Working paper number 26 -

https://www.monash.edu/education/research/projects/conceptual-playlab/publications

This is a pre-print of an article published (online) in *Research in Science Educatio*n. The final authenticated version is available online at: https://doi.org/10.1007/s11165-021-10012-y

Fleer, M. (2021). A Cultural-historical Critique of How Engineering Knowledge is Constructed Through Research in Play-based Settings: What Counts as Evidence and What is Invisible? *Research in Science Education*. https://doi.org/10.1007/s11165-021-10012-y

This work was supported by the Australian Research Council [FL180100161].

Valuing and constructing engineering knowledge in early childhood education: What counts and who decides?

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Abstract

It is reported that early childhood education engineering is a new body of knowledge under debate. Many studies show how play-based settings are full of engineering possibilities for young children, with others identifying missed engineering teaching possibilities. This paper answers the question, "What can we learn from a review of how engineering knowledge is being constructed in early childhood education?" A review of how analytical categories are established in studies of play-based settings was undertaken. This is different to previous reviews, because sources for establishing categories of analysis and how knowledge was being subsequently generated, were not the focus. This paper reviews how engineering knowledge is evolving in the research literature by examining the analytal categories of engineering constructs, and seeing how these categories are used to map or promote particular forms of engineering knowledge in preschools. The review is limited to studies of play-based settings. The results show that studies of play-based setting have primarily been guided by practices from only some engineering professions, knowledge construction is based on both pre-defined and emergent categories, research has tended to focus on constructing with things, and that gendered engineering knowledge also identified, only gives partial understandings of early childhood engineering education. The review identified knowledge construction that positively contributes to scholarship, but also identified gaps in what was being studied, thereby contributing to the building of a broader set of analytical categories for future research.

Keywords: early childhood; engineering education; gender; preschool; play

1 INTRODUCTION

Engineering education has emerged in recent times as an area worthy of study in early childhood settings (Brieseno, 2015; Penuel, 2016; Lippard, Lamm, & Riley, 2017). However, as an emergent research field, limited attention has been directed to understanding what this might look like in practice, and what might be learned by such young children. Lippard et al. (2017) note that "Research regarding engineering in early childhood is limited yet growing" (p. 454).

What is known, is that researchers of early childhood engineering education have tended to explore what might be the affordances for learning engineering concepts through examining the resources and structures of free play settings in preschools (Bagiati & Evangelou, 2016; Gold, Elicker, Choi, Anderson, & Brophy, 2015). Areas and resources that feature in early childhood engineering studies tend to centre on the block area (Bagiati & Evangelou, 2016), the outdoor environment and sand play (Bairaktarova et al., 2011), construction kits (Bairaktarova et al., 2011), puzzles (Gold et al., 2015; Bairaktarova et al., 2011), and the imaginary play area of the home corner (Gold, 2014). We know very little about how the other materials available in the preschool could support engineering (Hallström, Elvstrand, & Hellberg, 2015), such as box construction, drawing tables, collage areas etc.

Second, through examining the actions and structures of the play-based setting, researchers have noted how the resources within the free play areas of the preschool setting give possibilities for learning engineering. Researchers have focused on either engineering processes, such as planning and designing, or/and engineering principles, such as structures (Lippard et al., 2018). These studies have all concluded that the play-based environments are full of possibilities for learning about engineering, and children do exhibit engineering behaviours in these particular free play areas within the preschools.

Third, knowledge construction of early childhood engineering appears to be generated through research using predetermined categories. The categories used capture what counts as engineering knowledge and what are the privileged resource affordances. The sources of these categories have either come from standards generated for older children (see English & Moore, 2018) or from papers that have examined the work of engineers and determined what might be the processes and principles that define an engineering profession (Gold, Elicker, Bairaktarova, & Evangelou, 2017). In these latter studies, the results are considered for their suitability for young children and their application in early childhood settings. Some researchers have also drawn upon these emerging categories (e.g., Bairaktarova et al., 2011) and used them in their own studies, refining them based on the context and research question posed (e.g., Gold et al., 2017).

