

The Instrument Development of A Decision Support System (DSS) to Identify and Assess Autistic Syndrome

Abdul Salim

Head, Postgraduate Department of Special Education, Sebelas Maret University, Surakarta, Indonesia

Subagya

Sebelas Maret University, Surakarta, Indonesia

Munawir Yusuf

Sebelas Maret University, Surakarta, Indonesia

Erma Kumala Sari

Sebelas Maret University, Surakarta, Indonesia

Abstract - This research aims to develop the instrument of identification and assessment for the students with autistic syndrome using decision support system (DSS). This study was conducted in three steps: (a) need analysis to determine the kind of suspected autism, (b) the development of prototype instrument of decision support system (DSS), and (c) validation of DSS. This study was performed in Surakarta area, including 7 regencies and municipal with 20 Special Schools as the sample using purposive sampling technique. The analysis on the need for identification instrument and the data collection were carried out using close-ended questionnaire with 32 headmasters and teachers as respondents. The method of analyzing data was descriptive quantitative. The development of a DSS-based identification and assessment instrument prototype was conducted using web-based DSS application construction technique. The validation of identification and assessment instrument was conducted using expert test with FGD involving IT and Special Education Practitioners, headmasters and teachers of autistic children. Then, the prototype of instrument was improved and followed with limited field trial the result of which was analyzed by statistical test. The result of research showed that 97% of respondents in preliminary study needed the development of a DSS instrument to identify and assess the students with autistic syndrome. This study developed prototype of DSS with the validity of 0.361 in 32 subjects at significance level 5%. Mainwhile, the reliability measured in Cronbach's alpha was 0.875. Thus, 13 items of DSS-based identification and assessment instrument for students with autistic syndrome has sufficient validity and reliability level.

Keywords: Identification and assessment instrument, Decision Support System (DSS) of autism.

I. INTRODUCTION

Nowadays the trend of autistic child growth in Indonesia shows increasingly high figure and broader distribution level, not only in urban area but also in rural and remote areas. Currently, it is predicted that the number of autistic children is three millions with ratio of 6 in 10 thousands births. Furthermore, regarding the number of autistic children in the world, data of children with autism in various parts of the world shows varying figures. UNESCO (2011) reports that there are 35 millions people with autism throughout world. It means that, on average, 6 out of 1000 people in the world develop autism (<https://id.wikipedia.org/wiki/Autisme>). Center for Disease Control (CDC)'s study in America (2008) stated that the ratio of autism is 1:80. In American and out of America the number of autism disorder is close to 1% of population (DSM-5™). Yayasan Autisme Indonesia (Indonesian Autism Foundation) states that there is an increase in autism prevalence, in which ten years ago the number of autism children in Indonesia was predicted as 1:500 children, but this figure increased to 1 : 500 children. In 2000, psychiatric staff of Medical Faculty of University of Indonesia predicted that there are ± 6,900 children with autism in Indonesia (Moore, 2010).

In Indonesia, the number of people with autism is predicted of 2.4 millions (Central Statistic Bureau, 2010). In that year, the number of Indonesian population is 237.5 millions people with growth rate of 1.14% (Republika, April 09, 2013). The number of people with autism in Indonesia is expected to increase by 500 annually. From the above data, it can be seen clearly that the growth of autistic children increases more and more, so that some actions should be taken. Currently the attempt of the government is to expand education opportunity and access,

and to build autistic therapy center in a number of cities in Indonesia. It is expected that in the future, through therapy center the autistic children will be conditioned to have special competency before they start the school education, including interaction, communication, socialization and self-building competencies along their development level.

The initial duty of special education teacher for students with autistic syndrome is to identify and to assess. The result of identification will be followed up with assessment, the product of which will be the basis for organizing a learning program consistent with their ability and disability. Assessment is a screening activity for children identified as students with autistic syndrome. The assessment activity can be conducted by special education teachers and other professionals available corresponding to their competency.

