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Dot cards application development for learning to count 1-10 students with medium intellectual disability

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ABSTRACT

Learning to count in this research is a mixed to count operation of numbers 1 to 10. The purpose of this research is to produce a dot card application learning media to improve the counting ability of students with medium intellectual disability. Based on the preliminary study, it was found that the low to counting ability of students with medium intellectual disability in class XI was due to limited media to support the learning process. Learning to count for students with medium intellectual disability should use concrete and interesting media. The method use research and development (R&D) that adopts the Borg and Gall model modified into five stages of development, namely data and information collection, product planning, product development, product validation and product evaluation. The results showed that (1) the ability to count students with medium intellectual disability was still low; (2) the developed dot cards application is considered suitable for use in learning to count based on the assessment of the validators; and (3) the use of the dot card application has an effect on increasing the counting ability of students with medium intellectual disability.

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Introduction

Education is a forum that enables humans to develop abilities, skills, and enrich knowledge as well as to realize dual abilities, namely on the one hand being able to develop the person as a whole and be able to realize their participation in socio-cultural, economic, and technological developments in a free, balanced, and sustainable manner. Special education is an educational process specifically designed for students who have physical, mental, talent and special intelligence limitations. The main purpose of special education is to increase independence and life skills to meet personal needs. (Khairiyah et al., 2019) explained that every child has the right to education without exception, including children with special needs. To support this, it is the government's obligation to create access to education in order to provide education for children with special needs.

One of the children with special needs is Student with intellectual disability. Student with intellectual disability are children with special needs with low intellectual barriers in their thinking abilities (Sukotjo & Triarini, 2015). Student with intellectual disability are children who have limitations in the ability to think or use their minds. (Apriyanto, 2012) Student with intellectual disability are children who have significantly below the average intelligence of children in general, accompanied by obstacles in adjusting to the surrounding

environment. Classification of Student with intellectual disability is divided into three (mild, medium and severe). In this case, the classification of intellectual disability to be studied is children with medium intellectual disability.

Students with medium intellectual disability are usually called imbecils. (Effendi, 2009) say that student with medium intellectual disability have an IQ between 25-50. Characteristics of students with medium intellectual disability are barely able to learn academic subjects, if learning to read language development is limited, they still have the potential to be trained in self-restraint and some jobs that require mechanical training (Lisinus & Sembiring, 2020). (Amin, 1995) Students with medium intellectual disability can barely learn academic subjects.

The limited thinking ability of students with medium intellectual disability makes it difficult to think abstractly. As a result of these limitations, student with intellectual disabilities are having difficulties in academics, one of which is Mathematics, especially in numeracy. (Zahara & Efrina, 2013) Mathematics is learning that cannot be separated from the concepts of numbers and addition. Addition is a mathematical concept that children should learn. Learning mathematics for students with intellectual disability is intended to be used in everyday life and in society.

The results of the preliminary study found problems in class XI students with medium intellectual disability have low numeracy skills, they have not been able to perform mixed arithmetic operations from 1-10. They consider mathematics to be a difficult subject so that they have difficulty in counting and the limitations of the media make them less interested in learning to count. The ability to understand the concept of numbers of students with medium intellectual disability is far behind those of students with mild intellectual disability, this is because students with medium intellectual disability require a longer time to carry out reactions to a newly recognized number concept (Hendra, 2012). The numeracy skills of students with intellectual disabilities are not all the same, their abilities are indeed different from other friends. Counting is necessary in everyday life, wherever and whenever we are (Iriyanto & Wardani, 2014).

(Suparman, 2015) Learning to count on students with intellectual disabilities, teachers should use something concrete, easy to understand, using simple examples, using language that is easy to understand and equipped with teaching aids, carried out in interesting and fun situations. (Elfira, 2013) considering that students with medium intellectual disabilities have slow and limited thinking skills as well as boredom and easy to switch attention, to teach mathematical concepts requires learning that can actively involve students in learning, one of which is through the use of media in the learning process.

