

Research Findings from the Assessment of Early Maths Skills and Concepts (AEMSC)

Findings from the AEMSC are presented and analysed concurrently. The data from the AEMSC was scored using an Item Response Theory framework. Scores for the overall test and subtests are given using the percentage of correct scores. Certain subtests address both the child’s receptive knowledge of a concept and their ability to express the correct language of that concept. These scores are identified separately and then combined to produce an overall score. As well as receptive and expressive language skills, mathematics content comprised six domains; *Number, Measures, Direction and Position, Shape, Perception and Critical Thinking Skills, Early Maths Activities and Mental Maths*.

The overall findings from the study are presented followed by discussion of the findings.

4.3.1. Overall Performance on AEMSC Post-Test

Table 1.1 Summary of Mean Correct Scores (Percent)

TABLE 1 – SUMMARY OF MEAN CORRECT SCORES (PERCENT)			
	NEYAI	NON-NEYAI	OVERALL
MEAN AGE	4yrs	4yrs 6mths	4yrs 3mths
NUMBER	67%	86%	76%
MEASURES	79%	82%	81%
SHAPE	84%	90%	87%
MATHS SKILLS	92%	95%	93%
MENTAL MATHS	20%	40%	30%
TOTAL SCORE	73%	84%	78%

A total of sixty three children participated in this study. Thirty two attended pre-school centres run through the National Early Years Access Initiative (NEYAI), 44% were male and 56% female and their ages ranged from 3 years 5 months to 4 years 8 months. Thirty-one children attended privately run pre-school centres, 58% were male and 42% female, ages ranged from 4 to 5 years. The overall group, tested in May 2013, represented a sample of children from diverse socio-economic backgrounds, 90% (n=57) of whom were at the end of their pre-school education and about to embark on their first year of formal schooling. All sixty three participants were tested using the Assessment of Early Maths Skills and Concepts (AEMSC) an instrument designed by Terri Lalor a Masters student in UCD. The overall findings are highlighted in table 1.1 along with the results from individual subtests. Findings

from the AEMSC highlight an overall mean score of **78%** between groups. Sixty three percent of children from the NEYAI group and twenty nine percent of children from the non-NEYAI scored under the mean. Within group analysis found children in the NEYAI group achieved a mean score of **73%** with the lowest score being **46%** and the highest **95%**. Forty four percent from this group scored under the mean. Children from the non-NEYAI centres achieved a mean score of **84%**, with the lowest score being **57%** and the highest **99%**. Forty five percent of children from the non-NEYAI group scored under the mean. When comparing scores between the NEYAI and the non-NEYAI groups, it is important to note that the mean age of the NEYAI group was six months younger than the non-NEYAI group.

Shape was the subtest where children achieved the highest mean score of **87%**, the minimum score for the NEYAI group and the non-NEYAI group was **38%** and **44%** respectively and both groups achieved a maximum score of **100%**. Sixty six percent from the NEYAI group and seventy seven percent from the non-NEYAI group scored above the mean. The Mental Maths subtest was the area that children achieved their lowest score with a mean of **30%**; sixty percent of children from the NEYAI group and thirty six percent from the Non-NEYAI group were unable to answer any of the items correctly.

Due to the large number of items used throughout the assessment (114), the results are discussed in terms of mathematical territories that serve as an arena for this investigation. Receptive and expressive elements of concepts are measured throughout the assessment, the author being cognisant of their dual significance. *Number, Size and Comparison, Direction and Position, Shapes and Mental Maths* are each important concepts in their own right and permeate the primary maths curriculum at every level to some degree or another. Each has been the focus of this investigation to examine the degree of knowledge displayed by pre-school children at a foundational level.

The subtests dealing with Number, contained an assortment of objects and the numerals (1 - 20) displayed on individual cards. The items contained in these subtests measured the child's ability to identify symbols receptively; e.g. "Show me five" and expressively, e.g. "What number is this?" Receptive and expressive categories were separated to the maximum within the time constraints of the assessment. In terms of counting skills, subtests required children to rote count and count sets of objects. Items headed 'Combining quantity and symbol' required the children to combine their knowledge of counting sets of objects and matching the sets with corresponding numerals. The final subtests in this category 'Mental Maths' required the children to solve mental arithmetic problems involving both addition and

subtraction. E.g. “If you had 2 sweets and I had 2 sweets, how many sweets would we have altogether?”

