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Students' Perception of the Nature of Engineers and Engineering During an Integrated Life Science and Engineering Curriculum

BACKGROUND

Students often lose interest in STEM fields during middle school (Archer et al., 2010). One reason this might be happening is that many students have vague or incorrect ideas about what engineers do (Blotnicky et al., 2018).

This study examines elementary, middle, and high school students' understanding of these concepts as they complete an integrated life science and engineering curriculum. By gathering data about what students know about engineers and engineering while they are actively engaged in engineering practices, I hope to elucidate areas where students' understanding is strong along with areas where students need additional support.

RESEARCH QUESTIONS

What do students perceive about the nature of engineers and engineering while enrolled in an integrated life science and engineering curriculum?

PARTICIPANTS

Drawing and writing activity

Elementary	Middle	High
27	82	37

Interview

Elementary	Middle	High
16	14	13

CITATIONS/ACKNOWLEDGMENTS

Archer, L., DeWitt, J., Osborne, J., Dillon, J., Willis, B., & Wong, B. (2010). "Doing" science versus "being" a scientist: Examining 10/11-year-old schoolchildren's constructions of science through the lens of identity. *Science Education*, *94*(4), 617–639.

Blotnicky, K.A., Franz-Odendaal, T., French, F., & Joy, P. (2018). A study of the correlation between STEM career knowledge, mathematics self-efficacy, career interests, and career activities on the likelihood of pursuing a STEM career among middle school students. *International Journal of STEM Education*, *5*(22).

Valladares, L. (2021). Scientific literacy and social transformation: Critical perspectives about science participation and emancipation. Science & Education, 30(3), 557-587.

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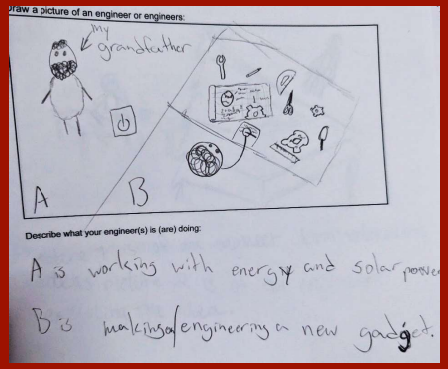
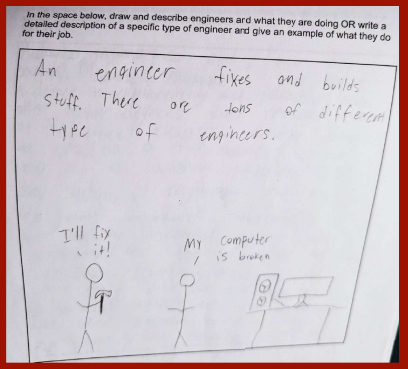
DRAWING AND WRITING ACTIVITY

Elementary

Middle school



High school



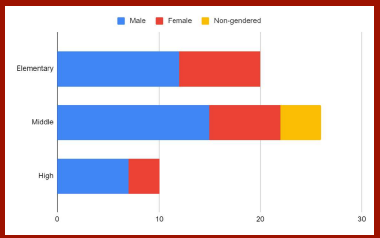
Limitations in understanding

- Shallow or incorrect understanding of practices
- Engineering as an event or a skill rather than a process
- Engineering applied to mechanical problems, but not other domains such as health or social
- Lack of consideration for constraints

Student responses indicating collaboration among engineers/others

Elementary – 29% of responses
Middle – 30% of responses
High – 12% of responses

Gender representation in student drawings



INTERVIEWS

Vision	Ideals	ES examples	MS examples	HS examples
Engineering for future engineers – 32 codes	"How to do" engineering	"First you to think about [what to build], then improve, then make then, like, make a miniature one. Then that and then you can make the big one."	"[Engineers] need to know how to mold. They know how to hotwire. They need to know how to solder. They need to know how to remove plastic. And there are other materials. Yeah, right. They need to know how to build it."	"[Engineers need an] idea of how to use tools correctly and efficiently, or to make something, like, durable and safe."
Engineering for all – 30 codes	Engineering that addressed real-world problems	"[Engineers] might need to choose between, like, they want to choose, like, the most mobility. Or if they want it to be high quality. They probably want it to be high quality, even though it'll cost more."	"[Engineers] solve problems. Build stuff and that might be for [the problem]. They yeah, they solve problems in the real world."	"[A]n engineer for me is like someone that just, like, designs things. But usually it's like helpful things. Not usually just, like, for fun stuff. It depends, but it's something that can, like, benefit people or something they can use."
Engineering for transformation – 3 codes	Engineering for societal transformation	"[O]n hot glue guns, when kids use them, their parents always have to watch them. Why couldn't they put something on top of that? Or it's not hot, and kids can use them and the parents don't have to worry."	"Replace all trash cans with a pipe that goes down to a composter, and that composter would be sent to all gardeners-slash-anyone who needs it. It'd be free because it's trash and the compost would be very large because there's a lot of waste"	"I feel like an engineer is also just like could even be like a mindset. Just like creating something new that can help people or were benefiting them in some way. I think I learned that they can also, like, benefit communities a lot more than I thought."

Adapted from Valladares 2021