(Arsyad, 2013) learning media for the teaching and learning process can generate new desires and interests, generate motivation and stimulation of learning activities, and even bring psychological effects on students. Learning media can be designed and developed in accordance with current technological developments. Learning media with the help of technology and information (ICT) can be used to make learning interesting and have a positive impact on academic performance in the form of learning motivation and student learning outcomes (Y. T. Chuang, 2014). Examples of ICT media that can be used are learning media that are operated on smartphones with the Android operating system. The use of android-based learning media is one of the applications of 21st century learning styles (T. Y. Chuang & Chen, 2007). The media that will be developed in this research is card media in the form of point cards in the form of applications for learning to count students with medium intellectual disability.

(Wijaya & Irianto, 2015) through the use of Doremi card media are known to improve learning outcomes to recognize numbers in students with intellectual disabilities. (Suparman, 2015) using card media can improve numeracy skills, in the second cycle an average post test score of 72.50 was obtained with a percentage increase of 68.52% or in the good category (success). (Faradillah & Ainin, 2017) the use of dot cards learning media can improve students' numeracy skills. (Nurbaeti et al., 2020) the use of dot cards learning media has an effect on increasing the ability to calculate the addition of prime numbers in students with mild intellectual disabilities in class V.

Based on the relevant research above, the media used is still manual media. All of them use card media for mathematics learning counting material. The novelty in this research is developing modern learning media for learning mathematics. One of the obstacles in academic skills that is often an obstacle for medium intellectual disability is the ability to recognize numbers (Andriyani, 2012). The development of this dot card application uses Adobe Flash Professional CS6 software which is operated via a computer for math material for intellectual disability in class XI. This product is packaged in the form of an application that can be operated on smartphone devices with the Android operating system. Android is a popular operating system and is widely used by the public, especially among high school students. Android is an operating system for Linux-based mobile devices that includes an operating system, middleware, and applications (Safaat, 2011). Android

is an operating system for mobile phones based on Linux. Android provides an open platform for developers to create their own applications.

This study aims to develop learning media in the form of dot cards application in Mathematics Subjects counting 1-10 students with medium intellectual disabilities in grade IX. The benefits of the developed dot cards application can increase interest in learning mathematics, especially counting material, learning material becomes more interesting, practical to use inside and outside counting learning at school so that the material is conveyed and is able to improve the numeracy skills of students with medium intellectual.

Method

The method used a research and development that seeks to produce a certain product and test the effectiveness of the product (Sugiyono, 2015)This research procedure adapts the Borg and Gall development model which consists of several development steps, namely (1) information gathering, (2) product planning, (3) product development, (4) product validation, and (5) product evaluation.

The subjects in this study consisted of expert validation subjects and test subjects. The subject of expert validation includes two media experts, two material experts and two PLB experts. The product trial consisted of a small group trial conducted at the school designated as the research site, namely six students with medium intellectual disabilities in class XI.

This research was conducted in five steps adapting the Borg and Gall development model. The steps taken in this research, namely (1) information gathering (literature study, observation, needs analysis), (2) product planning (Determining software, navigation button shape, application background color, font type and size, making flowcharts and story boards), (3) product development, (4) product validation (media experts, material experts and PLB experts), and (5) product evaluation (small group trials).

Data collection using media validation instruments and test instruments. The instruments given to the experts are in the form of a checklist for validation instruments related to media, materials and mathematics. The test instrument consisted of a student's media quality assessment sheet, and learning outcomes test questions. All instruments are validated by experts in construct and content. The learning outcome test instrument in the form of multiplechoice questions was validated by experts. Field trials were conducted to determine the effect of using instructional media on the ability to count 1-10 students with medium intellectual disabilities. The trial design in this study used the One-Group Pretest-Posttest Design (Sugiyono, 2018).