Identification and assessment activities above are the characteristics of other duty as special education teacher out of learning. The accuracy of Identification and assessment result determines the learning program. The difficulty level of identification and assessment activities is higher than learning organization and learning itself. Such a difficulty is due to 1) teacher competency level; 2) no application/software to be used as assessment instrument; 3) children diversity.

Autism in DSM-5 is called Autism Spectrum Disorder (299.00 (F84.0)), Autism Spectrum Disorder is characterized with permanent deficiency in social communication, social interaction in some social context, including the deficiency in reciprocal social relation, using nonverbal communication to interact socially, poor skill of establishing and maintaining social relation. The deficiency in social communication includes limitation in activity, interest and repetitive behavior. In Autism Spectrum Disorder (DSM-5TM) diagnostics, the child diagnosed with Autism Spectrum Disorder can be described specifically accompanied with intellectual disorder or without intellectual disorder, with or without structural language disorder, related to medical, genetic, and environmental conditions. Autism Spectrum Disorder diagnostics is related to neuro-developmental condition, mental condition and behavior disorder. Specific description of diagnostics should be equipped with age, with or without the loss of preexisting skill, and description on the severity of disorder.

Diagnostic criteria for Autism Spectrum Disorder based on Diagnostic and Statistical Manual of Mental Disorders (DSM-5) include: 1) permanent social communication and interaction deficiency in various contexts; 2) limited behavior, repetitive behavior pattern, interestedness, or activity manifested in at least two behaviors; 3) symptoms to emerge in early development period (but may not be manifested completely until the social demand surpasses limited capacity, or perhaps covered with learning strategy in their life); 4) Symptoms resulting in significant destruction in social life, work or other important setting of life; 5) these disorders are better explained with the term intellectual disability or intellectual development disorder or generally retarded development. So to establish autism diagnosis, the criteria of diagnoses A, B, C, D, and E ? should be met, if one of them is absent, the autism diagnosis cannot be established. So, other criteria of diagnosis should be considered (Kemendikbud, 2013). Social communication and interaction deficiencies are permanent in nature. It includes: (a) the deficiency of social and emotional communication abilities; (b) impaired non-verbal communication behavior used for social interaction in which integration of verbal and non-verbal communication is very severe, lost eye contact, body language and face expression; (c) deficiency in developing and maintaining relation. For example, the difficulty of adjusting behavior to a variety of social contexts, difficulty in imaginative playing or making friends, no interest in peer relation.

Limited behavior, repetitive behavior pattern, interestedness, or activity is manifested in at least two following behavior: (a) repetitive motor movement or stereotype, objects or language use, for example: simple stereotyping behavior, arranging toys in line or reversing object; (b) excessive attention to similarity, rigid routine or ritualized verbal or non-verbal behavior pattern, for example, extreme stress in small change, difficulty during changing process, rigid mindset; (c) high adherence and limitation to an abnormal interestedness, such as; strong adherence to or preoccupation with unusual objects, excessive limitation or persevered interest; (d) hyperactivity/hypoactivity in sensory input or unusual interestedness in sensory aspect of environment. For example: uncaring about pain or air temperature, opposite response to certain sound or texture, excessive olfaction or tactility of object, visual admiration with light or movement. In addition there are symptoms to emerge in early development period (but is not likely manifested completely until social demand surpasses the limited capacity or is likely covered with learning strategy in their life).

These symptoms result in significant impairment in social life, work, or other important settings of life. These impairments are better explained with term intellectual disability or impaired intellectual development or generally retarded development.

Therefore, the development of identification and assessment instrument for students with autistic syndrome was conducted based on attributes contained in DSMV explained in essential indicators underlying this content of instrument development. This instrument is one of criteria included in DSM-V, so that the finished product of instrument use is to recognize or to assume that the students observed are those with autistic syndrome. The final decision was that further observation is required to be conducted by authorized professionals. The criteria, among others, include: limited behavior, repetitive behavior pattern, interestedness, or activity. This syndrome consists of four symptoms. Each symptom in this instrument development consists of some indicator; this

instrument development contains 13 indicators. Each indicator has different characteristics, until the specified parameter is satisfied.

