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Developing Mathematics Assessment Instrument for Children with Autism Spectrum Disorder

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Abstract: Academic assessment instruments are necessary for obtaining data about student learning needs. Teachers need assessment instruments to collect accurate information as a reference in devising learning programs. The development of mathematics assessment instrument for children with autistic spectrum needs to be carried out to produce valid and easy-to-use instrument for teachers to assess their students' mathematical abilities. This research results showed that the developed instrument consisting of four aspects, including numbers, counting operations, place-values, and fractions. The validity check revealed that this instrument could be considered as valid and usable.
Key words: mathematics assessment, children with autism spectrum disorder

INTRODUCTION

Assessment and learning tailored to the needs of children reflect the very spirit of special education, especially for the basis of designing learning programs. The results of assessment analysis can be used to determine the potentials, barriers, and learning needs of children with special needs. These three components are used as the basis for devising learning programs. Regarding learning barriers and learning needs, the two might be in line but there is a chance that they are not, as learning barriers and learning needs refer to different things. Careful analysis on the results of assessment is crucial for the accuracy in designing learning process.

Accuracy in designing learning program for children with special needs is very important, because the devising learning process is carried out based on the design of learning program. In addition, the design of learning program is made based on student learning needs. Therefore, if the design of learning program does not match student learning needs, it is very unlikely that the learning process will be optimal.

Children with special needs are those who experience obstacles in terms of vision, hearing, intellectual, interaction and social communication, as well as emotional and behavioral. To optimize their development, special education services are needed. One group of children with special needs is children with autism spectrum disorder. These children experience obstacles in social communication, social interaction, and behavior. Such obstacles in social communication include verbal and non-verbal communication.

A preliminary research recorded no documented assessment instrument was available as instrument that could be used to assess children in their developmental and academic aspects. The assessments used so far at school were interviews and observations that were mainly not documented. In addition, children profile had not been described in relation to their potentials, obstacles, and learning needs.

Assessment is very important to be used as the basis for devising learning programs for children with special needs, including those with Autism Spectrum Disorder (ASD). Children with ASD are very diverse and individual, as they especially experience obstacles in social communication, social interaction, and behavior. Thus, to create their profiles, there must be developmental and academic profiles. These profiles must describe their potentials, barriers, and learning needs in both developmental and academic aspects.

Data of student needs can be obtained through assessment analysis used as the basis for devising learning programs for children with ASD. Nir, et al. (1995) stated that assessment is one of the characteristics in implementing education for children with special needs. Assessment is a process of collecting data about children that will be useful in considering and making decisions related to those children. The assessment result data can be analyzed and they will show student current performance.

A documented and valid instrument is important for teachers and schools that can be used to assess children with ASD. The special condition of children with ASD require teachers to use assessment instruments that are suitable for them. Those children with ASD are also visual thinkers which make it a challenge for developing academic assessment instruments for children with ASD.

Table 1. the instrument grids can be shown as the following.

No	Aspects	Sub-aspects	Indicators
1	Numbers	Counting	Able to mention the number of objects
			Able to mention less than or more than of objects
			Able to arrange objects from the lowest to the highest
			Able to pair the number of objects with their symbols
			Able to count numbers from the lowest to the highest
			Able to point at the number symbols being mentioned
			Able to arrange number symbols from the lowest to the highest
			Able to fill in the missing number symbols
2	Counting Operations	Addition	Able to add two numbers with the sum of 10
			Able to add two digits numbers with the sum of more than 20
			Able to add two digits numbers with the sum of more than 40
			Able to add two digit and three digits numbers
		Subtraction	Able to work on subtraction problems of two numbers
			Able to work on two digit and three digits number subtraction problems
		Multiplication	Able to work on multiplication of numbers
			Able to work on two digits multiplication problems
		Division	Able to work on division problems of two numbers
3.	Place-Values	Place-Value	Able to point at tens and hundreds place values
			Able to point at ones, tens, and hundreds place values
4.	Fractions	Fractions	Able to mention fractions of an object that is divided into 2, 3, and 4 parts

The existing condition of non-availability of documented assessment instrument became the reason for the researcher to develop academic assessment instrument, especially mathematics assessment for children with ASD. Teachers in schools had difficulties in carrying out mathematics assessment. In general, teachers did not yet have sufficient ability to carry out assessments and there were no resource or guide to perform the assessment.

Mathematics assessment refers to the process of obtaining data or information about students' abilities, obstacles, and learning needs as references in making efforts to develop learning programs (Soendari, 2011).

METHOD

This research implemented a qualitative approach. A qualitative approach was used to obtain qualitative data about the students' social interaction and communication skills as well as academic assessments. It was carried out by teachers in schools as the basis for preparing mathematics assessment instrument for children with autism spectrum disorder. The instrument was then validated by experts and practitioners. This research was conducted in special school in Bandung city. Interviews were conducted with teachers and principals to explore assessment instrument and its implementation by teachers.

FINDING AND DISCUSSION

The assessment instrument developed by the researcher was a numerical assessment to be used as the basis that must be mastered by students. Mathematics counting ability is a part of academic ability, and it is important to assess for each student because it will affect overall academic achievement.

Counting has also been shown to be an important factor for the development of mathematical skills, whereas procedural numeracy knowledge (the ability to perform counting tasks) has been shown to describe numerical skills and conceptual accounting knowledge (understanding why a procedure works or is logical) as a prediction for timeless mathematical achievement (Titeca, et.al, 2014).

Teachers are tasked with ensuring that all students' academic needs are met. Therefore, to identify students' learning needs and measure their progress, teachers must be able to efficiently assess students' numeracy skills (Purpura & Lonigan, 2015).