A detailed analysis of item responses follow:

Table 1.2
Correct Responses (with percents) to Test Items Number

No.	Items Type	Responses	NEYAI Group		Non-NEYAI Group		Total	
			(n = 32)		(n = 31)		(n = 63)	
			R	E	R	E	R	E
3a 11a	Identify Numerals 1 -5	Recognise & Label	81%	70%	95%	95%	88%	83%
3b 11b	Identify Numerals 6 - 10	Recognise & Label	67%	42%	81%	77%	74%	60%
2	Rote Counting	Up to 10 Up to 20	81% 16%		94% 39%		87% 27%	
10b	Counting Quantity (objects)	Up to 10 Up to 15 Up to 20	72% 31% 9%		90% 61% 29%		81% 46% 19%	
12a 12b	Combining Quantity & Numeral	1 - 5 1 - 10 1 - 15	61% 28% 13%		89% 55% 35%		75% 41% 24%	
OVERALL SCORE IN NUMBER			67%		86%		76%	

R = Receptive Language E = Expressive Language

The subtest of *Number* achieved an overall mean score of **76%** between groups. The minimum score in *Number* was **23%** and the maximum score was **100%**. Thirty four percent of children in the NEYAI scored over the mean and eight one percent of children in the non-NEYAI group. Within group analysis found children in the NEYAI group achieved a mean score of **67%** with a lowest score of **23%** and a highest score of **98%**. Fifty three percent from this group scored above the mean. Children from the non-NEYAI centres achieved a mean score of **86%**, with the lowest score being **44%** and the highest **100%**. Sixty one percent of children from the non-NEYAI group scored above the mean.

Findings highlight a difference between the two groups in the ability to recognise a numeral and the ability to express its term. In the subtest ‘Identify Numerals 1-5’, children from the NEYAI group present with a 11% difference between their ability to recognise the numerals and their ability to express the names of numerals. In subtest ‘Identify Numerals 6-10’ there is an 25% difference. Children in the non-NEYAI group have a 0% and 4% difference respectively.

Table 1.2.1
Correct Responses (with percents) to Test Items for Mental Maths

No.	Items Type		NEYAI Group		Non-NEYAI Group		Total	
			(n = 32)		(n = 31)		(n = 63)	
			R	E	R	E	R	E
17	Mental Arithmetic Addition	Up to 5	22%		46%		34%	
18	Mental Arithmetic Subtraction	Up to 5	16%		19%		17%	
OVERALL SCORE IN MENTAL MATHS			20%		40%		30%	

R = Receptive Language E = Expressive Language

The subtest ‘Mental Maths’ was incorporated as an additional element to the initial research questions. The items were purely ‘oral’ based questions without the use of concrete materials. An example question; ‘If you had four sweets and you ate two, how many would you have left?’. 30% was the overall score achieved across the groups. There was a 24% difference between the group scores in addition with the NEYAI children scoring 22% compared to the 42% from the non-NEYAI group. Only a 3% difference in scores were seen in the subtraction item with NEYAI children scoring 16% compared to the 19% of the non-NEYAI group.

Table 1.3
Correct Responses (with percents) to Test Items for Measures

No.	Items Type	NEYAI Group		Non-NEYAI Group		Total		
		(n = 24)		(n = 31)		(n = 55)		
		R	E	R	E	R	E	
4a	Understand concepts							
13a	big, small, heavy light, long, short	91%	73%	91%	72%	91%	73%	
4b	Understand concepts tall, thin, thick	67%		62%		65%		
4c	Understand concepts same, not the same &	73%		78%		76%		
13b	Understand the superlatives for 4a	88%		93%		90%		
5	Understand concepts							
14	on, under, in behind, beside	86%	68%	88%	82%	87%	75%	
OVERALL SCORE IN MEASURES			79%		82%		81%	

R = Receptive Language E = Expressive Language

Measures represented one of the largest subtests within the AEMSC. Children were assessed for their understanding of language around the concepts of size, length and weight and their ability to understand language around the equivalence of sets. An additional element included in this subtest was the understanding of certain prepositions as can be seen in items 5 and 14.

Scores were achieved by identifying from a group of objects; for example; *biggest, longest, heaviest*, or the position of an object; *on, under, beside*.

Measures achieved an overall mean score of **81%** between groups. The minimum score in *Measures* was **60%** and the maximum score was **100%**. Forty one percent of children in the NEYAI scored over the mean and fifty two percent of children in the non-NEYAI group. Within group analysis found children in the NEYAI group achieved a mean score of **79%** with a lowest score of **60%** and a highest score of **100%**. Fifty three percent from this group scored above the mean. Children from the non-NEYAI centres achieved a mean score of **82%**, with the lowest score being **60%** and the highest **97%**. Fifty two percent of children from the non-NEYAI group scored above the mean.

Items that assessed the children’s knowledge of Direction and Position included both a receptive and expressive element. Children were required to place objects in various positions requested by the administrator to determine their understanding of terms and then were asked to explain where an object was situated after the administrator had positioned it. A difference of **14%** was highlighted between the two groups in expressing the language of *Direction & Position*. NEYAI attained **68%** and non-NEYAI, **82%**.