Table 1: Blueprint of instrument development

NO	Syndrome	Indicator	
1	Repetitive motor movement or stereotype, object or language use	1	No eye contact, less alive face expression, less focused movement
		2	Cannot play with peer
		3	Less capable of establishing reciprocal social and emotional relationships
		4	When the child is speaking, his/her speech is not used for communicating.
		5	Often using strange, repeated, imitating language
2	Excessive attention to similarity, rigid routine or ritualized verbal or non verbal behavior pattern	6	Embedded to a ritualistic activity or useless routine
		7	Repetitive strange movement
		8	Extreme stress/anger with small change
3	High adherence and limitation to an abnormal interestedness	9	Maintaining one or more interest in typical or excessive way
		10	Often mesmerized with parts of object
4	Hyperactivity/hypoactivity in sensory input or unusual interestedness in sensory aspect of environment.	11	Unempathic/uncaring about
		12	Very sensitive to smell, touch, visual
		13	Dislike to be hugged

Those indicators serve as database for developing a digital identification and assessment instrument. The digital identification and assessment instrument in this research employed Decision Support System (DSS) application. Decision Support System (DSS) is Sistem Pendukung Keputusan (SPK) in Indonesian. DSS is based on information system computer supporting business or organization of activity decision making ([https://en.wikipedia.org/wiki/ Decision_support_system](https://en.wikipedia.org/wiki/Decision_support_system)). DSS caters to management, operation, and organizational plan level (usually intermediate and higher management) and helps decision making, that may likely change quickly and cannot be specified earlier (Unstructured and semi-structure decision problem). Decision Support System can be fully computerized, manual, or combination of them. Meanwhile, academician has considered DSS as an instrument to support decision making process. DSS user can consider DSS as a means of facilitating organization process. Some writers have extended the definition of DSS to include any system that can support decision making. Sprague (1980) defines DSS with its characteristics:

- a. DSS tends to be intended to be less well-structured, underspecified problem usually faced by top manager;
- b. DSS tries to integrate analytical model or technique use with traditional data access and function taking;
- c. DSS specifically focuses on features making them used easily by non-computer persons in interactive mode; and
- d. DSS emphasizes on flexibility and adaptability to accommodate the environment change and the decision making conducted by users.

DSS includes knowledge-based system. A well-designed DSS is an interactive software-based system intended to help decision making of useful information compilation from the combination of raw data, document, and personal knowledge, or business model to identify and to identify problem and to make decision.

There are several ways of classifying DSS application. Not all DSS matches tidily one of categories, but perhaps the combination of two or more architecture. Holsapple and Whinston, classifies DSS into six following frames: DSS-oriented text, DSS-oriented database, DSS-oriented spreadsheet, DSS-oriented solver, DSS-oriented rule, and DSS compound. DSS compound is the most popular classification for DSS. It is a hybrid system encompasses two or more of five basic structures explained by Holsapple and Whinston. The support the DSS gives can be divided into three different but interrelated categories: Personal Support, Group Support, and Organization Support.

The component of DSS can be classified into: a) input: factor, figure (number), and characteristic to analyze; b) user's knowledge and skill: input requires manual analysis by user; c) Output: transformed data from which "decision" DSS is produced; d) Decision: product yielded by DSS based on user criteria.

This DSS application is developed using web-based service. So this application should be run online, but we can run this offline in our computer. The supporting software should be installed first to access this application. Such the application is win32-1.7.3.exe existing in Software CD. Having this application been installed, the application will be installed on local server. After both of activities have been completed, DSS application is ready to use.

II. METHODOLOGY

The method employed in this study was Research and Development (R & D) (Borg & Gall, 2003: 772) and followed by experiment. The development model in this research encompassed conceptual, theoretical, hypothetic and final models. Conceptual model is the one in analytical manner, mentioning the components of product, analyzing the component in detail, and showing inter-component relationship to be developed. Theoretical model is the one representing framework based on relevant theory and supporting by empirical data. Hypothetic model is the one that has been reviewed by experts and practitioners through focus group discussion (FGD). Final model is the one that has been tried out empirically in limited manner.

