The Development of the Digital Identification Instrument for Children with Learning Disabilities using Decision Support System (DSS)

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Abstract: The study is a part of research and development which aims at developing Decision Support System-based (DSS) digital identification instrument for children with learning disabilities. The first-year study consists of three stages: (a) the need analysis of the instrument, (b) the development of instrument prototypes, and (c) the validation of the digital identification instrument.

The study was conducted in Surakarta, particularly in 20 special schools located in 7 regencies and cities and selected using purposive sampling. In the first stage, data were collected using a close-ended questionnaire from 32 respondents comprising principals and teachers. Meanwhile, the second stage use of a web-based digital application development technique. The identification instrument was then validated through expert judgment using focus group discussion (FGD) technique involving information and technology (IT) experts, special education experts, principals, and teachers of children with learning disabilities.

The instrument prototypes were subsequently revised and limited empirical tryout, and then analyzed using statistical tests. The results indicate that 97% of the respondents require the development of a digital identification instrument for children with learning disabilities. The study has successfully developed digital identification instrument prototypes for children with learning disabilities. All items of the DSS-based instrument have met the required criteria of validity: r-table with the number of subjects of 32, a significance level of 5% (0.361), and greater r-count compared to r-table (0.361). The reliability tests demonstrate Cronbach's alpha of 0.875. It's proved that 13 items of the instrument have a sufficient level of reliability.

Keywords: Digital instrument, identification, learning disabilities, special school, DSS-(Decision Support System).

INTRODUCTION

Basic academic skills which should be mastered by children at schools include reading, writing, and counting. Such skills present as an investment for students to reach their academic success at school, workplace environment, as well as social environment. However, a common problem which frequently occurs is the student's inability to master the basic academic skills well [1]. One reason for this is that children experience learning disabilities so that people around them underestimate their intellectual abilities. The learning disabilities in children should be of concern to parents, teachers, and psychologists.

The term 'learning disabilities' in Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5) refers to individuals with learning and academic skills difficulties, including such specific learning difficulties as reading, spelling, and mathematical reasoning. The learning disabilities are caused by individual internal factors and predicted to be influenced by the central nervous system, instead of by intellectual disability, visual acuity, auditory acuity, or other environmental factors [2]. A child is said to have learning disabilities if the two main characteristics, the developmental disorder of speech and language and the academic difficulty, appear in child development ages [2]. The learning disabilities experienced by children are related to the ability to process information and use logical reasoning to solve problems. This leads to barriers to acquiring language skills, literacy skills, and social communication development [3].

Such psychological effects as fear of failure, social anxiety, and low self-esteem will take place unless they are well-identified [1]. Children with persistent learning disabilities often reject to learn new things or involve in new experiences [4]. As a result, their improvement in academic learning and communication development can be hampered. This condition will subsequently cause fear of failure and of rejection from taking new risks [5]. The inability to use logical reasoning and to process information will cause social isolation in children [6]. Concerning this matter, most of the children choose to avoid interaction with other people and get rid of their negative judgment.

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The prevalence of children with learning disabilities varies in several countries, but the rate increases year by year. In the United State of America, about 5-6% of school children aged 6-18 years were detected to have learning disabilities [7]. The number of children with learning disabilities has increased from 1.8% of school-aged students (1976-1977) to almost 5.2% in 1997-1998 [8]. A study on the prevalence of students with learning disabilities in India indicates a high prevalence (about 10.76% to 13.41%) [9].

Such prevalence was also examined in Indonesia. The Office of National Education Research and Development carried out research which involved 24 primary schools in such provinces as West Java, East Java, Lampung, and West Kalimantan in 1997. The results of the research revealed that 13.9% of the sample students had the risks of learning disabilities [10]. Of 3,215 students of primary schools in Jakarta (grade 1-6), 16.52% of them were identified to have learning disabilities [10]. The latest research (conducted in 2000 above) on the prevalence of children with learning disabilities in Indonesia has not certainly been known.