Fourth, despite these naturalistic contexts for observing and analysing existing play structures and children's interactions in these spaces (Hallström et al., 2015), only some study designs engage with, or invite early childhood teachers to plan and implement engineering education (Bagiati, 2011; Brophy & Evangelou, 2007). Inadvertently in some studies, the early childhood teachers appear to be positioned in deficit because they are found to not optimise engineering thinking and activity of young children when interacting with children in these free play areas in the preschool (e.g., Lippard, Lamm, Tank & Choi, 2018). There is a small body of research on early childhood teachers' confidence and competence which studies this explicitly (e.g., Park, Dimitrov, Patterson, & Park, 2016). In many studies, what counts as engineering education is primarily framed in relation to the categories used for analysis by the researchers. We do not yet know enough about how early childhood teachers might foreground engineering concepts in their planning and in their day-to-day interactions with children. These are important gaps that need more research.

Different to previous reviews (Briseno, 2015; Lippard, Lamm, & Riley, 2017; Moore, Tank, & English, 2018; Penuel, 2016), this paper seeks to explore the question of "How is engineering knowledge being constructed, and what counts as valued forms of engineering research for early childhood settings?" To achieve the goal of this paper, we begin by examining in detail the research categories found in the literature, critique the results of those studies, and examine the conclusions made for early childhood engineering education.

2 SYNTHESIS AND CRITIQUE - THE CULTURAL CONSTRUCTION OF ENGINEERING KNOWLEDGE IN PLAY-BASED SETTINGS

This section is organised around a critique of studies that report a universal view of early childhood engineering and the categories or content of early childhood engineering noted as valued forms of knowledge in engineering education. Specific attention is given to how knowledges of early childhood engineering are framed and generated from play-based settings.

2.1 Early childhood engineering knowledge is primarily guided by practices in some engineering professions

Many researchers have been inspired by Bairaktarova et al. (2011) who were interested to examine free play settings in preschools (18 children aged 3-5 years from two classrooms) in order to see if the children exhibited early engineering behaviours of engineers. They argued that this kind of study had not been done, and categories of early childhood engineering did not yet exist. This important work created "a list of possible behaviors that describe the engineering field based on expert judgement and relevant literature, and then created a list of possible behaviours that are typical in all early childhood classrooms" (p. 219). The engineering-related behaviours that were identified by Bairaktarova et al. (2011) featured asking questions/stating goals, explaining how things work/built, construction/making things, problem solving, and evaluating design.

This early research sought to study free play settings (open or sensorial materials, semi-structured or step-by-step materials, and structured or closed materials), where children were filmed for 2 hours per day for 4 months and commonalities in behaviours were noted. In examining the video data, Bairaktarova et al. (2011) noted that "Each activity was analysed for instances [that] appear on the list of predefined engineering-related behaviors" (p. 220). It was found that when children used open-ended materials (sand play) they predominantly engaged in exploratory play. When the children were using structured or closed materials (puzzles and snap circuits) they asked three times as many questions than when using open-ended materials. It was concluded that children's engagement with artefacts constitutes engineering behaviour and supports them to engage with engineering ideas.

In closely examining what constituted the free play settings by Bairaktarova et al. (2011), some anomalies need to be taken into consideration when judging the finding of this fundamental research into early childhood engineering education. First, it appears that the snap circuits that were categorised as closed activities, might afford the ability to make creations, whilst the puzzles could only be completed in one way. Yet both were defined as closed activities. How or why these two very different activities were categories together was not explained. Knowing this could support future researchers when organising observational sites. Further, other resources in the environment, such as drawing materials, could have been used in relation to designing and planning from a range of perspectives, if a need arose or a social problem was posed which required these skills. If the analysis centres on affordances, then what might be possible could have been included in the discussion. The work of Tu (2006) in science affordances explains actual observations of resources in centres, but also includes what might also be possible. Finally, it is well known in early childhood practice that free play areas are not constant, they change, and the playful activities in each deepen over time, particularly when complex problems are introduced by teachers or peers. It is therefore surprising that Bairaktarova et al. (2011) did not identify changes over the 4 months of data gathering. Deeper insights into the affordances may have resulted if what the educators observed and planned for in each of the free play areas were included in the study of Bairaktarova et al. (2011). For instance, introducing a new set up in the home corner of a house renovation, or organising different construction materials to be available to the children over time, or how box construction could be combined (or not) with the block play of the children (see also Brophy & Evangelou, 2007; Hallström et al., 2015), could give a different reading of the discrete observations made of open and closed activities. The latter are all common planned practices for maturing the play activity of children in the free play areas. Yet the influential research of Bairaktarova et al. (2011) has not in its current design caught a holistic and dynamic conception of preschool practice. Including educators' perspectives through interviews of possibilities of what they introduce at different moments in their planning has been undertaken in early childhood science education research through a technique called a *science walk*, where educators are filmed discussing the affordances of the resources and how they expand the constant learning areas at different times in their program (e.g., Fleer, March, & Gomes, 2014). Including teacher perspectives could expand understandings of engineering affordances in ways not expected by researchers. Nevertheless, the study of Bairaktarova et al. (2011) has been influential in setting important research directions in early childhood engineering.

