Exploring Emphases on Engineering Practices Card Sort Protocol

The following questions are accompanied by a virtual or physical "deck of cards" with 26 distinct engineering practices listed on them. (See following pages for a printable list of practices or a virtual example using Google Jamboard) As originally administered, participants were asked about two distinct engineering contexts, repeating questions 1-7 for the second context. For example, participants were asked about their undergraduate coursework and a student project team, their undergraduate coursework and their graduate work, or their professional work environment and their previous educational context. Question 8 also draws on the deck, asking participants to select the practices they personally consider to be most important.

1. I'd like you to look through the list of practices and pick the top 3- 6 that you think were most emphasized or valued in your [context] experiences (to date), regardless of how important you personally think they were.
2. How can you tell these were the most valued or emphasized? (Can you think of any examples that highlight their importance?)
3. Were there any other practices or skills not included in the deck that you think were really valued in that setting? I want to make sure we're not missing something key to your experience.
4. How do you think those emphasized practices aligned with what you personally felt were the most important? (Are there things that you think are over- or under-emphasized?)
5. Can you now please identify the 3-6 practices that you think were the least emphasized or valued in [context]? Again, irrespective of your own opinions?
6. How can you tell these were the least valued or emphasized? (Can you think of any examples that highlight their importance?)
7. Did you participate in any groups, projects, or experiences within [context] where you got the sense different types of practices were emphasized? (Prompt: In what ways? How does that compare to your experiences in [context] overall in terms of how well it aligns with the things you personally prioritize?)
8. Now, I want to get your perspectives on the practices that are most important. Which five of these practices do you **personally** consider to be the most important in terms of solving complex problems in your field? Why?
9. How do you think what was emphasized in your [educational/work/research/team] experiences align with these things? (I noticed there is/is not overlap…)
10. Do you feel your personal skills and perspectives were generally recognized and valued in [context]? How so or in what ways were/weren't they?

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A - Conduct research on fundamental engineering principles

B - Draw on science and engineering principles to predict outcomes

C - Analyze a problem and define the constraints

D - Collaborate with others by sharing expertise, ideas, resources, etc. to achieve a common goal

E - Test and evaluate potential solutions

F - Manage work process across all stages of a project

G - Incorporate ideas and approaches from other fields of study when appropriate

H - Pitch your ideas and make a case for their value

I - Account for relationships between multiple elements or components of a project

J - Come up with innovative ideas and approaches for addressing a problem

K - Develop details or schematics of potential solutions

L - Account for potential future impacts in developing a solution

M - Prepare technical communication, including written and oral reports or use of figures, to represent work

N - Demonstrate social awareness, empathy, and self-awareness in interactions with others

O - Follow proper data collection procedures

P - Account for ways natural environment may affect or be affected by one's work

Q - Interpret data, such as results from modeling, validation, and other data processing

R - Develop plans and procedures for experiments

S - Build tangible artifacts as models, prototypes, or working products

T - Consider ethical responsibility

U - Negotiate tradeoffs in how different problem components or requirements can be addressed

V - Account for social or cultural context in which a project is embedded

W - Demonstrate leadership to ensure teams work effectively toward common goal

X - Communicate effectively about work with people from other academic or professional backgrounds in verbal or written form

Y - Iterate on and improve on ideas or designs

Z - Account for the immediate problem context as it relates to one's work

Most Emphasized

Least Emphasized

F - Manage work process across all stages of a project

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Personally Most Emphasized

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Additional Instrument Information and Use Examples:

Mosyjowski, E.A. (2020). *Engineering for social good? How professional and educational experiences inform engineers' solutions to complex problems*. Dissertation. University of Michigan.

Mosyjowski, E.A., Daly, S.R., & Lattuca, L.R. (2021). Assessing emphasized engineering practices and their alignment with engineers' personal values. Proceedings of the 2021 American Society of Engineering Education Annual Conference. Virtual Meeting.