Table 1.5
Correct Responses (with percents) to Test Items Shape

No.	Items Type	NEYAI Group		Non-NEYAI Group		Total	
		(n = 24)		(n = 31)		(n = 55)	
		R	E	R	E	R	E
6	Recognise & Label						
9	star, heart, circle, triangle square, rectangle, oval, diamond	90%	80%	94%	88%	92%	84%
OVERALL SCORE IN SHAPE		84%		90%		87%	

R = Receptive Language E = Expressive Language

Table 1.5 highlights the scores achieved in the Shape subtest. Item 6 assessed the children’s receptive understanding; “Show me the…….” and Item 9 assessed their ability to label the shapes; “What is this shape called?” *Shape* achieved an overall mean score of **87%** between groups with receptive understanding at **92%** and expressive ability **84%**. The minimum score in *Shape* was **25%** (one child only) and the maximum score was **100%**. Fifty nine percent of children in the NEYAI group scored above the mean in the expressive element.

Table 1.6
Correct Responses (with percents) to Test Items Early Mathematical Skills

No.	Items Type	Responses	NEYAI Group (n = 32)	Non-NEYAI Group (n = 31)	Total (n = 63)
7	Puzzles	Build 3,4 &6 pce	90%	90%	90%
8	Stacking Cups	Stacking 5 & 8 cups	91%	94%	92%
15a	Matching Identical Objects	Match All Correctly	97%	100%	98%
15b	Classifying	Match All Correctly	100%	100%	100%
15c	Associations	Pair All Correctly	81%	84%	83%
OVERALL SCORE IN EMA			92%	95%	93%

Finally Table 1.6 highlights the performance of this group of pre-school children in tasks categorised as *Early Mathematical Skills*. Pupils will spend over one third of their maths time working on these skills during Junior Infants. This sample of children achieved between **81%** and **100%** on these tasks. Both groups scored equally for the tasks of classifying and puzzle completion. The non-NEYAI group scored 3% higher in making associations between objects, matching identical objects and stacking cups. .

The sample (N=63) of pre-school children (mean age 4 years 3 months) assessed using the AEMSC displayed a variety of early mathematical skills and knowledge. The basic language of *Measures, Shape* and *Space* were securely established including the language of *equivalence; more, less, same, different*, the language of *comparison*, e.g. *short/shorter/shortest* and the language of *position; in front/behind/beside*. This corroborates with Vygotsky's argument that it is through language shaped by the child's families, communities and culture that concepts are formed. It also demonstrates that programmes of education make a difference and what is taught makes a difference (Schmidt, Houang and Cogan, 2002). Proficiency in number could also be observed in these children, who were competent in dealing with number and quantity up to five and fairly competent in number and quantity up to ten, emerging skills could be seen in mental maths. The ability of young children to comprehend number in its symbolic form reiterates what researchers of early child development have known for a long time, that the concepts that should be taught to children are those that can be attained with relative ease and effort (Montessori, 1949).

As is conducive to this sensitive period of concept formation, the children were apt at manipulating the equipment in order to make judgements and classify characteristics. They displayed the skills of rote counting and object counting using one to one correspondence and

combining relevant quantities with numerals. They readily understood the concept of zero and could identify small amounts from subitizing.

Throughout the assessment, the children demonstrated an ability to comprehend and follow instruction in over eighteen different subtests, each with their own individual instruction. The polarisation of attention, is a cause for discussion here as the entire assessment of one hundred and fourteen items, took approximately forty minutes to administer with almost all sixty three of the children exhibiting the ability to stay focused and on task during this timeframe. Administrators noted that the equipment and range of tasks had a positive influence on concentration.

All items in the AEMSC compare with objectives stated in either the Junior or Senior Infant curriculum. The overall mean score of the assessment was **78%**, children who resided in areas of socio-economic disadvantage achieved a mean score of **73%** and children from areas not designated disadvantaged achieved a mean score of **84%**. The difference of 11% may be, in part, due to the six month age difference between the two groups as the acceleration of learning during this formative period is spectacular. To reiterate this point, it should be noted that children from the NEYAI group were part of a pilot study for the AEMSC 6 months earlier, when the mean age was 3 years 9 months and the overall score was 53%. This **20%** increase, from **53%** in the pre-test to **73%** in the post-test over a six month period provides important information for programme content and structure. Based on the overall scores, the author suggests that the concepts the children have been exposed to during their pre-school years and that were subsequently assessed using the AEMSC appear to coincide with the natural cognitive development of this age group. This can be analysed further by examining the individual subtests, but may provide a rationale for future programme content.