In keeping with the same study sample and video data gathering as Bairaktarova et al. (2011), Bagiati and Evangelou (2016) narrowed their analysis to block building. Bairaktarova et al. (2011) did not analyse the block area. Different to Bairaktarova et al. (2011), Bagiati and Evangelou (2016) developed a cyclical design process model of initial goal, think/problem solve, (re)search, create (and improve), test, and consult. Additionally, Bagiati and Evangelou (2016) nuanced this model to include a synthesis based on multiple constructor interactions, and patterns repetition. The former begins to introduce more complexity to the playfulness of children, who usually play with other play partners when in free play areas of the preschool. But how this model was developed is in keeping with previous researchers, who drew upon the professional knowledge of the engineering profession, as noted by Bagiati and Evangelou (2016). They said their model was based on "professional experience of the first author as practicing engineer, as well as a thorough review of a series of design cycles representations available in current literature" (p. 74). This "model was then used as the basis on which children's engineering related behaviors were mapped" (p. 74). Importantly, Bagiati and Evangelou (2016) found that the children were able to exhibit engineering behaviours when block building. They concluded that, "Based on this analysis we confidently suggest that the innate behaviours we observed are precursors to engineering thinking emerging out of children's free block play" (p. 83).

The findings of Bagiati and Evangelou (2016) should be considered in the context of who used the block area. As will be discussed more further below, the longstanding research (Browne, 1991) and more recent research (Hallström et al., 2015) have collectively shown that it is boys who mostly use the block area. Is it possible that the conclusion of Bagiati and Evangelou (2016) in relation to "innate behaviours" (p. 83) should be directed to a particular form of gendering in the preschool within the block area? It is difficult to determine from their research the answer to this question, because the gender of the children was not a focus of their study.

The categories derived from earlier work of Bairaktarova et al. (2011) were also used by Gold (2017) as the basis of his study of engineering play. Gold (2017) said, "The first objective was to evaluate the validity of the engineering play observational measure for documenting the occurrence of children's engineering behaviors in educational play contexts, such as block play" (p.2). The categories used by Gold et al. (2017) were: communicates goals (verbal), construction (action), problem solving (verbal), creative/innovative action (action), solution testing/evaluating design (action or verbal), explaining how something is built or works (verbal), following patters or prototypes (verbal or action), logical or mathematical words (verbal), and technical words (verbal).

Engineering play was conceptualised by Gold (2017) as a way of capturing and analysing observations of children's play. He said that an engineering design process parallels "the way engineers think and work when they design, structure, and develop solutions to human problems" (p.1). Therefore, play is viewed as synonymous with the engineering practices of the profession. It is important to identify who is deciding what forms of knowledge matter the most for this early childhood period.

As a first step, but with the exception of Brophy and Evangelou (2007), the professional knowledge of the profession appears to underpin the foundational studies on engineering curriculum for preschools. Related, but with some important differences, has been a comprehensive study of engineering curriculum designed by Bagiati (2011), who designed and implemented a very detailed step by step program of engineering education. He invited a preschool teacher to implement the program and to periodically comment on the program. The primary assumptions were: "An early engineering curriculum must fulfil two primary criteria: 1) it must have content validity by being true to the engineering discipline, and 2) it must have pedagogical fidelity by being developmentally and culturally appropriate" (p. 17).

Unlike previous studies, Bagiati (2011) sought to only use four predetermined categories (design, artifacts, buildings and early engineering projects), with the rest being generated through "multiple readings of the raw data" (p. 78). Also unlike previous research, Bagiati (2011) also gathered and analysed teacher documentation, undertook teacher and parent interviews, and asked teachers to keep journals as they implemented the 24 lessons week program of engineering over three months. The study primarily centered on four focus children and their families, all boys, and primarily one teacher. The cohort who experienced the program were 11 children (10 boys and one girl) aged 3-5 years. The findings reported identified that all four boys exhibited engineering learning and it was concluded that the design based engineering education (gather information, sketch, model, test, consult, construct and present final product) developed by the researcher could be deemed developmentally appropriate for young children aged three years and older (artifacts and buildings).

