BUILDING EDUCATOR CAPACITY IN STEM LEARNING: THE ROLE OF PROFESSIONAL LEARNING

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THEME:

Teacher education and professional learning in STEM

SYMPOSIUM OVERVIEW

Many educators struggle to implement effective STEM learning opportunities in their classrooms (Margot & Kettler, 2019). A promising solution is professional learning (PL), which is the largest factor in supporting educator's changed practice and subsequent improved student achievement (Yoon et al., 2007). Unfortunately, many PL programs do not meet standards for high quality effective practice, nor do they focus on STEM (Yoon et al., 2007). The current symposium discusses the potential role of PL in building educator's capacity in STEM, taking into consideration practical, theoretical, and pedagogical factors related to teaching STEM specifically. We begin by identifying that educator's confidence teaching STEM does not improve over time, although growth can be seen in topics that traditionally receive PL (English and mathematics). We then explore elements of PL that may support educators understanding of STEM and its accessibility within their classroom; with the second paper reconceptualising STEM as a practice and the third paper discussing the Experience-Represent-Apply pedagogical model. The ERA model is a heuristic to support educators in providing authentic STEM learning opportunities. Finally, we experimentally assess the effect of high-quality STEM PL on STEM practices and ERA, finding that PL improves educator's confidence, interest, and leadership teaching STEM.

STRUCTURE OF THE SYMPOSIUM

The current symposium comprises four paper abstracts by Emily Ashcroft, Tom Lowrie, Kevin Larkin (and Tom Lowrie), and Ilyse Resnick (and Amanda Levido and Tracy Logan).

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FOUNDATION YEAR EDUCATORS' CONFIDENCE IN STEM EDUCATION AND THE IMPACT OF PROFESSIONAL LEARNING

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THEME

Teacher education and professional learning in STEM

BACKGROUND AND AIMS

The current study is part of a larger project examining how situational and personal factors influence educators' design choices when planning for STEM education in the Foundation year of school. Here I focus on educators' confidence teaching STEM (a personal factor) and its interaction with access to professional learning (a situational factor). Educators' confidence teaching STEM greatly influences their STEM teaching practices (e.g., Aldemir & Kermani, 2017), with educators experiencing low confidence on topics they do not fully understand. Professional learning (PL) is a promising approach to increasing educators' confidence as it provides opportunities for them to develop a stronger knowledge base (Nolan & Molla, 2017). Unfortunately, during their career, educators may only receive PL in certain topics, which may limit their confidence within other areas of their teaching practice. The current study examines educators' confidence teaching STEM and standard non-STEM (e.g., English) subjects and its relation to STEM PL opportunities and length of experience teaching.

METHODOLOGY

The current study used a mixed methods research approach, guided by a sequential explanatory design. A sample of educators from foundation year educators (n=80) completed an online survey about how they currently think about, and design, STEM learning for students in Foundation Year. This survey included Likert scale questions related to their confidence in understanding content and teaching different STEM and non-STEM subjects. An additional sample of educators (n=5) participated in in-depth semi-structured interviews to qualitatively provide a deeper understanding of how situational factors, such as PL, influenced their confidence in understanding content and teaching of STEM and non-STEM subjects.

RESULTS AND CONCLUSIONS

Although foundation year educators' confidence teaching mathematics and English is correlated with how long they have been teaching, their confidence teaching science and technology is not correlated. Case studies showed this is aligned with the PL they typically receive. Most participants had not received any PL in STEM. Two participants reported PL in Science, noting their specific examples included superficial demonstrations that lacked interconnectedness with other STEM concepts or disciplines.

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STEM PRACTICES: A NEW APPROACH TO STEM EDUCATION

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THEME

Teacher education and professional learning in STEM

ELSA BACKGROUND

Early Learning STEM Australia (ELSA) and ELSA (F-2) Programs were commissioned by the Australian Government to support STEM learning in the Preschool to Year 2 school years. The programs required the development of digital activities for children and learning tools for educators and families. A key feature of the ELSA and ELSA F-2 programs is the inclusion of professional learning (PL) to build educator capacity. One aspect of the PL concerns approaching STEM as a practice, rather than an approach focusing on content knowledge. This approach avoids STEM "turf wars" about what is and is not STEM (e.g., STEM(Medicine), STE(Arts)M, or ST(Reading)EAM, STEM+C and STEM+ education), and, as described below, makes STEM more accessible to educators and students alike.

STEM PRACTICES

Our take on STEM is different than the way it is often defined, as our focus is on practices that underpin the activities of STEM Practitioners (e.g., artists, gardeners, musicians, architects, surfboard designers etc.). Building upon the concept of "practice architectures" (Kemmis et al., 2014), we argue that STEM learning occurs best in activities where children are engaged with ideas, methods, and values that support authentic STEM learning. This has the advantage of disrupting the traditional content-based approach to schooling; however, the approach is not content neutral as content identified by national curriculums are addressed as children interact with STEM ideas, methods, and values. Using a STEM practices approach connects children's STEM learning to the real world, through the use of the "sayings", "doings", and "relatings" of STEM practice (Kemmis et al., 2014).

