Developing Cooperative Bowling Game as a Stimulating Activity of Mathematical Logical Intelligence for Children with Autism

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Abstract. The purpose of this study is to know the process and produce the development of the Cooperative Bowling game as a valid, practical, and effective stimulation of mathematical logical intelligence for early childhood with autism. The method used in this study is research and development or R&D (Research and Development) with the ADDIE model. The population from the study were students at PAUD Inklusi Pelangi Harapan, Jember Regency, with a single subject of children with autism aged 5 years. Based on this research, the development process carried out includes: 1) analysis, analysis of the concepts and steps of children's cooperative games in the background of inclusion, analysis of children's readiness to participate in cooperative games, and analysis of the profile of mathematical logical intelligence of children with early autism based on the MIICYCA instrument, 2) design, designing the form of the game in the form of steps, rules and instructions for the implementation of the Cooperative Bowling game, 3) development, designing the model and shape of the game with existing tools and materials, then validation tests are carried out by expert validators, 4) implementation, which is a game trial carried out 3 times for the required data and revisions / improvements, and 5) evaluation, practicality test and effectiveness test based on the data obtained. The results obtained from the application of the Cooperative Bowling game development are in the form of data on the average value of the validity test of 3.5, the average value of the practicality test of 3.6, as well as an average value of 3 and the percentage of the effectiveness test of 75%. Based on the results of the feasibility test for developing the game, it can be concluded that the development of the Cooperative Bowling game is feasible as an activity to stimulate the mathematical logical intelligence of early childhood children with autism in PAUD Inklusi Pelangi Harapan Jember Regency which is valid, practical, and effective.

Keywords: Autism, Cooperative Bowling, Mathematical logical Intelligence, Early Childhood.

1 Introduction

Among the general public there are still opinions that children with Autism Spectrum Disorder (ASD) or often called autism have intelligence or ways of thinking that are slow and low, but several studies confirm that children with autism also have intelligence above average or smart. There are several factors that make the reason why children with autism have intelligence above average refers to the characteristics of their thinking, such as very high

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concentration, sharp memory, paying attention to detail, and relying more on logic Click here to enter text.. Children with autism in making decisions also tend to rely more on logic than their emotions, because they usually think objectively and are not dominated by emotions within themselves [2].

This diversity of intelligence levels is one of the reasons behind the emergence of Howard Gardner's theory of multiple intelligences. he means that intelligence is a system of abilities that exist within a person to solve problems/getting solutions to problems that occur in human life. He categorizes multiple intelligences into 9 forms of intelligence; (1) Linguistics, (2) Logic-mathematics, (3) Spatial, (4) Musical (5) Kinesthetic-physical, (6) Interpersonal, (7) Intrapersonal, (8) Naturalist, and (9) Existential [3]. Mathematical logical intelligence according to Gardner is the capacity to use numbers effectively and reason well. This intelligence includes sensitivity to logical patterns and relationships, statements and propositions, functions, and other related abstractions [4].

The process of developing mathematical logical intelligence, especially children with autism, sometimes also experiences delays, given that they have difficulty communicating, socializing, and interacting with their environment. Providing special services through playing activities with cooperative games is one way that is expected to be effective as an activity to stimulate the mathematical logical intelligence of children with autism. Vygotsky argues that playing directly can help children's cognitive development. Thinking logically and mathematically including children's intelligence in cognitive [5]. Through playing can optimize the development of language, social, motor, intelligence, creativity and can be used as therapy [6]. Therefore, cooperative play is a game in a group that involves social interaction so that a feeling of group identity and organized activity arises [7].

Schools need to provide stimulating activities that can develop the potential or mathematical logical intellegence in children with autism [8]. stimulation is given through cooperative play activities when the learning process at school takes place. And to stimulate mathematical logical intelligence at schools for early childhood with autism in learning activities can be through the game "Cooperative Bowling". Through the cooperative bowling game children will get several benefits from the bowling game developed is to introduce numbers while summing, introduce colors, develop spatial intelligence, and practice gross motor movements [9]. Furthermore, the bowling game developed can stimulate the mathematical logical intelligence of children with autism at an early age, provided that modifications are made to suit the characteristics and needs of the children with autism.