Although there is no similar mathematical construct in primary schools, several important subcomponents are involved in adequate mathematics development (Titeca, et.al, 2014). Difficulties in mathematics can be manifested in four domains: understanding of numbers, number facts, calculations, or mathematical reasoning (APA, 2013).

The development of an assessment instrument was compiled based on the table 1. Validation to determine the readability of the assessment instrument was done by experts and practitioners, namely lecturers and teachers. Lecturers became the experts who conducted review to determine the accuracy of the theory used with the instrument grids and items. The teachers became practitioners who conducted review to find out the accuracy of the assessment instrument items with the students. The validation results showed that there were several items that were not valid and some items what were valid. The first validator wrote that the elaboration of indicators should refer to Dirjen Rules no X on KI-KD for autistic children in SDLB, specifically students whom he taught addition ≥40, the pictures in each item were not consistent, the images should be close to the original, place-value items should be assisted by written explanation, such as: 23 = … tens +… ones. Addition of two digits and three digits should be presented downward, not horizontally.

Point 1 Numbers: number 1 to number 20 were estimated and students could complete them as they were in accordance with students' current ability, as for number 21 about multiplication, students were actually able to count them but they showed doubt and asked questions about the answers, showing lack of self-confidence.

Point 2 Counting Operations: number 22 to number 31 were estimated as doable by students, considering that the materials were in accordance with the students' abilities, as for number 32 and 33 about counting operations with storing technique, sometimes students hesitated to determine which numbers should be stored below as the result of the sum and which ones must be stored above as numbers that would be added up again with the next number. Lack of confidence was what casted their doubt in solving these problems. As for "Place Value" counting operations, students were able to do them. Usually, there were problems when the numbers involved contained number zero (0) as shown in number 36 and number 39. In number 36 involving number (80) students assigned only the tens place value (8), the ones place value (0) was not written down because it was considered non-existent by them. Also, in number 39 involving number (203) students wrote hundreds place value (2), while tens place value was not written, and they wrote one place value (3). Meanwhile, for "Fractions" calculation operations, students were able to complete fractions up to ¼.

This research applied validity check done by four experts who were lecturers of Special Education at Indonesia University of Education and two practitioners. The test was done by the following formula:

Content Validity Ratio **(CVR) = (2Mp/M)-1**

Explanation :

Mp = The number of experts deeming important

M = The number of experts performing validation

CVR ratio index ranges of $-1 \leq CVR \leq +1$

Mp < 1/2M CVR < 0

Mp = 1/2M CVR = 0

Mp > 1/2M CVR > 0

In performing validation check, the CVR ratio index ranges from -1 to 1. If the CVR is less than 0, it means that less than half the number of experts who assess the instrument items as appropriate. If the CVR is equal to 0, it means that half of the experts assess the instrument items as appropriate, and if the CVR is more than 0, it means that more than half of the experts who assess the instrument items as appropriate.

After validation calculation, it was known that each instrument item obtained a CVR value>0, namely 1. The results showed that all the experts assessed the instrument as appropriate. So, the academic assessment instrument for children with autism spectrum disorder was declared valid and suitable for use.

The results showed that the implementation of assessment did not show the potentials, obstacles, and learning needs in detail and accurately, even though the assessment became the basis for determining the learning needs of children with autism spectrum disorder. The analysis results could be used to direct the formulation of learning objectives, materials, strategies, methods and evaluations. Assessment of student achievement provided the basic for any educational projects because it provided information about successful achievement of specific learning objectives (Guilbert 1992; Wass et al. 2001). Academic achievement requires both student motivation and active participation in learning activities, as well as appropriate form of interventions by teachers (who must utilize time required to identify students needs, set objectives, assess effectiveness, and record results) (Callahan, Wilkinson, and Muller, 2008).

Academic assessment instruments are needed to obtain data about the learning needs of children with autism spectrum disorder. Instruments are needed by teachers to collect accurate information, to create learning programs. This statement is in line with that of Hart and Whalon (2008) who said that instruments help doctors to collect detailed and structured information

and increase the accuracy and reliability of referrals for in-depth assessments and recommendations for support. The development of this instrument was based on the theory of Mercer and Mercer (1981) which explained: identifies before and after number to 10, identifies the greater or smaller number for 0 to 10 and use <and>, identifies places value with ones and tens, computes three two- digit number sum of ones greater than 20, demonstration material of subtraction facts: sum 0 -10, stages of learning, levels of learning (Underhill et al, 1980, Mercer and Mercer, 1981) which consists of: concrete, semi-concrete, and abstract.

The validation of this instrument was carried out by two experts and two practitioners. The validation was done until the instrument was stated feasible to be used on students. Validation according to Aripiani, Susetyo, and Tarsidi (2020) can be interpreted as a reflection of measurement objectives in the form of abilities, characteristics, or behavior measured through appropriate measuring instruments. A test is declared valid if the test items are able to measure the test targets in the form of abilities in certain fields.

CONCLUSION

Assessment of mathematics counting aims to explore data or information about students' abilities, obstacles, and needs to learn mathematics, that can be used as references in preparing learning programs. The mathematics assessment process requires valid instruments in order to make it easier for teachers to assess their students' abilities. The development of mathematics assessment instrument in this research has been validated by experts. Based on the results, it can be concluded that this assessment instrument is appropriate, declared valid and feasible to be used in assessing the mathematical abilities of children with the autism spectrum. This mathematics instrument consisted of four aspects, namely numbers, counting operations, place-values, and fractions.

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