weight would be equally distributed.

The teams explains their choice of materials and articulates why they choose them. However, the reasons are not researched. They also do not mention any other components apart from the aluminum and rubber.

- This would score a 2 in Materials and a 1 in Mechanical Design.

Example - Technology & Arduino Usage

The team needs to explain how they used the Arduino microcontroller and any sensors, peripherals, etc. in their design. This is separate from the Materials and Mechanical Design scores.

Example: We placed an accelerometer and a gyroscope on the bicycle that is connected to LEDs on the handlebars for each user. We use the LEDs and gyroscope to let the users know if the bike is leaning more than 10 degrees past vertical. This way the users can correct to prevent the bike from falling over. The accelerometer can measure the speed and distance that the users have ridden the bicycle. It will log the data and be able to be transferred to a computer via SD card.

- This would score a 3 in Technology Usage: Sensors, Wiring, Breadboard, etc. The team is using the Arduino to address some of the limitations of the bicycle as well as provide some health information. They went into detail about what sensors they were using and what data they will collect from them. To earn more, the team would need to discuss in more detail why 10 degrees is the value they choose and why they did not choose any other sensors.
- 1 for the Arduino Usage: Programming Logic Flow as they did not discuss their code in their presentation at all. They were asked in the interview but they just read what was on their poster.

The Rubric-Data

Data Collection: Input The selected Arduino hardware and/or sensors efficiently and effectively collect input data. The prototype is able to process input data appropriately. The team can convey what data the device collects and/or what variables are used to result in an output. This includes knowledge of input code and hardware.
Data Response: Output The selected Arduino hardware and/or sensors respond to data efficiently and effectively. Output is appropriate. The team can convey the output process and what happens during use of the prototype. This includes knowledge of output code and hardware.

Example - Data Collection: Input

The team needs to demonstrate that the device is collecting the target data efficiently and effectively.

Example: We have the Arduino programmed to collect speeds and distances travelled. We do this by measuring the circumference of the tire and a) determining how many times it rotates while travelling for distance and b) dividing the distance by the time to determine the speed.

The team is collecting data and using proper mathematical formulas for the collection. They vaguely identify their variables (i.e. time and rotations) but do not describe how they will measure time in motion. They do not describe how they put the formula into the code for the Arduino.

- This would earn a 2 in Data Collection: Input. To earn a 3, the team would need to go more in depth about their code and how the variable are determined and measured.

Example - Date Response: Output

The device must use the data input to produce an output relevant to the task(s) the device performs.

Example: We use the Arduino to collect distance from vertical and distance travelled. If the bicycle is more than 10 degrees from vertical, the LED on the bike will turn red. The riders will then be able to correct to prevent them from falling. The data collected from distance will be on an SD card which can be placed in a computer to read the information.

The output is a little cumbersome. The rider would need to remember to remove the SD card, put it in their computer, and then read the data. The LED is an interesting idea but could give an indication of which side the bike is leaning towards.

- This would score a 3 in Data Response: Output.

The Rubric- Design Process & Testing

Engineering Design Process: The team conveys their methodology and process, including the research, planning, creation, testing, and improvement phases, adequately well.
Challenges and Solutions: The team conveys their project challenges and correlating solutions through presentation or interview. The team is able to incorporate how their research informed their solutions adequately well.
Testing: Design Choices/Iterations Multiple tests were conducted, documented, and used to improve the design. The team is able to convey testing conditions, variables, and results of most tests. All testing was appropriate for their project. The team can convey how the tests helped to inform their design choice(s).
Conclusions and Recommendations The team is able to effectively present their final product and discuss conclusive findings, limitations, next steps, and recommendations for further development through presentation or interview. The team is able to incorporate how their tests resulted in their conclusions and discuss the future impact of their project.

Example - Engineering Design Process

The team describes the steps they went through to reach their solution. Interviews, research, and testing should be part of this conversation.

Example: We spoke with Mr. Johnson, who is 78 and has glaucoma. He needs to get him and his neighbors to work but can't drive. It is too far to walk. We designed the bicycle to allow him to do this and it will be self driving. We researched other self-driving cars and realized that we could place sensors on the front and rear bumpers for collision detection as well as redesign the drive train to process information from the sensors to control acceleration and braking.