Based on the results of observations at early childhood education institutions that autistic children have a lot of potential in their mathematical logical intelligence, but the opportunity for autistic children to play with other children is very less, even though based on the concept of Zone Proximal Development (ZPD) by Gardner that knowledge and development can be built and encouraged through social interaction between two or more people, both children and adults and children with peers [10], so that children will become tutors or behavioral models for other children, interacting and learning in groups is very possible.

This research on the development of the Cooperative Bowling game aims to develop an interesting game that can be used as an activity to stimulate mathematical logical intelligence in autistic children at an early age that is adapted to the characteristics and needs of autistic children, namely children who have the potential for mathematical logical intelligence that can be developed further and children's interest in throwing and catching ball activities so that bowling can be chosen as a type of game developed. Cooperative Bowling play activities in general are to stimulate children's abilities, recognize numbers, learn to mention numbers 1-

10, count the number of bowling pins gradually, the ability to work together in analyzing numbers, plus help children interact and socialize, etc.

Therefore, this research will try to solve this problem through the development of a bowling game so as to produce a Cooperative Bowling game as a stimulating activity mathematical logical intelligence of children with autism at an early age that is valid, effective and practical.

2 Method

The type of research used in this research is development research or R&D. This research method is used to create / produce a new product and test the effectiveness of the product [11]. R&D research uses the ADDIE (Analysis, Design, Development, Implementation, Evaluation) model developed by Robert Marine Branch. This research was conducted at PAUD Inklusi Pelangi Harapan which is located at Perum Bhayangkara Indah I/I-6 Hamlet Ajung Wetan, Ajung Village, Ajung District, Jember Regency using a single subject, namely children with autism. The implementation of this research is carried out in the 2021/2022 academic year.

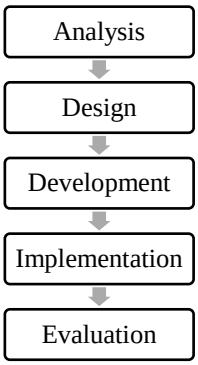

Fig. 1. R&d Research Steps with the ADDIE Model

3 Results and Discussion

3.1 Results of the Development of Cooperative Bowling Games as Mathematical Logical Intelligence Stimulation Activities

The research on the development of the Cooperative Bowling game as a mathematical logical intelligence stimulation activity for children with autism at PAUD Inklusi Pelangi Harapan, Jember Regency, consisted of five stages.

The first stage 1) analysis which includes a) analysis of concepts and steps of cooperative play for children in inclusive backgrounds, with children in inclusive schools as backgrounds, the development of Cooperative Bowling is limited, intended and adapted only to children with autism at an early age with light and moderate category only. In addition, the characteristics of the autistic children chosen to play Cooperative Bowling are children with autism who have an interest in numbers, are able to play throwing balls and are able to receive

commands, even though all of them are not optimal because they still require assistance and direction from teachers/others, analysis of the intelligence profile of children's mathematical logical using the Multiple Intelligences Identification Checklist for Young Child with Autism (MIICYCA) instrument, based on the results of the analysis, the child got a score of 7 from the range of 4.67-9.33 with the predicate "medium". Several indicators that describe the child's interest in an object, activity or thing that is the focus of the child, it can be concluded that the child is interested and has the potential for objects/activities that contain elements of numbers/numbers. Therefore, it would be very good if these interests and potentials were developed again with play activities that children can participate in to hone their potential for mathematical logical intelligence.

Then the second stage 2) Design, at this stage an initial game design is produced in the form of game steps, game rules and instructions for teachers as a guide for implementing the Cooperative Bowling game. The third stage 3) Development, namely the design stage and the form of the game developed from its initial form, equipped with the necessary tools and materials adapted to the design made, and is a simplification of the real bowling game.

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Table 1. Results of Validation of Cooperative Bowling Game Instruments

No	Assessment Aspect	Average	*Va*
1.	Supporting Theory	3,5	
2.	Game Tool Design	3,6	3,5
3.	Game Steps	3,6	
4.	Rule Of The Game	3.2	
Category			**Valid**

Table 2. Category Validity Level

V_a **Range**	**Interpretation**
$0 \leq V_a < 1$	Invalid
$1 \leq V_a < 2$	less valid
$2 \leq V_a < 3$	quite valid
$3 \leq V_a < 4$	Valid
$V_a = 4$	Very Valid

Source : Hobri (2010: 52-53)

Based on the data above, it can be concluded that the new product that has been designed in this study in the form of a Cooperative Bowling game has met the validity requirements. Then the fourth stage 4) Implementation, namely the trial stage as well as improving the design and form of the game. The trial was carried out twice at the initial stage and once at the final stage. After the second implementation, the final design, steps, rules and instructions for the implementation of the Cooperative Bowling game were produced.

