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Numeracy Abilities of Children in Grades 7 to 9 with Mild Intellectual Disability in AlJouf

Khalid Habib Alshamri
Jouf University, Saudi Arabia
khalshamri@ju.edu.sa

A quantitative study was undertaken to identify factors that affect the numeracy of children with MID in Al Jouf, Saudi Arabia. A survey was conducted on 41 participants who have children with MID. Subsequently, their children were asked to accomplish a numeracy test. Results found that children with MID had below average numeracy scores across all numeracy aspects. Furthermore, children who were provided with more special education services beyond those that were publicly available performed better in the numeracy test than other children.

Keywords: Numeracy, Special Education, Mild Intellectual Disabilities, Al Jouf

I. Background

The subject of numeracy abilities among children with mild intellectual disabilities (MID) has received considerable attention in recent research [1] [2] [3]. The diagnostic criterion for intellectual disability (DSM-5) defines MID as having an intelligence quotient (IQ) score of between 55-70 [4]. Demographically, about 85% of people who have intellectual disabilities belong to this subgroup [4]. People with MID have impaired cognitive, adaptive, life, or social skills or any combination thereof, which can affect their everyday life and development [4]. This means that such individuals will tend be slower in learning new skills and concepts compared to their peers, but are still capable of doing so given sufficient assistance and support [4]. At the same time, the DSM-5 underscores the importance of characterizing the different aspects of such people's learning idiosyncrasies which may greatly help in the design of appropriate curricula or scaffolding techniques. These aspects can vary from subject matter to subject matter and, as pointed out in some studies, from culture to culture [5] [1]. This has led to intensive research within specific subject areas and geocultural regions, with results tending to have significant variabilities across contexts [2] [3]. In line with this, this study focuses on the subject matter of numeracy, which is defined as the ability to understand and work with numbers [6]. Recent studies conducted in areas such as Singapore [3] [1], and the United States [2] provide significant insights on how children with MID learn to understand and work with numbers, but nonetheless recommend replication in other geocultural contexts. As such, this study examines the numeracy abilities of children with MID in Grades 7 to 9 in the region of Al Jouf, Saudi Arabia. While Saudi Arabia has had a special education program in place since 1958, it still faces multiple challenges that need to be addressed through curriculum development based on sound research outcomes [7]. In particular, this study seeks to identify factors that affect such children's ability to understand and apply basic numerical concepts appropriate to their grade level and in so doing construct a proposed theory of instruction tailored for these children.

II. Factors that affect achievement of students with MID

There are a wide range of factors that have been found to affect achievement in general of children with MID. Common among different studies is the presence of sufficient, accessible support for the child and the child's parents [8] [9] [7]. As explained by [9], MID in itself is not debilitating to the development of a child for so long as those taking care of the child are accurately away of his or her condition and how to nurture the child properly given this condition. This coincides with input about MID from [4] in the DSM-5, which consider individuals belonging in this category as absolutely capable of achieving high functioning status and being significant contributors to society. However, as also pointed out by [9], it is precisely the lack of sufficient support, typically brought about by an incorrect mindset about what a person with MID can accomplish, hinders many children with MID from achieving their full potential. These inputs identify a diverse array of specific variables that can be examined in characterizing factors that affect the numeracy of children with MID in Al Jouf. In particular, these are the socioeconomic status of the child's family, whether or not the child has received professional special education services, and the nature and extent of such services. It is also important to examine the extent to which the parents of such children understand the condition of their child, and characterize their habits in teaching their child. In addition to this, [8] discussed the

broader context of emotional support, which can be affected by whether or not the child is an only child, how many brothers and sisters the child has, and if he or she has siblings that also have MID.

III. Measurement of Numeracy

Another important aspect of this study is being able to accurately measure and characterize the numeracy ability of children with MID in Al Jouf. Towards this end, different studies were found to use different standardized instruments [2] [3] [1] which were typically locally developed in order to suit the particular cultural and linguistic specifications. In Saudi Arabia, [10] discussed the development of standardized assessment tools for numeracy in the Saudi Arabian school system which identified five core domains of knowledge. These are number concepts, mathematical operations, geometry and patterns, measurement, and mathematical applications.