Based on the data of the described prevalence in such countries as the USA, India, and Indonesia, it is clear that the prevalence of children with learning disabilities is increasing. One factor influencing the increase is a less reliable instrument for the identification of learning disabilities [9]. Another factor includes bias in measurement and identification performed to children under 9 years old [8]. Therefore, it is crucial to conduct identification process to detect the learning disabilities in children.

Initial indicators of learning disabilities generally appear in preschool or preprimary age, but identification is infrequently done before the preschool or preprimary age. Children are specifically found to have learning disabilities when they are in primary school. Some children with learning disabilities, particularly those who have high intelligence, in a long time, are not identified [11]. Incorrect identification can lead to another problem, for example, low motivation and confidence.

The identification of children with special needs can be performed by either teachers or parents. However, more comprehensive assessment process related to the condition of the children should involve professionals to provide different perspectives on barriers faced by the children [12]. Such comprehensive assessment is important to administer due to the low level of agreement between different informants: parents, teachers, or children [13,14].

Teachers play a vital role in identifying children with learning disabilities. However, they often administer observation and assessment based on students' memoir and daily cumulative facts, instead of on the results of the standardized tests which describe students' conditions at the time the tests are performed [15]. If compared to the combination of intelligence tests and academic tests, an assessment by a teacher, which identifies students with learning disabilities has higher accuracy [16]. Several studies also show that teachers successfully help predict students' academic problems. This is, in the end, useful for the initial identification of learning disabilities [17-19]. Besides, a study reveals that the assessment can serve as a valid and comprehensive source of information in accurately identifying and predicting learning disabilities [20].

The accuracy of the identification and assessment results will determine the appropriate Lesson Plans. However, researchers, clinicians, and teachers deal with many difficulties in identifying and understanding children with learning disabilities, and therefore they often get confused in determining an appropriate method to teach children with learning disabilities [21]. Moreover, the fact obtained from the field indicates that special education teachers still find difficulties to identify and assess children with special needs, particularly those with learning disabilities [22].

To deal with problems related to the difficulties of identification of children with learning disabilities, it is necessary to develop an identification instrument which can be easily used by teachers. The development of the digital identification instrument is based on Decision Support System (DSS), an alternative in the globalization era [23]. DSS is a computer-based system which runs and processes information providing possibilities to make more productive, dynamic, and innovative decisions [24]. It will give appropriate and flexible decisions towards aspects influencing the emergence of a decision, as well as produce informative reports for users to help understand the decision [25]. Furthermore, it enables teachers to easily identify and decide special needs in children.

The development of the DSS-based digital identification instrument for children with learning disabilities is based on the characteristics and types of children with learning disabilities as stated in DSM-5

[2]. In the instrument development process, the two main criteria or symptoms of children with learning disabilities were elaborated into indicators, which then serve as the basis of the development of digital instrument prototypes to identify children with learning disabilities.

Table **1** presents the blueprint of the characteristics of children with learning disabilities as content in the development of the digital identification instrument. The indicators are used as a database for the development of the digital identification instrument for children with learning disabilities. The software application used in developing this instrument is the Decision Support System (DSS) application.

The study aims to develop the digital identification instrument for children with learning disabilities based on DSS. The study also aims to find the validity and reliability of the instrument. This digital identification

Table 1:   The Blueprint of the Characteristics of Children with Learning Disabilities as a Content in the Development of the Digital Identification Instrument

