Valuing young children and promoting participation in early STEM education: Introduction

MARIA KAMPEZA

Department of Educational Sciences
and Early Childhood Education
University of Patras
Greece
kampeza@upatras.gr

Researchers have sought to discover, from various perspectives, how children learn, and how learners' development can be enhanced. Recent research in early childhood education has adopted a sociocultural theoretical framing in order to understand children's development. Theories describing child development as occurring in linear and universal age-related stages have been challenged by sociocultural perspectives drawing particularly on Vygotsky's theories, according to which children are considered, from an early age, as agents of their own learning and as active meaning-makers (Robbins, 2005). Learning in Early Childhood Education can take many forms, such as visual, audible, tangible (e.g. drawing, sociodramatic play, storytelling, model-making). Furthermore, learning is understood as a joint participation in meaningful everyday activities, in which meaning is actively co-constructed by the direct involvement of children through the mediation of cultural tools (Rogoff, 2003). In other words, children are learning within cultural contexts and their learning is influenced by their interests and is sustained by social engagement.

Participation is the process of becoming actively involved, becoming a member of a community, and implies a sharing of power. Hedges and Cullen (2012) have proposed participatory learning theories (PLTs) as a contemporary conceptual framework for early childhood education. In these teaching, learning and playing are connected, emphasizing the importance of teaching and learning relationships. "In the early childhood context, participation is more active than mere presence, which in itself may not engender learning without attention to relationships, content, change, context and cultures" (Hedges & Cullen, 2012, p. 926). Within this educational framework, children's participation is related to processes whereby children can think, talk and feel confident in expressing their views, interact and feel encouraged to make decisions about issues

that are important, meaningful and relevant to them. Therefore, we could consider participation as both a means that enables learning, and as a process which leads to learning for both children and adults.

Acknowledging this perspective, causes a redrawing of the boundaries between adults' and children's roles in the research process, as there is a methodological shift in researching *with* young children rather than *on* young children (Clark, 2010). Prioritizing a view of the child as an active participant in the research process, may give research a new, richer meaning, as it is enhanced with the unique insights a child can offer about his/her life, the viewing of the world around him/her, issues that may attract his/her curiosity and interest; hence, revealing his/her competency. This led to an alteration of the position of children in the research process, since they could now be viewed as 'experts' in their lives and as knowledgeable social actors (Clark & Moss, 2001; Corsaro, 2005). Also, children could be seen as 'co-researchers', who require ways of communication and exploration of their perspectives, participating thus – in the case of a research – in the data collection phase, plus the processing and capitalization of results. Educational research can integrate participatory processes using appropriate tools. "Observation, participation, language, dialogue and co-construction of learning are common features of PLTs. Through the mediation of people and cultural tools in settings that promote learning, such as learning communities and other social systems, individuals inquire into and make sense of new concepts" (Hedges & Cullen, 2012, p. 930). The adoption of participatory methods in early childhood research provides children with the opportunity to take an active role in the construction of meanings and knowledge, making their own perspective more visible, and this perspective can lead a researcher to redefine his/hers own perspective, in order to include these of children. "Researching with children, using participatory methods does not mean that adult researchers are abandoning their research roles, but the nature of their roles will change with new opportunities for the co-construction of meanings" (Clark, 2010, p. 120). Therefore, children are allowed to take the responsibility to contribute to their own development and learning.

Science, technology, engineering, and mathematics (STEM) learning have gained a prominent role as a key lever in the progress toward high quality education for all students. Research on learning and participation has influenced STEM as it redefined the context wherein children can express their knowledge, experience and interests. "If an outcome of STEM education is enhanced scientific literacy, and scientific literacy is a formal goal of education as early as kindergarten, then providing opportunities for PreK students to participate in STEM activities seems a worthy endeavour" (Tippett & Milford, 2017, p. 68). Effective practices for STEM are closely related to effective practices for education in general, e.g. exploring and observing, developing skills and processes, communicating, and playing – creating thus a rich learning environment that is accessible to all children in the classroom.