The rules of the Coopertaive Bowling game are as follows.

a. The formation of groups is done by sequentially counting children from numbers 1-2 and returning to number 1, or adjusted to the number of groups to be formed (in children with autism it is assisted by being shown the number that must be mentioned).

b. Determination of group members based on the calculation of the numbers above, children who get the same number of children become one group. Each group has 4-5 members.
c. The group has the right to determine the division of roles, 1 member of the group acts as a guard player to pick up the pins dropped by his partner, the rest act as throwers.
d. Each throwing player has the opportunity to throw 3 times (As for children with autism there is no limit on throwing until the child drops the bowling pin).
e. Throwing players must strategize how to make the bowling pin fall as much as possible by throwing the ball.
f. The guard player picks up the fallen bowling pin.
g. Throwing players count the number of bowling pins dropped (As for children with autism are stimulated by showing the number 1 to start counting).
h. The throwing player names the number on the bowling pin that was dropped.
i. The other pitchers take turns playing.
j. After all group members have played, then work together to calculate the total number of bowling pins in stages.
k. The group with the most number of bowling pins is the winner.

Fig. 2. Cooperative Bowling Game Final Design

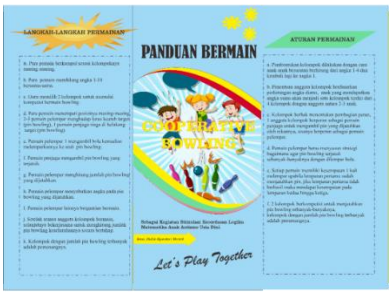

Fig. 3. Pocket Book of Cooperative Bowling Game Implementation Instructions

The last stage 5) Evaluation, the results of the improvement of the forms, steps and rules of the cooperative game will be re-tested from a total of 3 trials. This is done to assess the effectiveness and practicality of its application in stimulating the mathematical logical intelligence of children with autism. From this stage, the practical value is taken from the data on the implementation of stimulation activities through the Cooperative Bowling game and the effectiveness value is taken from the data on children's playing activities. The data recapitulation for each is as follows.

Table 2. Recapitulation of the Results of the Implementation of Stimulation Activities

No	Rated Aspect	Score	*Ai*
I.	**SYNTAX**		
1.	The level of implementation of all stages of stimulation activities through cooperative bowling games as development	4	
2.	The scope of mathematical logic intelligence in activities	4	3,7
3.	The implementation of the sequence of activities reflects the stimulation activities through cooperative bowling games	3	
II.	**SOCIAL SYSTEM**		
4.	The level of implementation of the desired situation	3	
5.	The level of teacher-teacher and child-child interaction in activities	3	
6.	The implementation of children's behavior embodies the intelligence of mathematical logic with cooperative bowling games	4	
7.	The level of implementation of children playing cooperative bowling	4	3,5
III.	**PRINCIPLE OF REACTION AND MANAGEMENT**		
8.	The expected scope of teacher behavior in play activities reflects stimulation activities through sangat rendah cooperative bowling games	3	3,5
9.	The level of implementation of teacher behavior involves children in activities	4	
	Amount	32	10, 7
	Average (*IO*)	3,6	3,6

Table 3. Category Level of Execution

***IO* Range**	**Interpretation**
$0 \leq \text{IO} < 1$	Very Low
$1 \leq IO < 2$	Low
$2 \leq IO < 3$	Currently
$3 \leq IO < 4$	High
$IO = 4$	Very High

Source: Hobri (2012: 54-54)

Recapitulating the value of the results of the implementation of the stimulation activities through the Cooperative Bowling game above, it is known that the total average for all aspects (IO) is 3.6. Based on the category scale of the level of activity implementation, the Cooperative Bowling game meets the practical criteria. Furthermore, the effectiveness data analysis uses data analysis of the results of playing activities for children with autism by giving a score for each indicator that will be achieved in the activity. The results obtained are presented in the table below.