Greater insights into the context of the preschool education and the knowledge and challenges to implementing engineering education by the teacher were included in the study, giving a more holistic conception of early engineering than previous studies in this area. However, focusing only on boys with potentially different experiences (Browne, 1991) could suggest that the program implemented may only support boys. Without a study of girls experience and participation in the program of engineering with its focus on gathering information, sketching, modelling, testing, consulting, constructing and presenting final product, it is difficult to have confidence in the results for all children.

In conclusion, the early and foundational engineering knowledge appears to have been primarily constructed from what researchers have perceived to be core content of the engineering profession. This is an important first step in generating engineering knowledge about early childhood engineering education for play-based settings. In developing knowledge construction in early childhood engineering further, it can be asked, what forms of knowledge are being validated as early childhood engineering, and how might this shape what becomes visible in the data gathered and conclusions reached?

2.2 Knowledge construction is based on both pre-defined and emergent categories

In examining the literature discussed in the previous section, and other studies which focus on knowledge generation of engineering for young children, the forms of engineering knowledge that appear in the literature for studies of play-based settings can be loosely summarised at pre-defined and emergent categories, as shown in Table 1.

Table 1

Categories of knowledge identified by engineering researchers studying play-based settings

Study	**Context**	**Pre-defined categories**

Brophy and Evangelou, (2007)	Blocks	creative problem solving, the balancing of multiple constraints to achieve an appropriate solution.
Bagiati (2011)	24 lessons – building a city using puppets	design, artifacts, buildings and early engineering projects: knowledge, skills, dispositions and feelings.
Bagiati and Evangelou (2016)	Blocks	cyclical design process model of initial goal, think/problem solve, (re)search, create (and improve), test, and consult.
Bairaktarova et al. (2011)	Tangible, open (sensory – sand and water), semi-structured (paint, drawing) and structured materials (puzzles, games/snap circuits).	asking questions/stating goals, explaining how things work/built, construction/making things, problem solving, and evaluating design.
Gold (2017), Gold et al. (2017)	Blocks	communicates goals, construction, problem solving, creative/innovative action, solution testing/evaluating design, explaining how something is built or works, following patterns or prototypes, logical or mathematical words and technical words.
Lippard, Lamm, Tank and Choi (2018)	Across the preschool. Categories were identified in: Art, blocks, sensory, manipulatives and dramatic play area	engineering habits of mind: systems thinking, creativity, optimism, collaboration, communication and ethical considerations.
Hallström et al. (2015)	Construction materials - kits (e.g., Lego),	

The categories that appear to be valued as forms of knowledge of engineering are primarily pre-determined categories. The pre-determined categories were shown in the previous section to closely mirror the engineering profession, and according to the researchers these generic process models could be easily applied to play-based settings. The processes of engineering, such as a cyclical model of practice (Bagiati and Evangelou, 2016), featured in all of the predetermined categories. However, there were also some categories that related to ethics, creativity and communication, such as communicates goals (Gold, 2017; Gold et al., 2017). The latter were described by Lippard, Lamm, Tank and Choi (2018) as engineering habits of the mind and that these were found in play-based settings, and described as precursors for engineering thinking.

2.3 Engineering knowledge types emerge from the study of free play settings

The categories that have emerged from naturalistic studies of engineering affordances of the existing preschool resources used during free-play time include three very different types of knowledges. The first is knowledge that mirrors closely the processes of engineering, such as gathering information, sketching, modelling, testing, consulting, constructing and presenting final products (Bagiati, 2011). The other knowledge form aligns with the practices of the preschool, such as, construction play, purpose of construction, gender differences, self-confidence and teachers' activity (Hallström et al., 2015). The third knowledge form centres on engineering thinking, such as visual representation of an imaginary world and engineering concepts, like material properties and the laws of physics, and the related understanding of structural integrity of their creations (Brophy & Evangelou, 2007).

Although limited in number, the studies which go beyond the categories from the engineering profession appear to include a broader set of identifiers, and this means that subsequent researchers have the possibility to look for more types of engineering behaviours and evidence of engineering thinking. This is particularly evident in the research of Brophy and Evangelou (2007) who investigated the relationship between free play activity and engineering thinking of just four children but important, they found, "The ability to construct beyond a simple visual representation of an imaginary world to an actual structure is an important step toward developing engineering thinking" (p. 9).They ask,

> We want to better understand why children want to construct with blocks, what they construct and how do they use them when they are done. … we are interested in understanding the process associated with how learners construct with blocks. We believe the process, not just the end product, can inform our understanding (p.2).