The team discussed their client and his needs, their research for sensor placement, and how they were going to address acceleration and braking. If this is all they said, this would be a 1. If the team continually made references like this through the entire presentation and how they used the client, planning, creation, and testing in all decisions, it could be a 4 or a 5.

Example - Testing

The team needs to conduct tests to see if their prototype is a valid solution. The data collected from the tests needs to be analyzed and used to make improvements to their device.

Example: We were able to simulate the testing on a small scale. The sensors on the Arduino were able to determine when the 1/5th size bicycle was past the 10 degree mark accurately. We only needed to adjust the code slightly to have the lights turn on. Our small scale model had some issues with the pedals being in sync to turn the wheels but we were able to determine that the gear ratios on the drive chains needed to be adjusted. We hope to be able to build a full scale bicycle with more time.

The team conducted multiple tests and determined the flaws in their design. The team described that their testing was done on a small scale model that they want to be able to enlarge for the next round of testing.

- This would score a 3 in Testing: Design Choices/Iterations.

Example - Conclusions and Recommendations

The team communicates a plan to continue work, send it to production, overcome any shortcomings, or whatever the next step is in their process. They discuss next steps.

Scoring:

5 – The team recognizes where they are in the process, what they need to do, and how they will do it. They know any shortcomings and have plans for how to address them. They have exceptionally addressed all questions from the judges in this area.

3 – The team recognizes that more work needs to be done and have some ideas as to what they will do in the future. They know the shortcomings and have some plans to address them.

1 – The team is unsure of where they are and where they are going. They have no plans for the future.

The Rubric-Presentation Quality

Presentation Skills: The team displays relaxed, self-confident nature and is mostly free of fidgeting and/or nervous movement. Body language was appropriate and did not detract from presentation. The team uses direct eye contact and holds the audience's attention.
Verbal Skills: The team shows enthusiasm and can verbally convey knowledge about the topic during the presentation and interview session. Team members speak in clear voices and use technical terms correctly. The team shares equally in the presentation and interview time and all show adequate skill and knowledge.
Support Material: The team is able to effectively use support materials (e.g., poster, logic diagrams, engineering notebook, etc.) to increase the audience's understanding of the project.
Response to Questions: The team's responses to technical questions demonstrate adequate technical knowledge of the concepts and processes used in the project.
Team Contribution: All members contribute to the presentation and to answering questions. Team has shown that all members have contributed to the overall project.

Example - Presentation and Verbal Skills

The teams need to be practiced in both presentation (body language) and verbal skills.

Scoring:

5 – Exceeds the standard. Team is extremely confident and is well spoken, is well practiced without cue cards, demands the audience's attention. All team members practice this. WOW presentation!

3 – Meets the standard, but not all team members are equally engaging.

1 – The team does not hold attention well, they are reading a lot of information from a script or cue cards. It is hard to hear the team and they are very fidgety.

Example - Support Material

Teams can use whatever material they would like to enhance their presentation and convey knowledge.

Scoring:

5 - Has relevant models, seamlessly references their engineering notebook, references their poster exceedingly well, all extra material is used and referenced appropriately to greatly enhance understanding.

3 - Meets the standard. References their notebook, poster, and models.

1 - The team has a poster, but does not reference it. When asked about it, they read from the poster without adding any understanding of the purpose.

0 - Team does not have any support materials.

Example - Responses and Team Contributions

The team will need to answer questions about their device and its capabilities from the judges

Scoring:

5 - All questions are answered completely, demonstrating knowledge of the device and how it operates. All members of the team contribute to the answers

3 - All questions are answered but with a textbook answer. The answers lack intimate knowledge of the device. All team members contribute but the answers are dominated by 1 or 2 members of the team.

1 - The questions are not answered completely or not answered at all. Some team members do not contribute to the answers.

Questions?

If you have any questions while scoring, please look back at these slides or reach out to your point of contact.

Thank you for serving as a judge for the National Engineering Design Competition.

We will see you at MESA Day!

Thank you!