When and why do children make decisions about STEM careers?

Daniel JAMES[1], Charlene WILLIS, Jeff PARKER and James LEE[1]
[1] Charles Darwin University, AUSTRALIA
[2]Griffith University, AUSTRALIA
[3] Northern Territory Departtment of Education, AUSTRALIA

Anecdotally, engineering and STEM professionals make decisions about their career choice as early as primary school. During this time there are significant developmental biology changes in the body, with a tendency for gender differences, cultural differences and access to STEM rich environments having strong influences on choice. Understanding the key factors in career decisions and in particular the timing of those decisions is critical to attracting students to STEM professions, as well as noting other barriers to participation based on gender, socioeconomic status and cultural differences.

The biology of cognitive development, physical maturation and gender differences are key considerations in understanding potential barriers and sweet spots of opportunity in adolescents[1]. It is at the cusp of these developmental changes that the prerequisites for skill development are occurring as they engage in learning that contributes to longer term career decisions through orientation [2] and development of higher order conceptual thinking, prevalent in STEM and other disciplines. These decisions are often made in early to late primary school [3].

Su et al. [4] ascertains that STEM activities are traditionally solitary activities in the school environment. Su's results show that of students with similar aptitude in STEM activities, those that have less developed verbal cognition skills are more likely to engage in them. Those with STEM and verbal social skills are less likely to under-take STEM activities. It is here that a key variable in STEM gender differences is partially explained, females tend to develop social and verbal skills at a younger age and are thus more likely to self-select out of STEM activities at a younger age.

This is driven by STEM opportunities presented at this time tending to focus on solitary activities, such as coding and robotics. Thus students with well developed social skills tend to opt out and are more likely to miss key stages of strategic skill development, making it more difficult to opt in to STEM subjects later. Indeed, looking at STEM uptake in the tertiary sector we can see STEM disciplines that are

Corresponding author email: Daniel.james@cdu.edu.au

more people centric seem to have greater gender balance than those about things e.g. sports science and medicine when compared to engineering and physics [3].

Pubertal hormones, a key chemical in physical and risk-taking behaviour also emerges as a key behavioural input with significant sex differences [5]. Activities that support archetypal role models for risk taking behaviour tend not to be those with STEM careers, leading to a separation, with boys in-particular seen as brilliant or bad [6], further leading to gender based identity separation in boys that is progressively developed through school as their identity develops [7].

Conclusions

The literature supports that late primary school [1] is where STEM choices are made and that tendencies for developmental biological differences between genders and cultural differences will highlight areas [2] where STEM activities can be better targeted and delivered more suitably, such as targeting domains of student interest rather than 'things' eg a robot. One of these is through using sport as a vehicle [8], where integrated activities can 'engage' students though personal intrest and relevance, that is often lacking in the classroom. It is here that sports enginerring type activities can really shine as a STEM engagement tool.

References

1. Viner, R. M., Allen, N. B., & Patton, G. C. (2017). Puberty, developmental processes, and health interventions. Child and adolescent health and development, 8, 1841.
2. Holmegaard, H. T., Madsen, L. M., & Ulriksen, L. (2014). To choose or not to choose science: Constructions of desirable identities among young people considering a STEM higher education programme. International Journal of Science Education, 36(2), 186-215.
3. van Tuijl, C., & van der Molen, J. H. W. (2016). Study choice and career development in STEM fields: an overview and integration of the research. International journal of technology and design education, 26(2), 159-183.
4. Su, R., & Rounds, J. (2015). All STEM fields are not created equal: People and things interests explain gender disparities across STEM fields. Frontiers in psychology, 6, 189. https://www.frontiersin.org/articles/10.3389/fpsyg.2015.00189/full
5. Bjorklund, D. F., & Pellegrini, A. D. (2000). Child development and evolutionary psychology. Child development, 71(6), 1687-1708.
6. Musto, M. (2019). Brilliant or bad: The gendered social construction of exceptionalism in early adolescence. American Sociological Review, 84(3), 369-393.
7. Morris, E. W. (2012). Learning the hard way: Masculinity, place, and the gender gap in education. Rutgers University Press.
8. Lee, J., Willis, C., Parker, J., Wheeler, K., & James, D. (2020). Engaging the disengaged: A literature driven, retrospective reflection, of a successful student centric STEM intervention. Proceedings of the AAEE2020 Conference Sydney, Australia,

Corresponding author email: Daniel.james@cdu.edu.au