This suggests how important it is to study naturalistic settings for not just their affordances of engineering as pre-defined categories from the engineering professions, but to examine what other thinking and behaviours emerge during construction play in preschool settings.

2.4 Engineering knowledge is primarily based on research into constructing with things

The studies of early childhood engineering in play-based settings appear to be primarily associated with blocks, construction kits, loose objects in the outdoor area (usually large light weight blocks) and the sand box (see Table 1). Only a few have studied beyond building materials. For instance, in the study by Hallström et al. (2015) of 165 children aged 1 to 6 years from 2 Swedish preschools they digital observed children in mixed aged groups engaged in construction technology (e.g., Lego, blocks, wooden railways indoors, and ropes, cans and pipes outdoors) during free play time. But also, they looked at use of technology and what might be loosely considered by previous researchers as engineering, such use of pipes, sticks and stones in the sandbox and elsewhere, the construction of roads and "transport of different kinds" of materials on the road (p. 142). Teachers put out different boxes, such as tools for a barber and another with small cars. Grounded theory was used where

> at the beginning of the study was how technology was manifested in free play in the preschools, but gradually we came to zoom in on how children explore technology as well as the role for the teachers in this. In the analysis of data the field notes were coded and, after repeated readings, the codes were finally clustered into … categories crystallised such as construction play, purpose of construction, gender differences, self-confidence and teachers' activity. (p. 141).

Only one study looked closely at how children engaged in an extended engineering unit that was designed by the researcher and implemented by teachers (Bagiati, 2011). Although the analytical frame used pre-determined categories, the curriculum itself was expansive, and included puppets and social problems that preschool children solved. But mostly, the engineering research is focused on everyday affordances of the existing materials in the play-areas of the preschool.

There were some studies that looked at the dramatic play area which included drawing materials, but did so primarily to study what kinds of engineering language might be afforded. Some studies looked at the sandbox (Bairaktarova et al., 2011), jigsaw puzzles, and water trolley activities to determine the affordances of engineering in closed- and open-ended problem-solving situations. But studies that included these objects or free play areas were not common. With the exception of Hallström et al. (2015) and Brophy and Evangelou (2007), researchers tended to study block building indoors and outdoors and looked closely at how children constructed when using construction or technology kits.

It can be concluded that most studies to date on engineering in play-based settings has tended to study behaviours associated with construction objects, leaving open the question of engineering affordances associated with the other areas of the preschool where children play, such as dolls' houses, theatre play, drawing tables, outdoor sandpits and digging patches, gardens, dress-up areas, home corner, and specially created spaces by educators, such as shops, hospital settings, camping, and digital communications spaces.

2.5 Gendered engineering knowledge only gives us partial understandings

Interestingly, the areas of the preschool that have been studied to date (Table 1) have traditionally been play areas of play dominated by boys rather than girls. There is also evidence from the longstanding research of Beat (1991) that

> There was a general tendency for boys to gravitate towards the construction activities, once there, to stay for almost the entire session excluding any girls who made attempts to join the group. (p. 78)

Beat (1991) found that

> …boys tended to make models that moved and were part of an imaginative scene they had created… Girls tended to make non-moving models such as houses or gardens and while making them they were usually talking about something quite different. (p. 79).

This was also noted by Hallström et al. (2015), "Construction can be seen as the play itself; the boys are focused upon making the construction as solid as possible, which is why they during the play they negotiate about the best building methods" (p. 143). Girls also negotiate and problem solve during design and construction play, but their play is different. They "construct with another end in mind –the play" (p. 143). Consequently, "The masculine concern with things fits more easily with the dominant form of physical science than the feminine concern with people" (Kelly, 1987, p. 73). Rather than assuming these as innate behaviours in STEM, perhaps these claims can be better understood in the context of research into access to STEM resources.

