STEM educational engagement through coopetition, sport and wearable technology

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Student engagement in Science, Technology, Engineering and Mathematics (STEM) activities are often perceived as solitary activities, resulting in a limited range of students that are intrinsically interested in it [1]. Historically STEM activities are often about "things rather than people" [2]. For those whom STEM is not perceived as intrinsically interesting, its lack of relevance to everyday life and social engagement means potential STEM students' interests are focussed elsewhere.

A previously reported education program [3] utilised a range of sports technologies and sport-based activities to engage students in sport and play activities that were more likely to be of interest and have a significant social context through working as a team and competition. These were then linked to classroom activities involving numeracy and engineering based. The vehicle for this were principally inertial sensors, which have emerged in recent decades as a viable alternative for the quantification of human movement at the elite level [4] as well as emerging as popular consumer electronics [5] through wearable technologies (an important hook for children).

Recent studies of the program (STEMfit) [6] measured its efficacy for educational engagement and improving education outcomes [3]. These investigations garnered international interest for the potential to undertake cross cultural activities and exchange (even in a pandemic). Typically, in this program, physical activities are combined with classroom-based analysis using time series data developed from the STEMfit program and collected using a single body worn inertial sensor (Fig. 1).

Here we introduce the ISEA STEMfit International cup, an ISEA Education co-sponsored program that was supported by global expertise in inertial sensors from

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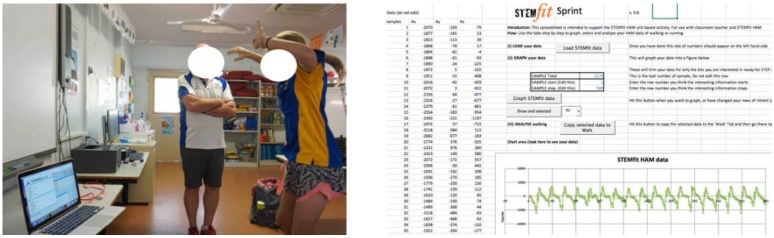
the wider ISEA community. Furthermore, it supports interest in translational outcomes to foster the education of children as a pathway into STEM careers, in particular in Sports Engineering. Figure 1 shows a sample activity, jumping together with associated time series data collection and visual representation of the vertical axis. The analysis can be varied and scaled, depending on student capabilities e.g. early primary school students may count how many jumps they did in 10 seconds.



(a) (b)

STEMfit (a) A lower back sensor mounted physical activity, (b) data output for classroom analysis

In the developed competition and through partner schools of the co-authors, student teams from around the globe competed in a series of physical Olympic style athletic events and by using a range of sports technologies, collected data for a STEM analysis project. Student teams were judged by an international panel comprising of a senior sports engineer, an inertial sensor manufacturer, and an elite sports athlete/administrator. Students made a video presentation of their STEM analysis (in their own language and English) to share with other teams.

References

1. 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.
2. 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
3. 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. Australasian Association for Engineering Education Annual Conference 2020
4. Ohgi, Y. (2002, June). Microcomputer-based acceleration sensor device for sports biomechanics-stroke evaluation by using swimmer's wrist acceleration. In *SENSORS, 2002 IEEE* (Vol. 1, pp. 699-704). IEEE.
5. James, D. A., & Petrone, N. (2016). *Sensors and wearable technologies in Sport: Technologies, trends and approaches for implementation* (pp. 1-49). Berlin, Germany: Springer.
6. James, D. A., Parker, J., Willis, C., & Lee, J. (2020). STEMfit: Student Centric Innovation to Improve STEM Educational Engagement Using Physical Activity, Wearable Technologies and Lean Methodologies. In *Multidisciplinary Digital Publishing Institute Proceedings* (Vol. 49, No. 1, p. 33).

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