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Author(s)	Norman Kiak Nam Kee
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Numeracy Literacy Challenges of Children with Special Needs in the Twenty First Century

Norman Kiak Nam KEE, M.Ed, M.Tech
Early Childhood & Special Needs Education
National Institute of Education
Nanyang Technological University, Singapore

Abstract

Parents of children with special needs generally turn to professionals with specialized knowledge to help their children's developmental needs, believing that professionals alone hold the key to make a difference. Unknown to most parents, numeracy literacy initial development is through prolonged and persistent exposure to sounds, adult modeling of the usage of the sounds and encouragement to participate in making the sounds in multiple social situations. Parents will need to actively provide multiple and repeated opportunities of diverse contexts for the gradual development of language used in numeracy as well as opportunities through trial and error in association of sounds to objects and concepts, where multiple cycles of experimentation, validation and verification lead to the development of number sense.

Keywords: cognitive modifiability, literacy, mediated learning experience, number sense, numeracy

Introduction

In the twenty first century, parents of children with special needs are faced with a buffet of diverse intervention approaches (Goin-Kochel, Mackintosh & Myers, 2009) and professionals with diverse skills that may help their children with special needs (Brookman-Frazee, 2004). Depending on the choice of educational and developmental philosophy adopted or choices available within affordability, many parents are observed to invest and rely on the professionals to help their child "catch up" with the missing developmental milestones. Moreover, the mass media and electronic games appear to have dominated the attention of most children during their development years in metropolitan cities (Lieberman, Bates & Jiyeon, 2009).

However the development of numeral literacy or number sense for all children, with or without special needs, will require human mediated learning experiences over prolonged and repeated exposure in diverse social contexts for social cultural and social cognitive constructivism of the meanings of signified and signifier in the semiotic domain of the lived in culture of the children (Chandler, 2002). Essentially, experience and education (Clements & Sarama, 2009) for enculturation and appreciation of constructs of society needs takes time. Children with special needs, especially those with behavioral or intellectual challenges, are often not provided with the

opportunity to be exposed and to experience the social cultural learning needed for the gradual development of literacy for integration into school and society. This is based on the assumption that family characteristic and child characteristic stressors often lead to poorer patterns of interaction and thus poorer child development (Guralnick, 2005).

Generic Development of Number Sense

All children follow natural developmental progressions in learning and development (e.g. crawl, walk, run, skip and jump) in their own way and this includes the development of number sense. Clements and Sarama (2009), curriculum researchers in mathematics, have revealed sequences of activities and developmental paths, described as learning trajectories that are validated through their own research and others, for effective guidance of students to develop number sense for primary grade mathematics.

Essentially, young children love to think mathematically (Clements & Sarama, 2009). The motivation could be due to the need to describe the quantity of food desired, such as cookies or sweets, or to describe the dimensions of clothes and even volume of water they desire to drink. Good education allows play and exploration of the world, where mathematics is experienced and learnt informally, with fun and meaningfulness (Jonassen & Land, 2000). For example, learning of counting can initially proceed by "sing-song" of numbers one to ten, such as shown in "Sesame Street" programme on television. Verbal chants initially may have no meaning for the child but only as fun singing activity (Clements & Sarama, 2009). This does not matter initially as the goal is to allow the child to develop familiarity and ability to articulate the sounds of numbers. Persistent and repeated use of number songs for counting physical objects such as number of cookies for tea break, number of clothes being folded, number of stationery items and numerous other everyday situations, where counting is needed, will allow the child to gradually think of counting as a meaningful way to quantify number of objects observed or desired.

Generally, people learn meaning of words by association through "hearing those noises as they accompany actual situations in life" (Hayakawa & Hayakawa, 1990, p. 36). The natural development of the understanding of counting by the child requires multiple and repeated experiences where human modeling, patience and persistence are critical for enculturation and for imbibing the conventions used by society. Parents or caregivers are expected to fulfill this critical role of inculcating the social learning of language as well as mathematical concepts and to think of their children as apprentices. The child is expected to observe, follow and develop the expertise of the "master craftsman" of society by fulfilling the roles and duties of a responsible and independent citizen.

However, most working parents, especially those in metropolitan cities and those with behaviorally challenging children, may not be spending enough quality time or providing enough needed experiences for trial and error learning for their children to enable their development of number sense.