CONCLUSION

We appreciate that a philosophy of moving away from a content base works particularly well in the early years of schooling, where learning is more associated with play-based engagement and intentional teaching, rather than discipline content and curriculum syllabi. However, we contend that our STEM Practices approach has wider application across F-12. Most schools and education systems will continue to be overwhelmed by the challenge of integrating discipline content into a STEM program if subjects within the acronym continue to drive initiatives. PL can support educators in understanding STEM as a practice, and, subsequently, support the provision of authentic STEM experiences within their classrooms.

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THE EXPERIENCE-REPRESENT-APPLY (ERA) HEURISTIC: AUTHENTIC STEM LEARNING IN THE EARLY YEARS

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THEME

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Conceptualisation of ERA

One of the learnings from our early engagement with educators in the Early Learning STEM Australia (ELSA) program was that many of them had not considered the role and nature of STEM engagement within the Early Years Learning Framework (EYLF). To operationalise the links between STEM and the EYLF, we developed the "experience, represent, apply" (ERA) heuristic, which assists educators to incorporate STEM into the authentic activities that they already develop and deliver in their "normal" teaching. Thus, the heuristic works as a bridging device between their non-digital and digital experiences.

The three stages of the heuristic are:

- *Experience*. Children's lived experiences are used as the foundation for concept development through social engagement and language. Children participate in a range of play-based, off-device experiences that provide opportunities for them to use language in ways that connect personal experiences with new understandings.
- *Represent*. Children engage with activities on the device with affordances that represent STEM concepts in different ways. These representations include creating images, interpreting pictures, visualising, and using symbols. Children have opportunities to create their own representations via the microphone and camera tools.
- *Apply*. Children build on their learning from the on-app activities through a range of off-device activities, guided by their educators and families.

ERA as Technology Design

The ERA heuristic is a design principle that was used in constructing both the ELSA program (2016-2020) and the ELSA F-2 (2021-2025) program. The digital design component was undertaken by a team, led by Lowrie, that comprised university academics, digital design experts and early years educators. Early years educators worked as co-designers of activities in the [E] and [A] phases that align to the [R] engagement on tablets. In this way the digital activities that were created "out of house", were explicitly linked to the ERA heuristic, thus ensuring that pedagogical principles drove the design process.

CONCLUSION

The ERA heuristic was a critical factor in the implementation of the ELSA project. Cognisant of the possible hesitation of early educators to include digital devices into their teaching, our program design made explicit the link between digital engagement and more traditional play-based activities. ERA is therefore a conceptual framework that can be used to incorporate STEM in play-based, intentional ways that support children's play and help them represent their learning.

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EFFECTS OF PROFESSIONAL LEARNING ON PRESCHOOL EDUCATORS' CONFIDENCE TEACHING AND LEADERSHIP IN STEM

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THEME

Teacher education and professional learning in STEM

BACKGROUND AND AIMS

Engagement in high quality STEM experiences has been identified as a critical part of F-12 education (Australian Curriculum, Assessment and Reporting Authority, 2014). Unfortunately, many early years educators struggle to incorporate STEM learning opportunities in their classroom, which can be due to limited understanding of, or exposure to, STEM content/pedagogy (Duschl et al., 2007). The current study examines if professional learning (PL) can improve preschool educators' understanding, interest, and confidence in teaching STEM, and if this supports engagement in leadership.

The current study was part of the Early Learning STEM Australia (ELSA) program, an Australia-wide initiative to engage children in STEM. ELSA's theoretical and pedagogical frameworks will be described in other papers in this symposium, however, of relevance here, is that the ELSA PL was designed to build educator capacity in STEM pedagogy with the provision of tools that can be flexibly implemented across different contexts.

METHODOLOGY

A sample of educators from early childhood centres/preschools, who either participated (n = 42) or had not yet participated (n = 46) in ELSA, completed self-report surveys assessing their understanding of, and interest and confidence supporting students in, the content/tools covered (versus not covered) in the ELSA PL. The inclusion of content not taught in the ELSA PL serves as a contrast to assess the effectiveness of the program. Participants were also asked to identify and describe leadership experiences they engaged in, in the two years after their ELSA PL was completed.

RESULTS AND CONCLUSIONS

Educators who completed the ELSA program (compared to those who had not) had a significantly better understanding of the STEM content and pedagogy, and significantly higher rates of interest and confidence engaging children in these topics. This suggests that PL can be an effective route for building educator capacity in teaching STEM. The ELSA educators engaged in significantly more leadership, with many educators crediting the ELSA program, and their subsequent increased knowledge, in supporting them to undertake leadership positions.

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