The data collection in pre-development stage was conducted using questionnaire technique. The sampling technique used was purposive sampling one, taking 32 teachers and headmasters as the sample.

The feasibility test on DSS-based identification and assessment instrument was carried out through FGD consisting of two IT experts, two identification and assessment practitioners for autistic students, two psychometric experts, two linguists, and 20 users/teachers.

The data collection in limited trial was conducted using simulation technique. The sampling technique used was purposive sampling with 33 teachers/therapists for students with autistic syndrome in Surakarta area. Technique of analyzing the result of limited field test was done using statistical test: internal consistency for validity test and Cronbach's Alpha with SPSS.

III. RESULT AND DISCUSSION

The result of research shows that 88% respondents stated the need for assessment competency mastery, 100% agreed with the need for assessment instrument development, 94% wanted the assessment instrument standardized, and 97% wanted the assessment instrument to be digitally based.

The participants of FGD were rated based on their own expertise. Two IT experts stated that this application of identification and assessment is feasible to use in the term of DSS application system. Two psychometric practitioners stated that the construct has satisfied psychometric norm: content has contained the developed attributes, questions have been formulated clearly and satisfied the criteria according to the theory used, and question contained no multiple negative. Two linguists stated that the language used had satisfied correct spelling rule, not using local dialect. Two education experts for autistic child stated that content has been based on the theory used, indicator formulation has been consistent with autistic syndrome based on DSM-V, and indicator formulation has satisfied general intersection of autistic spectrum likely occurring. 20 users stated that this application facilitated the early identification of students with autistic syndrome and this application is easy to use and has high accuracy.

The result of validity test in limited trial is as follows:

Table 2: Instrument Validity

Item-Total Statistics				
	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
AUT1	8.5152	10.633	.669	.859
AUT2	8.3939	10.746	.637	.861
AUT3	8.4545	11.193	.484	.870
AUT4	8.0909	12.148	.362	.874
AUT5	8.2424	11.064	.606	.863
AUT6	8.0606	12.059	.468	.871
AUT7	8.2424	11.377	.495	.869
AUT8	8.1212	11.985	.387	.874
AUT9	8.2727	10.892	.644	.860
AUT10	8.5152	10.633	.669	.859
AUT11	8.2424	11.002	.629	.861
AUT12	8.0606	12.184	.404	.873
AUT13	8.4242	10.627	.670	.858

Considering the table with 33 subjects at significance level of 5%, r table is 0.361, while r statistic in table 2 above shows that all of items are higher than r table (0.361), so that all of items in the DSS-based identification and assessment instrument for students with autistic syndrome have fulfilled the required validity criteria.

Table 3: Reliability of Instrument

Reliability Statistics	
Cronbach's Alpha	N of Items
.875	13

Table 3 shows that the cronbach's alpha value = 0.875 (higher than 0.7 required), so that the 13 items of DSS-based identification and assessment instrument for students with autistic syndrome have fair reliability level.

Statistical confidence level shows the accuracy of this instrument result, but this instrument development had not been conducted holistically, so that its justification result is an assumption. Nevertheless, the assumption is very beneficial to teacher/therapist/assessor of special education teacher. It is useful to take reference action and or individual learning plan.

The further step is to conduct the standard test that can be carried out by the authorized professionals only. Based on Sleuwen's experience (1996), special test for autistic child is called Psycho Educational Profile Revised (PEP-R). The test was developed in Teacch, a special education program for autistic child. This test is used for autistic or impaired development-children and for the children with six-month to seven-year chronological age. This PEP-R test provides information about development functions such as imitation, perception, fine motor skill, gross motor skill, eye and hand coordination, cognitive performance and verbal cognition. PEP-R test can also detect problems in the term of relation and affection, game and interest in object and sensory and language responses. PEP-R score is used to develop an education plan for individual children so that the teacher can be aided in dealing with the autistic children.

Wing and Gold (Dodd, 2005) stated that an autistic child is characterized by three constraints called 'a triad of impairments', autistic disorder affects an individual's ability of communicating, interacting socially, and limited interest and repetitive behavior.