Validation assessment carried out by experts using a Likert scale instrument where the assessment consists of 4 assessment criteria, namely Very Worthy (VW) score 4, Worthy (W) score 3, LessWorthy (LW) score 2, and Not Feasible (NF) score 1. Determination of the value by using the following formula:

$X = \frac{\sum x}{N}$
X = average score of each component
$\sum x$ = total score
N = number of indicators assessed

The percentage of quantitative data obtained from the expert validation questionnaire was classified descriptively into the criteria for the level of product validity with the existing standard criteria. The following table of criteria in determining the level of product validity by (Pratama, 2013).

Tabel 1. Product Validity Level Assessment Criteria

Criteria	Validity Level	Description
75 - 100	Very Worthy	Can be used without revision
50 - 74,99	Worthy	Can be used with minor revisions
25 - 49,99	Less worthy	Can be used with multiple revisions
0 - 24,99	Not feasible	Can't be used

The test data (pretest and posttest) were used to measure the effectiveness of the learning media by comparing the test scores obtained from before and after using the dot cards application. To process data Data analysis techniques used are: The score of each student is obtained through a formula adapted from (Astuti, 2016) Hypothesis testing in this study uses non-parametric statistics. The nonparametric test used was the Wilcoxon marked level test. (Djarwanto, 2004) the Wilcoxon marked level test is a refinement of the sign test, so the magnitude of the difference between the signs (positive or negative). The test criteria are Ho is accepted if Tcount < 0.05 Ho is rejected if Tcount > 0.05.

Results and Discussions

The development of dot cards application for numeracy learning adapts the development model (Borg & Gall, 1983)by grouping the development stages into five main parts, namely information gathering, product planning, product development, product validation and product evaluation.

Information gathering is carried out as an initial step of development. Information gathering consisted of literature study, field survey and needs analysis. The results of the literature study show that improving academic achievement can be helped by the use of interesting and supportive media for learning. Learning media can be designed according to the latest information technology developments to make it easier for teachers and students to access learning materials.

The field survey was conducted at SLBN Manisrejo. Mathematics learning in this school still uses manual media in the form of number cards. Students look less enthusiastic because the number card media used by the teacher is less attractive. Most of the students in this class have smartphones. Smartphone's, especially Android, can be used as a source of additional information and alternative learning if students are getting bored. Needs analysis is carried out based on the results of the field survey. Based on the results of the field survey, it was formulated that android-based media was needed to help learning Mathematics in schools. This media is expected to facilitate students in learning, increase learning motivation and help improve learning outcomes.

Curriculum analysis is carried out by identifying Competency Standards (SK) and Basic Competencies (KD) for mixed arithmetic operations material according to the K13 curriculum. The material that will be used in this study uses knowledge competency KD 3.1 Understanding mixed arithmetic operations of natural numbers (addition and subtraction) in problem solving in everyday life and competency skills KD 4.1 Computing mixed operations of natural numbers (addition and subtraction) in problem solving in Simplified daily life according to the abilities of students with medium intellectual disabilities.

Product planning is done by making product designs and the form of flowcharts and storyboards. Flowchart describes the navigation flow in operating learning media on android devices. Storyboard is a visual script that is used as an outline in making media. The product planning stage is also carried out by selecting the software, the shape of the navigation buttons, the background color, the type and size of the font. The product development of the dot cards application is carried out using Adobe Flash Professional CS 6 software. The product output is in the form of a file with the extension (apk) that can be opened on android devices and can be installed with a minimum specification of 5.0 (Lollypop).