Three Kinds of Knowledge (Kamii, 2000)

Kamii (2000) expounded that there are three kinds of knowledge children need for the acquisition of number concepts. Physical knowledge refers to knowledge of objects in external reality where their attributes (e.g. colour, weight, dimensions, shape, texture, sounds) are experienced with fidelity as well as through social knowledge of others describing them. Children in the twenty first century are getting more and more engaged in the digital media (Lieberman et al., 2009), resulting in increasingly lesser and lesser exposure to physical knowledge of our environment. This is based on the assumption of conservation of time, where spending more time in one area reduces time spent in other areas. Exposure to graduated experiences of the various physical attributes allows the development and fine-tuning of appreciation for description and manipulation in number sense. For example, appreciating the difference in weight between one kilogram and ten kilograms will allow the child to assess sensibly what is manageable to carry for a backpack trip, which is appreciating number sense in terms of weight.

Social knowledge and appreciation of language are socially constructed through multiple interactions with constructive feedback on expected and appropriate use in conventions by people of the community (Kamii, 2000). The ultimate source for social construction is partly through people and partly through constructive abstraction. Constructive abstraction refers to personal understanding and construction of mental relationships between concepts (e.g. good versus bad) and between objects (different or similar). Children with special needs generally lack critical interactions of socialization with peers through play. They also lack transactional interactions with people in the community through communal activities like buying food from supermarkets or restaurants. Thus, the opportunities for testing of perceived schemes of social knowledge during social interaction, where matching allows equilibrium and mismatch motivates adaptation and development so as to work towards equilibrium, are grossly lacking. "We actively create the meanings according to a complex interplay of codes or conventions of which we are normally unaware" (Chandler, 2002, p. 11) and equilibrium is a cognitive state in which we can explain new experiences by using existing understanding (Berk, 2010).

Logico-mathematical knowledge consists of mental relationships and these relationships have to be made by each individual (Kamii, 2000). For example, two beads which are exactly the same except for colour (one-green, one-red), will be perceived differently depending on how the person puts the objects into a relationship. Should shape and size be considered as the criteria, then there is no difference between the beads. However, if colour is to be the criterion, then the two beads are certainly different. The similarity and differences exist neither in the red bead nor in the green bead but in the empirical abstraction of the person making the comparison. Empirical abstraction involves focusing on a certain property of the object and ignoring the others. For example, when we abstract the colour of an object, we simply ignore the other properties such as weight and the material of the object. Constructive abstraction on the other hand "involves making mental relationships between and among objects, such as 'the same', 'similar', 'different,' and 'two' "(Kamii, 2000, p. 9), through the facilitation of the mediator of the knowledge when the attributes of the objects being focused on are highlighted.

Mediated Learning Experience (MLE)

The interactive digital media of computers generally lack the abilities of humans to dynamically assess and intelligently adapt the communication and knowledge needed to address and match the needs of the other communicator. For example, the non-verbal communication language (e.g. frowns, scratching of the head, bewildered eyes, impatience, boredom) will either not be perceived or will not be perceived with as much fidelity as a face to face perceptive human mediator. The efforts to date in science and technology are working towards good approximation of real humans in terms of communication and human behaviour. Perhaps, it could be that humans are generally unpredictable in many ways, especially in terms of reactive behaviour to unexpected circumstances. Perhaps this may be appreciated through the knowledge that there is no existing system in the world that can accurately predict how the stock market will move in terms of profitability in response to world circumstances. Learning to be a fully functioning human will require another human who is fully functioning to provide guidance and mentorship. Learning of number sense as envisaged and experienced by humans will require another perceptive human mediator to provide quality mediated learning experience (Feuerstein, 1991) to effect the learning. Feuerstein et al..(1980) consider a mediated learning experience as the way in which stimuli emitted by the environment are transformed by a "mediating agent", usually a parent, sibling, or other caregiver, in such a way that the child is able to perceive the stimuli in the way the mediator intended. The mediator selects stimuli that are most appropriate and then frames, filters and schedules for effectiveness and impact of intended meaning. There are three critical parameters for effective MLE.

Mediation of Intentionality and Reciprocity (Feuerstein, Rand & Feuerstein, 2006; Kee, 2011)
Professor Reuven Feuerstein, together with many other researchers (Kee, 2011) supports the belief that all humans are modifiable (Feuerstein, Rand, Feuerstein, 1988). Structural cognitive modifiability is achievable (Feuerstein, et al., 1988; Tan & Seng, 2008). Garland and Howard (2009) have found many neuroscience studies to provide evidence that the adult brain continue to form novel neural connections and grow new neurons in response to learning or training even into old age (Draganski et al., 2004). The mediator needs to believe that every person has the potential to learn and is able to learn. The quality to devise and innovate with creative initiatives so that the learner is able to perceive the intended information and knowledge with clarity and precision by transforming the stimulus to become salient and attractive to the child is the mediation of intentionality and reciprocity.