The development of a DSS-based identification and assessment instrument refers to DSM V by developing indicators observable to assessor/teacher/therapist. PEP-R test can only developed based on DSS by the patent holder and by authorized professionals. The symptoms suggested by Wing and Gold are closer to the criteria developed in this instrument.

Compared with other similar instruments, this instrument development has such advantages as not too many question lists (13 items/yes/no), digitally based, quicker and more proper. Similar instruments developed and used by some institutions/experts are illustrated below.

Table 4: Options of Assessment Instrument for Students with Autistic Syndrome

Scale (see legend)	Uses	Age Range	Method of Administration	Population Studied	Scale characteristics	Reference
ABC	screening	children	parent rated	AD	57 items, scale 1-4	Krug et al., 198043
CARS	screening	children	clinician rated	AD	15 items, scale 1-4	Schopler et al., 198044
M-CHAT	screening	toddlers	parent rated	AD	23 items, yes/no	Robins et al., 200145
CSBS-DP-IT-Checklist	screening	toddlers	parent rated	AD	24 items	Wetherby et al., 200846
ASQ	screening	child/adult	parent rated	AD/AspD	40 items, yes/no	Berument et al., 199947
AQ	screening	child/adult	self or parent rated	AspD	50 items, scale 0-3	Baron-Cohen et al., 200148
CAST	screening	4-11 years	parent rated	AspD	37 items, yes/no	Scott et al., 200249
ASDS	screening	5-18 years	parent or teacher rated	AspD	50 items, yes/no	Myles et al., 200050
GADS	screening	3-22 years	parent or teacher rated	AspD	32 items, scale 0-3	Gilliam, 200151
ASDI	screening	child/adult	interview + clinician rated	AspD	50 items, yes/no	Gillberg et al., 200152
SRS	screening	4-18 years	parent or teacher rated	AspD	65 items, scale 1-4	Constantino et al., 200353

Source: (Volkmar, et al., 2004)

Notes: ABC = Autism Behavior Checklist; AD = autism disorder; ADI = Autism Diagnostic Interview-Revised; ADOS = Autism Diagnostic Observation Schedule; AQ = Autism Quotient; ASDI = Asperger Syndrome Diagnostic Interview; ASDS = Asperger Syndrome Diagnostic Scale; AspD = Asperger's disorder; ASQ = Autism Screening Questionnaire; CARS = Childhood Autism Rating Scale; CAST = Childhood Autism Screening Test; M-CHAT = Checklist for Autism in Toddlers; CSBS-DP-IT-Checklist = Communication and Symbolic Behavior Scales Developmental Profile Infant-Toddler Checklist; DISCO = Diagnostic Interview for Social and Communication Disorders; GADS = Gilliam Asperger's Disorder Scale; Parent = primary caregiver; SRS = Social Responsiveness Scales.

The table 4 above shows similarity to the instruments developed by the author: screening, option model has 2 models: rating scale and yes/no option. Five out of 11 instruments (table 4) used yes/no option, while the other seven used rating scale option.

IV. CONCLUSION

The result of research shows 97% respondents in preliminary study need the development of DSS-based identification and assessment instrument for students with autism, with 13 indicators of symptoms necessary to be included into the DSS-based identification and assessment instrument for students with autistic syndrome. This study has successfully developed prototype of DSS-as an instrument to identify and assess the students with autistic syndrome. The result of limited trial shows fair validity and reliability, so that this instrument is feasible to use.

This identification and assessment instrument only develops one out of 5 criteria required by DSM-V. It is adjusted to the teacher/therapist authority. Teacher/therapist of students with autistic syndrome has the authority of identifying and assessing based on his/her position only. It is because of the limitation in this instrument development in which it did not cover entire procedure contained in DSM V.

The application of identification and assessment for students with autistic syndrome has satisfied the feasibility criteria in substantial aspects of IT system, psychometric, autistic theoretical content, language, and user-friendly for teacher/user. The result of application, however, remains limited to an assumption rather than final justification.

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