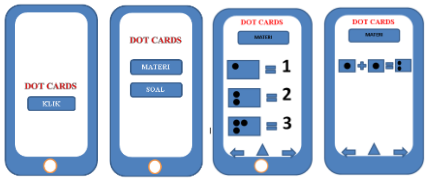

Figure 1. Example of the developed Dot Cards Application

Product Validation

Product validation was carried out to test the feasibility of the application and was carried out by six experts, namely media experts, material experts and PLB experts. The media is feasible to use if it obtains a minimum value for the decent quality category. The media quality category was obtained from expert validation test data by six experts to determine the feasibility of the product being developed so that it has valid content or material, the right use of it and the product developed is needed. Here are the test results by validation experts:

Table 2. Validator Assessment Results

No	Areas of expertise	Score	Category
1.	Media Expert - 1	92,85	Very Worthy
2.	Media Expert - 2	95,53	Very Worthy
3.	Material Expert - 1	95,19	Very Worthy
4.	Material Expert - 2	94,23	Very Worthy
5.	PLB Expert - 1	93,18	Very Worthy
6.	PLB Expert - 2	90,90	Very Worthy
	Average	93,64	Very Worthy

Based on the test results by the validation experts in table 2. it is known that the qualified dot card application is very suitable for use in the next stage. Judging from the results of the assessment by media experts, the results were 92.85 and 95.53 with very decent qualifications. The results of the assessment obtained from material experts are 95.19 and 94.23 where the qualifications obtained are also very feasible. Likewise, the results of the assessment of PLB experts, namely 90.90 and 93.64 also obtained very decent qualifications. The results of the assessment from this validator product are declared very suitable for use at the field trial stage.

Field trials were conducted to determine the effect of using the developed learning media on increasing the numeracy skills of moderate mentally retarded students. The learning media used in this trial is in the form of media that has been revised based on suggestions and input from the validator. Small group trials were conducted on six students with moderate mental retardation. The increase in the numeracy skills of mentally retarded students can be seen based on the difference in scores at the pretest and posttest. Pretest is given at the beginning of learning at the first meeting in class to determine students' numeracy skills before using learning media while posttest is given at the end of learning at the last meeting after being given treatment four times by obtaining the following data:

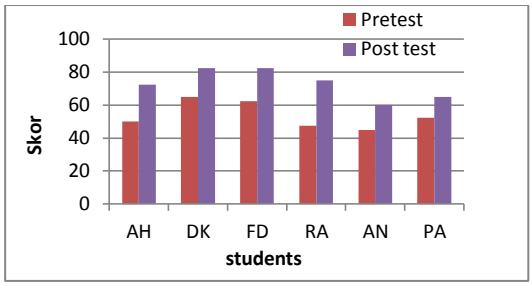

Figure 2. Data Recapitulation of Pretest and Posttest Values

Figure 2 shows the students' numeracy skills before being given treatment using the dot card application, the students got the highest score of 65 and the lowest score of 40. From the results of the pretest, information can be obtained that the numeracy skills of 1-10 students with medium intellectual disabilities are still low. After obtaining the pretest data, the next step is to provide treatment using the dot cards application when learning mathematics. After giving the treatment, a posttest was conducted to determine the students' numeracy skills after using the product and showed the students' numeracy skills after being treated with the dot cards application, the students got the highest score of 82.5 and the lowest score of 72.91. From the posttest results, it can be seen that all students experienced an increase in numeracy skills after receiving treatment four times. After knowing the pretest and posttest scores, it can be seen that there are significant differences in the numeracy skills of students with medium intellectual disabilities before and after using the dot cards application.

Hypothesis testing

To test the hypothesis using the Wilcoxon-signed level test formula. The formulation of the null hypothesis and its working hypothesis are: H0 = Dot cards application does not affect the numeracy ability of students with medium intellectual disabilities, Hi = Dot cards application affects the numeracy ability of students with medium intellectual disabilities. The following are the results of calculations using the Wilcoxon test formula:

Table 3. Find Tcount

No	Name	Score		Different	Rank	Sign	
		Pretest (X)	Posttest (Y)	(Y – X)		+	-
1.	AH	50	72,5	22,5	5	+5	0
2.	DK	65	82,5	17,5	3	+3	0
3.	FD	62,5	82,5	20	4	+4	0
4.	RA	47,5	75	24,5	6	+6	0
5.	AN	45	60	15	2	+2	0
6.	PA	52,5	65	12,5	1	+1	0
		Average				T=21	