Number concept refers to the ability to relate mathematical ideas to real world situations. Some of the indicators of this domain were enumerated by [10] as 1.) assigning numbers to objects that are of that number, 2.) ordering of sets of objects according to how many there are, 3.) actually counting objects in a set correctly, and 4.) recognition that the ordering of objects is irrelevant in counting. The mathematical operations domain refers to the child's ability to recognize and accomplish numeracy tasks that are entirely symbolic, making use of the four fundamental operations (addition, subtraction, multiplication, and division). The third domain is geometry and patterns, which mainly consists of recognition of different shapes and understanding of the defining attributes of each shape and their relationships with other shapes. The fourth domain deals with the ability to make measurements, recognize and relate units of measurement, and accurately make comparisons between and among different quantities. Finally, the fifth domain is on the ability of the child to rationally answer a problem using the appropriate mathematical tools. Based on these domains, an instrument for assessing the progress of Saudi Arabian children in numeracy was developed [11] which is continued to be used as a standard measurement of numeracy in the country.

IV. Education for Children with MID in Al Jouf

Saudi Arabia has made considerable progress in developing its educational system to cater to students with MID [12] [13]. Specifically, [13] discussed that there has been continuously increasing government support and more specialized strategic planning in integrated special education in the country, with services reaching more remote areas such as small region like those in Al Jouf. However, [12] discussed that there is still much improvement that needs to be made, particularly with regard to identifying specific, controllable factors that affect the learning ability of children with MID. As a small region in the north of Saudi Arabia, progress in special education in Al Jouf has not been as fast as that in large, highly developed cities. While there have been studies on professional development in the region [15] [14], none of these have focused specifically on factors that affect the performance of students with MID. Thus, this is the gap in literature that this study sought to address.

V. Methodology

This study made use of a quantitative, descriptive design. The population of interest in this study was children in Grades 7 to 9 who have MID. Potential candidates were identified through the public school system records based on diagnosis by the school physician. The parents or guardians of these candidates were privately sent invitations to participate in the study and give consent for their children with MID to participate as well. A total of 41 participants were recruited.

Data gathering was conducted in two stages. On the first stage, the parents or guardians of the child were asked to accomplish a survey instrument. The instrument collected information on different potential factors that were considered to possibly have some effect on the numeracy of their children. These factors included parents' marital status, the family's socioeconomic status, family size, number of children in the family, number of siblings with MID, the birth order of the child with MID, and the extent of special education services, whether private or public that was received by the child in previous years. The survey also collected information about the parents' knowledge regarding the child's condition, the extent to which they understood MID in children and how this affects the potential of the child to develop normally in numeracy. The instrument also measured the extent to which parents believed their child could develop in numeracy as they grew up.

The second stage of data gathering was to measure the numeracy of the children. For this stage, the children were individually scheduled to take the standard numeracy test discussed in [11]. The instrument measured each of the five components of numeracy on a scale of 1 to 5, where 3 is predetermined as the median competence level for students in Saudi Arabia in general. In addition to this, the grades of the students in Mathematics subjects for the current school year were collected from their respective teachers.

Analysis of Covariance (ANCOVA) was used to analyze the data collected in the two-stage data collection process. The students' scores in the numeracy test was used as the dependent variable and the data collected from the survey was used as explanatory variables. Another ANCOVA was conducted using the students' previous mathematics subject grade as the dependent variable. All analysis was conducted at $\alpha=0.05$.

VI. Survey Results

From the survey that was conducted on the parents of children with MID, it was found that a large majority was married (82.9%), and that all claimed to be either in the upper middle class (51.2%) or lower middle class (48.8%). Over 50% of the respondents had only one child, and only 1 respondent reported having more than one child with MID. Household size ranged from 2 to 7, with the majority reporting a household size of 5 (29.3%).

With regard to the support that children with MID are receiving in relation to their studies. All of the respondents reported that their children received some form of support from the public school or social development ministries. In terms of parents' reported knowledge about MID, about half the parents claimed to know enough about MID while the other half reported that they did not.