Table 4. Results of Observation of Children's Playing Activities in Game Trials

No.	**Day/Date**	**Child Activity**						**Total Score**	**Mean *(x)***	**Value *(pi)***
		Indicator 1	Indicator 2	Indicator 3	Indicator 4	Indicator 5	Indicator 6		***Total Score*** ***n***	***Individual Score*** ***Max Score*** ***X 100***
1.	Thursday, 24	4	3	2	2	2	2	1	2,5	62,5 %

	February 2022							5		
2.	Thursday, 17 March 2022	4	4	3	3	3	2	1 9	3,2	79 %
3.	Tuesday. 22 March 2022	4	4	3	3	3	3	2 0	3,3	83,3 %
Percentage (%)									3	75 %

Table 5. Criteria for Children's Play Activities

Score	Criteria
$1 \leq Sr < 1,5$	Not Active
$1,5 \leq Sr < 2,5$	Less Active
$2,5 \leq Sr < 3,5$	Active
$3,5 \leq Sr < 4$	Very Active

Table 6. Student Mastery Level

Score	Criteria
$0 \leq TPS < 40$	Very Low
$40 \leq TPS < 60$	Low
$60 \leq TPS < 75$	Currently
$75 \leq TPS < 90$	High
$90 \leq TPS < 100$	Very High

The average score (mean) for all children's playing activities is 3 and the percentage of the average score for the overall value of children's play activities obtained is 75%. Based on the criteria above, it can be concluded that when the teacher applies this game, it can be said that it has met the active criteria, and the level of student mastery in achieving the existing indicators has met the high category. So it was concluded that the application of cooperative bowling game development was proven to be effective. Cooperative Bowling game development research activities that have been carried out in several stages, then the data is analyzed and recapitulated based on the determination of the previous criteria at each stage of the trial. All analysis results are presented in the table below.

Table 7. Recapitulation of Data Analysis Results

No	Data	Result	Criteria
1.	The results of the validation of the Cooperative Bowling game instrument	3,5	Valid
2.	The results of the analysis of the implementation of stimulation activities	3,6	Practical
3.	Observation results of children's play activities Results of achievement indicators of mathematical logic intelligence	3 75%	Effective

Based on Table 7 above, it can be concluded that the development of the Cooperative Bowling game as an activity to stimulate mathematical logical intelligence in early childhood autism has met the requirements for valid, practical, and effective categories.

3.2 Discussion

The product resulting from this development research is a cooperative bowling game, the result of the development of bowling in general. With the Cooperative Bowling game, it is expected to be an activity that stimulates the mathematical logical intelligence of early childhood autism children that focuses on the development of cooperative games because it is in accordance with the constructivism theory by Vygotsky in his Zone Proximal Development (ZPD) concept that knowledge and development can be built and encouraged through social interaction between two or more people, children with adults and children with peers [8], so that children will become tutors or behavioral models for other children, interacting and learning in groups is very possible. The benefits obtained are that children will actively engage in interactions to plan and carry out games, children are able to give each other encouragement and support, improve mathematical abilities such as recognizing and mentioning numbers 1-10 and counting objects. Improving children's logical abilities such as children who are able to think and plan strategies so that bowling pins fall, the next step is to train cooperation between children with special needs and regular children because regular children can become tutors for children with special needs, etc.

This development research (R&D) uses the ADDIE model which consists of five stages of research, namely 1) Analysis, 2) Design, 3) Development, 4) Implementation and 5) Evaluation. The first process is 1) analysis, at this stage the researcher analyzes the concepts and steps of cooperative games for children in the inclusion background and analyzes the readiness of children to participate in cooperative games. The appropriate conditions for children to be interested in playing cooperatively with friends are when children are given favorite objects or activities such as puzzles, playing number patterns, throwing and catching ball activities or anything related to numbers. This is also supported by analyzing the profile of mathematical logical intelligence in children with autism at an early age using the Multiple Intelligences Identification Checklist for Young Child with Autism (MIICYCA) instrument. and got a score of 7 from the range of $4.67>x>9.33$ in the medium category. So from this analysis, indicators of mathematical logical intelligence are also produced which will be stimulated through cooperative bowling activities.

Stage 2) design, at this design stage the researcher designs and produces a Cooperative Bowling game model in the form of steps, game rules and teacher instructions in the implementation of the Cooperative Bowling game adapted to the indicators of the child's mathematical logical intelligence to be stimulated. Stage 3) development, at this development stage the researcher designs and produces a visual design for the developed Cooperative Bowling game. Researchers designed pictures of numbers 1-10 which would later be affixed to bowling pins, as well as a pocket book design for the implementation of the Coopertaive Bowling game. Furthermore, the validity of the Cooperative Bowling game was tested by two experts on. The overall average score obtained from the validation of the Cooperative Bowling game is 3.5 from a range of 0-4, so it meets the valid criteria.