This Special Issue offers six papers deriving from a range of contexts from within early childhood education, and aims at contributing to the discussion about the concept of participation. It aspires at shedding some light on participation and its relation to the concept of children's competency, and on participation in early STEM education. More specifically, Alison Clark and Rosie Flewitt discuss the concept of 'competency' and 'the competent child' in relation to young children, particularly those who may be considered 'less competent' than others, whether through disability, ethnicity or socio-economic background. In addition, they present brief accounts of findings from two UK-based early childhood research studies which were both founded on the principle that all young children are knowledgeable commentators on their own lives. The first example is taken from a small-scale study exploring the learning experiences of four-year-old children with special educational needs who attended both 'special' and 'mainstream' early education settings. The second example draws on a longitudinal study with young children, aged from three to eight, in the re-designing of their early childhood education environment. In an attempt to develop a deeper understanding of how participation and pedagogy can embrace young children as knowledgeable communicators on their own lives the authors adopt a socio-material perspective highlighting the relationship between competency, participation and pedagogy.

Elizabeth Carruthers presents a research which focuses on the pedagogy of mathematical pretend play within a socio-cultural perspective. She points out that although it has been identified that children, if given the opportunity, use pretend play as a vehicle for rich mathematical learning, it is not common to observe it, or see teachers supporting pretend play, in early years settings. Data collected from two nursery schoolteachers, in English Nursery Schools, revealed the unconventional teaching these teachers engaged in, so as to enhance children's mathematical thinking in play, offering us an understanding of pretend play pedagogies, and of the conditions that might support children's own mathematical thinking, especially in early years classroom.

Maria's Papandreou and Zoe's Konstantinidou study puts participatory pedagogies into practice, in order to promote early mathematical learning, and seeks to delve into children's emerging mathematising and the teacher's role, when the latter attentively follows children's initiatives. Presenting selected critical incidents that evolved as the children of a kindergarten classroom engage with the investigation of linear measuring tools, she demonstrates how children, through a series of ongoing mathematising processes, elaborated and gradually developed key measurement concepts. Additionally, she highlights the teacher's role in supporting children's emerging mathematising, using five lines of action.

Another paper in this special issue addresses the value of communicating ideas and highlights the importance of freedom children should enjoy in order to cultivate rich repertoires of graphical signs across all their 'literacies', as they begin to employ standard

mathematical symbols. Maulfry Worthington in this evidence-based position paper explores the extent to which children's graphical sign lexicons support their emergent understandings, as they move from intuitive marks and informal signs to formal symbols. These inscriptions, including those that are drawn, written and mathematical, are shown to have significant implications for the study of young children's understanding of the abstract symbolic language of mathematics.

As the articles of this Special Issue attest, children have rich ideas to share as long as researchers and educators value and facilitate their contribution in meaning making. Josephine Convertini directly addresses problem solving tasks within the field of STEM, and more specifically explores the issues discussed by preschool children during engineering activities. She focuses on the issues which participants discuss during three building problem solving instances, presented to young children at a kindergarten classroom. Examining three illustrative cases, she highlights the variety of issues explored by children involved in solving problems related to building tasks, from an argumentative perspective; thus she foregrounds the issues occurring in each argumentative episode, the standpoints, the arguments, and the argumentative structure.

Finally, Maria Kampeza and Alice Delserieys focus on young children's drawing activity in the context of science education research. Adopting a qualitative research methodology, they analysed two sets of drawings collected from different classes in Greece and Singapore during a common teaching intervention, designed to foster children's understanding of the change of state of matter. In their paper they present their findings concerning children's visual representations of melted objects and the process of melting, discussing the categories which were found and their educational implications for the teachers.

I am delighted to share with the reader the research contributions of established academics who have been working with young children using participatory research methods and who kindly accepted my invitation to participate and help us understand more deeply the relationship between participation and learning in different contexts and learning areas. I would also like to thank the editor of the "Review of Science, Mathematics and ICT Education", Prof. Konstantinos Ravanis, for granting us the opportunity to make this Special Issue on "Valuing young children and promoting participation in early STEM education".

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