Mediation of Transcendence
Feuerstein et al. (1991) defined "transcendence as the orientation of the mediator to widen the interaction beyond the immediate primary and elementary goal, creates in the mediate a propensity to enlarge his cognitive and affective repertoire of functioning constantly" (pp. 21-22). Essentially the mediator needs to help the child to apply the knowledge of number sense in repeated and diverse contexts, for the child to internalize as well as generalize the learning of number sense.

Mediation of Meaning
Humans in general have the propensity to make sense of whatever is being taught (Berk, 2010). Mediation of meaning is the motivational component for the child that answers the "questions of

when, where, how, what, how much, by whom, etc." (Feuerstein, 1991, p. 24). It satisfies the need for understanding and the drive for equilibrium (Eggen & Kauchak, 2013).

Conclusion

The prevalence and ubiquitous nature of digital media in the twenty first century does not necessarily lead to development of number sense. Parents and caregivers with and without children with special needs ought to realize the critical role of enculturation and the development of number sense through effective mediated learning experiences.

References

Berk, L. (2010). *Development through the lifespan* (5th ed.). Boston, MA: Pearson Education

Brookman-Frazee, L. (2004). Using Parent/Clinician Partnerships in Parent Education Programs for Children with Autism. *Journal of Positive Behavior Interventions, 6*(4), 195-213.

Chandler, D. (2002). *Semiotics: The Basics*. New York, NY: Routledge.

Clements, D. H. & Sarama, J. (2009). *Learning and teaching early math: The learning trajectories approach*. New York: NY: Routledge

Draganski, B., Gaser, C., Busch, V., Schuierer, G., Bogdahn, U., & May, A. (2004). Neuroplasticity: Changes in grey matter induced by training. *Nature, 427*(6972), 311-312.

Eggen, P. & Kauchak, D. (2013). *Educational psychology: Windows on classrooms* (9th ed.). Upper Saddle River, NJ: Pearson Education.

Feuerstein, R., Rand, Y., Hoffman, M. B. & Miller, R. (1980). *Instrumental Enrichment: An intervention program for cognitive modifiability*. Baltimore, MD: University Park Press.

Feuerstein, R., Klein, P. & Tannenbaum, A. (Eds.). (1991). *Mediated learning experience: Theoretical, psychosocial and learning implications*. London: Freund.

Feuerstein, R., Rand, Y. & Feuerstein, R. S. (2006). *Don't accept me as I am : helping the Low Functioning Person Excel*(Rev. and Enlarged Ed.) Israel: ICELP Publications

Garland, E., & Howard, M. (2009). Neuroplasticity, Psychosocial Genomics, and the Biopsychosocial Paradigm in the 21st Century. *Health & Social Work, 34*(3), 191-199.

Goin-Kochel, R. P., Mackintosh, V. H., & Myers, B. J. (2009). Parental reports on the efficacy of treatments and therapies for their children with autism spectrum disorders. *Research in Autism Spectrum Disorders, 3*(2), 528-537.

Guralnick, M. J. (2005). *The development systems approach to early intervention.* Baltimore, London, Sydney: Paul H. Brookes.

Hayakawa, S.I., and Hayakawa, A.R. (1990). *Language in thought and action* (5th ed.). Boston, MA: Harcourt.

Jonassen, D. H. & Land, S. M. (2000). *Theoretical Foundations of Learning Environments*. US: Lawrence Erlbaum Associates.

Kamii, C. & Housman, L. B. (2000). *Young children reinvent arithmetic* (2nd ed.). New York, NY: Teachers College, Columbia University.

Kee, N. K. N. (2011). Mediated Learning Approach for Working with Children with Autism. In *Practical tips on teaching children with mild/moderate autism in mainstream schools* (pp. 254-294). Singapore: Cobee Publishing House. Part of a series of titles on autism.

Lieberman, D. A., Bates, C. H., & Jiyeon, S. O. (2009). Young Children's Learning With Digital Media. *Computers in the Schools, 26*(4), 271-283. doi: 10.1080/07380560903360194

Tan, O. S., & Seng, A. S. H. (Eds.). (2008). *Cognitive modifiability in learning and assessment: international perspectives*. Singapore: Cengage Learning

About the Authors

Norman Kiak Nam KEE is a lecturer with the Early Childhood and Special Needs Education Academic Group at the National Institute of Education, Nanyang Technological University, Singapore. He is also Board Certified in Special Education awarded by the American Academy of Special Education Professionals, Washington, DC, USA.