Stage 4) implementation, which is a game trial after the initial revision by the validator. The validator provides revisions to the developed game model and design. Process design with revised design certainly differs both from the visual design and in the steps and rules of the game. This implementation phase was carried out with 3 game trials, 2 initial trials and 1 evaluation trial. In the first trial, researchers found revisions to the steps and rules for

implementing the game because some points were not in accordance with the abilities of children with autism, so that after revision the steps and rules of the game could be more easily implemented by children and more optimal in stimulating mathematical logical intelligence. In the second and third trials the game model and design can be applied without revision.

Stage 5) evaluation, this stage is the evaluation trial stage to test the practicality and effectiveness of the Cooperative Bowling game. Practicality criteria are obtained through the results of the implementation of the Cooperative Bowling game stimulation activity with a recapitulation of the average score obtained is 3.6 from a range of values 0-4, so that it gets a high category and meets the practical criteria. The effectiveness test is carried out to measure whether the game can improve the achievement of indicators of children's mathematical logical intelligence through analysis of the level of children's playing activities and their level of mastery.

From the data of the first to third trials, a significant increase in ability was obtained. The child's ability to count the number of bowling pins still gets a little help from the teacher, namely the teacher stimulates the child to start counting by showing the fingers according to the numbers. The ability of children to mention the last number called the total bowling pin in one group still gets the help of the teacher, namely the teacher stimulates the child by mentioning the initial term of the number to be continued by the child. The ability of children to work together to form groups based on the same numbers still gets the help of the teacher, which is shown pictures of the numbers that children get when dividing groups. And finally, the child's ability to develop strategies to drop the pin also still needs the help of the teacher, although a little, namely the teacher at the beginning exemplifies various styles/models of how to throw the ball towards the pin.

Based on the average total score obtained by each indicator, the average score (mean) on all children's playing activities is 3 from a range of values of 1-4 and the percentage score of the average score of mastery scores obtained is 75% from the range 0 -100. So it can be concluded that the Cooperative Bowling game is proven effective.

Through the concept of the Cooperative Bowling game that was developed, demanding other children as tutors for other children, the steps and rules of the game children can play cooperatively with other inclusive friends. The process that runs is not as smooth as the child will immediately actively join his friends, but gradually with the assistance of the teacher the child will participate in playing cooperatively with his friend. Based on the theory and previous research, it can be concluded that the Cooperative Bowling game can be used as an activity to stimulate mathematical logical intelligence in children with autism at an early age, with an outline that the game has developed its concept, design, steps and game rules in accordance with the characteristics of the analysis results. carried out on children with autism in detail.

4 Conclusion

Based on the process and results of the development of the Cooperative Bowling game that has been carried out, it can be concluded as follows: 1) The process of developing the Cooperative Bowling game as an activity to stimulate mathematical logic intelligence in children with autism at an early age uses the ADDIE research model with 5 stages, consists of (1) analysis, (2) design, (3) development, (4) implementation, and (5) evaluation. 2) The

results of the development of the Cooperative Bowling game as a mathematical logic intelligence stimulation activity for children with autism at an early age were declared valid, practical, and effective. The results of the development of the Cooperative Bowling game are categorized as valid with an average value of 3.5 based on the assessment made by the validator. The implementation of the Cooperative Bowling game is categorized as high with an average value of 3.6 seen from observations on the implementation of stimulation activities carried out by teachers to children so that it can be said to be practical. The Cooperative Bowling game and its implementation are categorized as effective with an average value of 3 with a percentage of 75% seen from children's play activities that show active criteria, the level of student mastery on the achievement of indicators of mathematical logic intelligence shows positive results.

Authors' Contributions

Based on the objectives to be achieved from this research that is to find out the process and produce the development of the Cooperative Bowling game as a valid, practical, and effective mathematical logical intelligence stimulation activity for children with autism. It is hoped that the games that have gone through this trial can get a positive response for readers or other researchers. some suggestions that can be given that the use of bowling pins is better to use a larger size so that the number image is more visible and the pin is more firmly standing on the floor. It is hoped that this game can be developed for children with autism with severe categories and other types of special needs children, as well as the need for full assistance when stimulation activities are carried out.

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