No	Criteria	Aspects		Indicators	
1	Impaired speech and language functions	a.	Speaking Skill	1	Difficulty in mentioning names
				2	Difficulty in mentioning body parts
				3	Difficulty in mentioning the number of body parts
				4	Low-level abstraction/ fantasy (the ability to imagine)
				5	Minimal speech development
				6	Imitative behavior
				7	Letter misrecognition
				8	Difficulty in recognizing the concept of combination
				9	Difficulty in recognizing the concept of numbers
				10	Difficulty in recognizing the concept of time
				11	Difficulty in recognizing the concept of colors
				12	Slow speech
		b.	Language Skills	13	Difficulty in producing certain letters/ words
				14	Difficulty in using verbal language
				15	Difficulty in recognizing the concept of colors
				16	Production of disorderly words
				17	Difficulty in recognizing the concept of "good" and "bad" (for example: beautiful-ugly)
				18	Difficulty in recognizing concepts
2	Impaired academic function	a.	Reading Skills	19	Inaccuracy in reading
				20	Slow reading
				21	Difficulty in using words with a similar sound (for example: *rusa* (deer), *lusa* (the day after tomorrow))
				22	Repetition of words or word guess
		b.	Expressive Writing Skills	23	Ability in writing texts
				24	Ability in spelling words
				25	Grammatical error
				26	Punctuation error
				27	Poor writing
		c.	Counting Skills	28	Difficulty in learning numbers
				29	Difficulty in engaging the process of counting
				30	Repeated miscounting

instrument is intended for teachers, especially special education teachers. It is expected that the results of the study help identify children with learning disabilities in an accurate manner. Furthermore, teachers are expected to be able to provide appropriate education services according to the needs and abilities of children as immediately as possible.

RESEARCH METHOD

Participants

In the pre-development stage, data were collected using a questionnaire. The purposive sampling technique was applied to select 32 respondents. The feasibility test of the DSS-based identification instrument and assessment was carried out through FGD which involved 2 IT experts, 2 experts in the identification and assessment of students with learning disabilities, 2 psychometric experts, 2 linguists, and 20 users/ teachers.

Before collecting the data, all participants were given by the informed consent letter. It is contains a declaration of willingness signed by the subject to voluntarily declare its willingness to be a participant in the study. The informed consent sheet also contains explanations of research objectives, procedures to be performed, potential risks, and benefits received by the research subject.

Method

The method used in this study is Research and Development (R&D) [26], which was then continued with experimentation. The development model in this study went through such stages as a conceptual model, theoretical model, hypothetical model, and final model. The conceptual model is analytical, mentioning product components, analyzing components in detail, and demonstrating the relationship between components to be developed. The theoretical model is a model that describes a framework that is based on relevant theories and supported by empirical data. The hypothetical model is a model that has considered feedback from experts and practitioners through focus group discussion (FGD). The final model is a model that has been empirically tested using limited empirical tryout.

Meanwhile, in the limited empirical tryout, data were collected using a simulation technique. The purposive sampling technique was applied to select 32 teachers in Surakarta. The analysis technique of the results of the limited empirical tryout involved the use of statistical tests, i.e. internal consistency for validity tests and Cronbach's alpha using Statistical Package for the Social Sciences (SPSS) program.

RESULT

The results show that 88% of the respondents agree on the importance of mastery of competencies, 100% agree on the need for the development of assessment instrument, 94% desire the standardized assessment instrument, and 97% wish for a digital-based assessment instrument.

Table 2: The Estimated Corrected Item-Total Correlation of the Instrument

	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
KES1	0.659	0.839
KES2	0.637	0.861
KES3	0.484	0.870
KES4	0.362	0.874
KES5	0.606	0.863
KES6	0.468	0.871
KES7	0.495	0.869
KES8	0.387	0.874
KES9	0.644	0.860
KES10	0.669	0.859
KES11	0.629	0.861
KES12	0.404	0.873
KES13	0.606	0.859
KES14	0.368	0.851
KES15	0.595	0.838
KES16	0.637	0.888
KES17	0.584	0.861
KES18	0.462	0.819
KES19	0.506	0.837
KES20	0.668	0.831
KES21	0.637	0.853
KES22	0.595	0.871
KES23	0.482	0.839
KES24	0.636	0.857
KES25	0.494	0.836
KES26	0.628	0.879
KES27	0.495	0.816
KES28	0.437	0.859
KES29	0.637	0.863
KES30	0.486	0.852