Based on the criteria for testing the hypothesis: If Tcount < Ttable = H0 fails to be rejected, If Tcount > Ttable = H0 is rejected. Then it can be seen statistical calculations using the Wilcoxon test, namely Tcount is obtained 21 and Ttable is obtained 2, so Tcount < Ttable 0.05 or (21 > 2) then H0 is rejected and Hi is accepted, meaning that there is an influence on the ability to count between before and after using the dot application. cards so that it can be concluded that the dot cards application has an effect on the numeracy skills of students with medium intellectual disabilities.

A dot cards application to improve the numeracy skills of students with intellectual disabilities is being developed using Adobe Flash Professional CS 6. The resulting media product is in the form of a file in the android package (apk) format. The file in (apk) format is a required application installation file on an android smartphone of at least version 5.0, if this file is opened on an android smartphone of at least version 5.0 then the dot cards application will be automatically installed on the device. The dot cards application has several advantages, namely: a product in the form of software that can be operated using an Android smartphone at least version 5.0; (2) the product supports learning to count from 1-10; (3) the media can be used inside or outside of learning to count at school.

The results of product validation and testing indicate that the media is suitable for use in learning counting from 1-10 students with medium intellectual disabilities in class IX. Based on the results of the pretest before being given treatment, there were some students who had low numeracy skills. Students with medium intellectual disabilities have low numeracy skills, this agrees with (Hendra, 2012) that the concept ability of medium intellectual disability is much lower than students with mild intellectual disabilities. (Iriyanto & Wardani, 2014)states that the numeracy skills of students with intellectual disabilities are not the same, their abilities are different from one another.

(Soemantri, 2012) students with medium intellectual disabilities are those who can be educated to take care of and protect themselves from harm. Students with medium intellectual disabilities are one of the classifications of students with intellectual disabilities who have abilities below those of students with mild intellectual disabilities (Esi, 2012). The use of card media is suitable for use in the learning process because it can help students when learning to count (Wijaya & Irianto, 2015). The results of field trials conducted on students with medium intellectual disabilities got higher posttest scores than pretests, this indicates that the dot card application has an effect on increasing the numeracy ability of class 1-10 students. The results of the trial are in line with the opinion of (Sudjana & Rivai, 2010), (Sadiman, 2010) and (Arsyad, 2013)that learning media can clarify the presentation of messages and information, is useful for directing students' attention, making learning more enjoyable. interesting and fun and can have an effect on improving students' abilities.

The use of the dot card application can improve the numeracy skills of students with medium intellectual disabilities, because this media can help students learn to count. This is in line with research by (Faradillah & Ainin, 2017), (Nurbaeti et al., 2020), and (Suparman, 2015) that the use of dot cards learning media can improve students' numeracy skills and the use of picture card media with striking colors can attract students in learning to count and can improve the numeracy skills of students with intellectual disabilities.

Learning media in the form of this application has several advantages, namely this media has an attractive design appearance in terms of colors, images and writing. This media is easy to operate and easy to understand by students with intellectual disabilities. In addition, this media can be used independently both at school and outside of school, it can be used practically by installing it via a smartphone. This medium is limited to mixed arithmetic operations with numbers 1-10.

Conclusions

The conclusion obtained from this research and development is that the application software for mathematics learning media on numeracy material has been successfully developed, the application developed is considered suitable for use in numeracy learning in terms of the validation assessment of experts and the use of dot cards application has an effect on increasing numeracy skills 1-10 students with medium intellectual disabilities in grade IX. The dot card application learning media can be used as an evaluation material for the use of effective learning media and this media can be used as a reference and data source for other researchers who develop mathematics learning media for students with intellectual disabilities.

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