Significance of STEM Literacy

An analysis and comparison of STEM literacy strategies in Australia and Finland

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This paper will compare and contrast STEM literacy strategies that are currently being implemented in Australia and Finland. Specific examples and initiatives from each country will be discussed, and their national and global significance will be analyzed.

Strategies to address STEM literacy in Australia

The concept of integrated STEM education in Australia is a relatively recent phenomenon, the acronym having only gained common acceptance in most education communities there during the last ten years (Murphy et al., 2019, p. 123). One of the catalysts for this increased focus on STEM education was the emergence of data showing that Australian students were turning away from STEM majors and performing poorly in STEM-related tests (p. 123). The Australian STEM education movement's seminal publication, the Education Council's "National STEM School Education Strategy", traces the origin of the movement back to a 2008 declaration signed by all Education Ministers (2015, p. 3). While not specifically using the STEM acronym, the declaration acknowledged the need to "support the development of skills in cross disciplinary, critical and creative thinking, problem solving and digital technologies, which are essential in all 21st century occupations" (p. 3). A national integrated STEM education strategy can be seen as a means of developing what we now know as 21st century skills.

Within two years of the Educational Council's strategy being published, the education departments of all six states of Australia had published their own STEM education strategy documents (Murphy et al., 2019, p. 128). With the widespread adoption of integrated STEM education in Australia only happening so recently, one might be tempted to judge the Australian

education community as being slow to act; however, the difference between Australia's implementation timeframe and that of other developed nations is a matter of years, not decades. As Bentley et al. noted, while educators have been discussing the integration of mathematics and science for over 100 years, the widespread use of the acronym STEM and accompanying attempts to integrate all four disciplines only began to emerge in the late 2000s (2022, p. 6).

Although the Australian Education Council's STEM strategy document identifies five "key areas for national action" (2015, p. 6), two specific exemplar strategies for addressing STEM literacy will be described here. The first relates to improving mathematical thinking ability, which is, self-evidently, fundamental to improving STEM literacy. There are two aspects to this; one being the need to improve the minimum mathematical proficiency level among the general population, and the other being how to encourage Australian students back into advanced STEM subjects at the senior high school level. The specific strategy suggested by the Education Council for achieving this is to "increase the recognition of the subject load of advanced STEM subjects" (2015, p. 8). The second specific, exemplar strategy is related to the first, in that it acknowledges the difficulty of attracting not only students into advanced STEM subjects, but also of attracting STEM graduates into the STEM teaching profession. The document suggests working with universities to "improve the pathway for STEM graduates into teaching, for example through financial incentives" (2015, p. 9). Perhaps Australian secondary schools might also consider the *teaching* load of advanced STEM subjects when designing their timetables.

Strategies to address STEM literacy in Finland

The Finnish education system is often cited as an "outlier" in the area of STEM literacy, because their students continue to achieve relatively high scores in standardized science and mathematics tests, despite their adoption of the more progressive educational philosophies of

Western democracies where students are generally seen as struggling with STEM literacy (Technological and Vocational Education Research Center & K-12 Education Administration, 2022). Nevertheless, Finland has experienced a similar emergence of an increased focus on integrated STEM education (and accompanying national level strategies) to the rest of the developed world; for example, their own LUMA (an acronym composed of Finnish words for mathematics and natural sciences) Centre was established in 2013, with similar aims to the Australian Education Council's STEM strategy document described earlier (p. 52).

Finland has also defined what they call "STEM-literacy views" (p. 58), and many aspects of their middle school science curricula are comparable with the Next Generation Science Standards (p. 55). Additionally, secondary education in Finland already has a framework and requirement in place for extended interdisciplinary and transdisciplinary learning to be a part of every student's school experience (p. 80); however, in practice, its authentic implementation still faces many of the same barriers as those present in Australia and discussed by Bentley et al (2022). Ledbetter et al. (2017) credit highly qualified, professional teachers and a collaborative approach to learning as the reason that Finnish teachers and students are able to spend less time in STEM classrooms than their counterparts in other nations where students score well in STEM subjects (for example Singapore), while still achieving comparable results. And yet, Finland still faces similar challenges to Australia and other OECD countries, in that there has been a decline in enrollments in upper secondary and tertiary STEM subjects and majors, and that within this dwindling pool of STEM students and graduates, women continue to be underrepresented (Salmela-Aro, 2020, p. 122).

Analysis of national and global significance

The national significance of the specific strategies mentioned above, such as the Australian Education Council's focus on improving mathematical proficiency, or Finland's LUMA initiative, are fairly obvious – they are direct interventions that should, if implemented effectively, result in improved uptake of STEM subjects, majors and careers throughout a country, and therefore (one would assume) a subsequent improvement in a nation's high-tech industry competitiveness. At their core, though, all these STEM education initiatives and reforms that are trying to gain traction in progressive education systems around the world are effectively working towards educational reforms of greater global significance. In the foreword to the book "Invention Pedagogy – The Finnish Approach to Maker Education", Paulo Blikstein argues that we have known what progressive, student-centered education (of the kind that integrated STEM education has the potential to be, if implemented authentically) looks like for over 100 years now – the issue has been the failure of most educational systems around the world to implement them at scale, resulting in what he calls a "pedagogy divide" (Korhonen et al., 2023, p. xiv). In most countries around the world, we can see examples of a progressive education being delivered (and often in an integrated STEM context), but most of the time it tends to happen in well-resourced private schools that only an elite few are able to access.

Conclusion

STEM literacy has recently become a focal point of Australian educational policy, in an attempt to reverse concerning declines in mathematical proficiency and enrollments in STEM courses seen in recent decades. While the development of STEM education initiatives in Finland is somewhat more advanced, Finland continues to experience some of the same barriers to truly integrated STEM learning and student uptake of STEM careers and majors as other countries.

The Finnish education system, currently a rare example of successful progressive education, might just be a model that *can* be scaled by other public education systems around the world.

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