The FGD participants administered the assessment based on their respective expertise. Two IT experts stated that the application of identification and assessment was systemically feasible to use. Two psychometric experts claimed that the constructed design had fulfilled the psychometric rules: contents of the developed attributes, clearly-formulated questions, conformity in the theories, and the absence of double negative questions. Two linguists stated that the language met correct spelling rules and avoided local dialects. Two special education experts said that: (1) the content had been based on the theories used, (2) the formulation of indicators had been appropriate and based on DSM-5, and (3) the formulation of indicators had met the general intersection of the learning disability criteria that were likely to emerge. Twenty users claimed that this digital application provided ease in immediately identifying children with learning disabilities. Moreover, they found out that the application was easy to use and had high accuracy. The results of the validity tests on the limited empirical tryout are demonstrated as follows:

The r table with the total number of 32 subjects and significance level of 5% (0.361) and the r count which shows that all items are greater than r table (0.361) prove that all items stated in the digital instrument of identification and assessment of children with learning disabilities have met the criteria of validity requirements.

Table 3: Instrument Reliability

Cronbach's Alpha	N of Items
0.875	30

Table **3** indicates that the Cronbach's alpha value is 0.875 (greater than what is required (0.7)) so that 30 items of the digital identification instrument and assessment of children with learning disabilities have sufficient level of reliability. The level of statistical confidence shows the accuracy of the results of this instrument, but its development has not been carried out holistically, and therefore the justification results are still in the forms of hypotheses. Nevertheless, the development of the instrument is beneficial for teachers/ shadow teachers/ special education teacher assessors. Moreover, it is useful for making referral actions and/or individual learning plans.

DISCUSSION

The goals of this study is to make an digital identification instrument results in indications or hypotheses on whether certain children have learning disabilities, instead of in diagnoses. The development of the instrument is beneficial for teachers/ shadow teachers/ special education teacher assessors. Moreover, it is useful for making referral actions and/or individual learning plans. Pengembangan instrumen identifikasi digital untuk anak berkesulitan belajar ini menjadi salah satu solusi untuk memudahkan guru dalam mengenali anak kesulitan belajar. Though identifying children with learning disabilities is challenging for several reasons. Children with learning disabilities are difficult to distinguish from children without learning disabilities, both physically and behaviours, especially outside school settings [27]. Some children are sometimes identified as having learning disabilities because they have problems in reading. Nevertheless, some children did not show any difficulties in reading and writing but identified as learning disabilities.

Terlihat dari hasil penelitian bahwa the level of statistical confidence shows the accuracy of the results of this instrument, but its development has not been carried out holistically, and therefore the justification results are still in the forms of hypotheses. Considering such limitation, further assessment process by authorized professionals such as psychologists should be conducted. Also, the results of the identification cannot provide a definitive diagnosis of learning disabilities in children since further involvement of psychologists is required. Furthermore, the instrument prototypes will be revised following the experts' suggestions and followed up with broad-scale tryout.

CONCLUSION

Based on the validation of the expert judgment, corrected total items correlation value ranged from 0.362 to 0.669 with a reliability of 0.875. The results of the study prove that 97% of the respondents in the pilot study need the development of the digital identification instrument for children with learning disabilities which includes 30 symptom indicators. The study has successfully developed digital identification instrument and assessment prototypes for children with learning disabilities. The results of the limited empirical tryout indicate sufficient validity and reliability to assure the feasibility. This identification and assessment instrument only developed one of the five criteria which is required by DSM 5 and corresponds to teachers'/ shadow teachers' scope of expertise (identifying and giving assessment). In other words, not all procedures stated in DSM 5 were performed.

The application of the instrument and assessment for children with learning disabilities has met the criteria of feasibility in such aspects as IT system substances, psychometrics, theoretical contents in autism, as well as language and the ease of its use for teachers/users. The results of the justification of this application are provided in the forms of hypotheses, instead of final justification. Finally, the digital identification instrument for children with learning disabilities is expected to be used to assist teachers in the process of accurate identification and assessment and hence to formulate a learning program which fits the abilities and needs of the children.

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ABBREVIATIONS

DSS   = Decision Support System

DSM-5 = Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition

FGD   = focus group discussion

IT   = information and technology

SPSS   = Statistical Package for the Social Sciences

R & D   = Research and Development

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