VII. Numeracy Test Outcomes

Table 1 shows the results of the numeracy test conducted. As previously explained, a score of at least 3 indicated grade-appropriate competence in the numeracy component. None of the average scores reached this threshold. Students scored highest in Geometry and Patterns and Measurement and had the same average mean scores in the other three components. However, standard deviations were relatively high, indicating that individuals' scores were well spread around the mean.

TABLE 1: NUMERACY TEST RESULTS

	Mean	Std. Deviation
Number Concepts	1.61	0.862
Arithmetic Operations	1.61	0.703
Geometry and Patterns	2.41	1.024
Measurement	2.24	0.799
Problem Solving	1.61	0.862
Overall	1.898	0.4982

VIII. ANCOVA

ANCOVA was used to identify possible factors that explain the variability in students' overall numeracy scores. Due to restrictions in the sample size, only main effects were considered. As shown in Table 2, only one variable among all of those included in the model was identified as statistically significant. This variable was whether or not the child received private special education support ($p<0.05$).While the ANCOVA cannot directly infer about a causal relationship between this and the students' numeracy scores, some implications can be derived. First, this shows that there is a difference between the average scores of children with MID who have received private special education services and those who only received support from public special education services. This creates an impetus to examine what services are being offered in both service types and how they may differ. Second, this result may support the existence of an underlying confounding variable about the general availability of resources for some families over others. The participants may not have been able to accurately respond to the question on socioeconomic status, and further nuances in their financial ability to provide more special education services for their children may have an underlying effect on the children's numeracy scores.

TABLE 2: ANCOVA RESULTS

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	3.806[a]	11	.346	1.638	.140
Intercept	2.592	1	2.592	12.275	.002
Marital	.075	1	.075	.354	.556
SocioStatus	.111	1	.111	.527	.474
ChildwMID	.176	1	.176	.835	.368
BirthOrder	.062	1	.062	.291	.593
Private	1.310	1	1.310	6.204	.019
MIDKnow	.016	1	.016	.075	.787
CurrentNum	.004	1	.004	.017	.897
FutureNum	.037	1	.037	.174	.680
Household_size	.010	1	.010	.049	.826
NumChildren	.233	1	.233	1.104	.302
Duration	.008	1	.008	.039	.845
Error	6.124	29	.211		
Total	157.560	41			
Corrected Total	9.930	40			

IX. Discussion

Results from the survey are consistent with different articles that confirmed the existence of public special education infrastructure and support systems in Saudi Arabia [12] [13] and in Al Jouf specifically [15]. However, among the respondents, only 26.8% claimed to have availed of private special education support for their children with MID. Furthermore, survey outcomes also aligned with [12], which stressed the importance of reaching out and educating parents

in Saudi Arabia about what MID means for their child and how they can help to keep this from limiting their child's potential. An large majority of parents (85.4%) claimed that their child's current numeracy ability is below that of children without MID, while about 53% believed that their child will develop to have a normal level of numeracy as they get older. This shows that parents are generally divided about whether or not the condition of their children where numeracy is concerned can improve, which is alarming when considering that sufficient emotional support and encouragement has been identified in reviewed literature as an important factor to helping children with MID improve [8].

Results of the numeracy test further establishe the importance and urgency of the situation in Al Jouf. Despite all of the children having received support from public special education services, their overall performance in numeracy is still well below the grade-appropriate performance levels.

Inferences derived from ANCOVA ties up consistently with numerous studies, including one in Saudi Arabia, that concluded about the importance of having sufficient external support provided for children with MID and their parents [8] [9] [7]. While all of the children in the study availed of public special education services, it is clear that children who were provided with further special education services were able to show stronger numeracy abilities.

X. Conclusion

Numeracy is a vital aspect of learning that must be sufficiently developed in every member of a society.Children with MID are known to have difficult in many aspects of their intellectual development, including numeracy. This study was able to establish and at the same time examine different factors that may be affecting the level of difficulty that children with MID have with developing their numeracy skills. Overall, the finding of this study points to the importance of support, mainly in the form of special education services. Existing publicly available support services for children with MID may look into the results of this study as motivation for introspection; comparing the value that it is currently able to provide compared to what is added on by parents seeking further assistance for their children from private entities. Doing so can help bridge the gap and enable them to provide the same quality of support as these entities, which can be instrumental to the intellectual development of children with MID.

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