Hallström et al. (2015) argue that early engineering experiences can lead to different ways of playing. They found that Swedish children approach and handle technology differently. When given access, girls tend to build for a social purpose. That is, they build structures to support their imaginary play. In contrast, boys tend to use blocks for the purpose of constructing. That is, their focus is on the process of building. Hallström et al. (2015) research found that "The gender differences in children's play are much more pronounced among the oldest children in the data, that is, the 5-6 year olds" (p. 142). Furthermore, Lyttleton-Smith (2015) when examining the play activities of children noted that the focus boys she studied,

> did not engage in the traditional home corner activities of food preparation and dress-up when they entered the space, but instead performed the stereotypically

masculinised activities of violent video-gaming using the same resources, making them unavailable for the feminised narratives of home-making that the girls tended to engage in through the home corner space. (p. 242)

3. DISCUSSION

The central focus of the paper was on what might an epistemological study of the evolving nature of early childhood engineering education reveal. This review identified categories and content of early childhood engineering noted in the literature as valued forms of knowledge for engineering education for play-based settings. The epistemological journey showed: 1) *Early childhood engineering knowledge is primarily guided by practices in some engineering professions;* 2) *Knowledge construction is based on both pre-defined and emergent categories*' *3) Engineering knowledge types emerge from the study of free play settings;* 4) *Engineering knowledge is primarily based on research into constructing with things*; and 5) *Gendered engineering knowledge only gives us partial understandings.* These five key areas identified, when taken together, give new insights and directions for moving research forward for early childhood engineering education.

First, what these studies show is a skewing of research towards free play areas that have traditionally been dominated by boys, suggesting that engineering knowledge construction that is being noticed, measured and validated may privilege areas that have been the exclusion zones for girls. Could the areas being studied be biased towards boys' experiences and therefore expected engineering behaviours already demonstrated within the engineering profession, where 88% of the profession are males (Little & de La Barra, 2009; Australian Academy of Science, 2019)? Consequently, more research into girls and boys' experiences of engineering within a broader range of free play areas is needed.

Second, the universals that emerge are not necessarily universals at all, but rather represent categorise of engineering primarily valued within the engineering profession. The categories that have generally been used in research have come mostly from early and emergent studies, that have been adapted in subsequent research. The pre-determined categories have centered on particular play areas with particular materials, much of which has been skewed to particular types of engineering.

Third, only some researchers have broadened the net to include other areas of the preschool in their study of engineering affordances, such as drawing in the home corner, or included early childhood teachers' perspective when researching the implementation of programs designed by engineering educators. "The institutional conditions in the preschools in terms of how space and time are organised are important factors" (Hallström et al., 2015, p. 142). Many of the studies appear to miss important understandings about the professional knowledge of the teachers who design the educational programs for the children in what is not a static setting. For instance, Hallström et al. (2015) identified how boxes introduced into the traditional play and learning areas both inside and outside were important because they could "Inspire children to a different kind of play" (p. 142). This means that we know less about the rationale for the longstanding tradition of the play and learning areas in the preschools and how teachers develop concepts of engineering within these over time, and in different ways.

The resources and the play and learning areas do feature engineering, but these affordances are already well known to educators – but perhaps not named as engineering. Since the times of Froebel, kindergartens have been organised to actively support a broad range of play and learning and educators are well versed in how to expand learning opportunities in these areas. There is a sophisticated body of longstanding literature on the design of blocks and their learning affordances which are conceptually (e.g., balance, force, structure, shape, etc.) defined, rather than defined in relation to the engineering profession. It is beyond the scope of this paper to bring these into focus here. The point is that early childhood educators have deep knowledge of the conceptual basis of blocks, construction kits, outdoor equipment, etc., but asking educators about their knowledge has not yet been the focus of previous research into early childhood engineering education. Interviews with teachers about their knowledge of structures for instance, might reveal more sophisticated affordances for the block area, the inclusion of a variety of loose parts and other construction kits designed for preschool children, but also for the reason for why there are box construction area, collage tables, ever changing dramatic play areas (including house renovations), use of pipes and water in the sandpit etc. Is it possible that valuable engineering knowledge in early childhood education might just be about the 'naming' in the research of 'engineering' and teachers understanding about what might be involved in "engineering education", than it is about missed opportunities of teachers to teach engineering principles. We know from interviews of children in primary schools that when asked to draw an engineering that they explain engineering to be associated with engines or fixing things. A deep knowledge of the engineering profession appears to not be well known in the community, and therefore it is not surprising that teachers may not respond directly to conceptions of what the profession does and therefore what might be engineering education.

4. CONCLUSION

The engineering lens on the play and learning areas of the preschool have given valuable insights into the affordances. However, not only do we need more research into this increasingly important area, but we need studies which look at knowledge construction of early childhood engineering that goes beyond things, to the broader areas of the preschool to examine engineering across a broader set of engineering professions and a more inclusive set of categories so that genuine knowledge construction in early childhood engineering can result.

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