

Innovation in Mathematics Learning on Students with Disabilities in Asia: Literature Review

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ABSTRACT

The literature review is aimed to analyze research regarding innovative mathematics learning in Asia. The research utilizes six articles discussing five media innovation learning in Indonesia and one instructional innovation learning in Malaysia. The results of the study shows that media learning innovation preferred to be implemented in the Mathematics classroom rather than instructional innovation learning. Furthermore, the students with the disability who usually appear as a subject are mentally retarded students, hearing impaired/deaf students, and students with learning disabilities.

Keywords: *Innovation, Special Education, Mathematics Learning, Students with Disabilities.*

1. INTRODUCTION

Mathematical ability is a fundamental ability that every human being needs to master. Mathematics has an essential role as a means of solving life's problems [1]. [2] defined that mathematics is universal knowledge that provides benefits for human life and a foundation in the development of modern technology. Mastery of mathematical abilities is crucial because it is beneficial and helps people solve problems in the life that these individuals go through. Problem-solving requires reasoning skills and critical thinking skills, and this is contained in mathematical abilities. Every individual needs to master this ability in solving various life problems that require reasoning and logic, including children with special needs.

On the other hand, children with special needs experience problems in mastering various abilities, including in mastering and developing mathematical abilities in their own. Learners with special needs have different learning characteristics from learners in general so that sometimes they have different abilities in developing their mathematical skills. The obstacles experienced by children in developing mathematical abilities can be influenced by factors of the intellectual level below the average of children in general, perceptual problems, difficulties in doing mathematical calculations, and the inability to take a systematic approach to solve problems [2]. These obstacles are very influential on learners with special needs so that children experience difficulties in developing mathematical skills like learners in

general. These obstacles also has an impact on their ability to solve problems.

Math calculation skills are required to understand and organize the world [3]. Some of the math calculation skills that need to be mastered in mathematics, namely understanding the number of objects, managing time, and other functional activities in daily life. The processing of numerical values, especially the relationship between numbers and quantities, seems to be a significant problem for mentally retarded children [3]. [4] stated that children with intellectual disabilities show much lower math achievement scores than children in general. [3] explained that children with Down Syndrome have problems with mathematical competence so that they have difficulty understanding the principles and concepts of numbers. Therefore, a particular strategy is needed to develop the mathematical abilities of children with special needs.

The impact of mathematics learning difficulties on children with special needs can be seen from their difficulties in carrying out daily activities, for example, managing time, measuring and using money. In a study conducted by [5], it was found that individuals with intellectual disabilities have difficulty calculating necessary mathematical abilities when doing transaction. These situations can be understood because the transaction process is a complex activity in which the individual must first identify the price of the goods, estimate the amount to be paid and paid for the sale and, if any, receive the change. Transaction or purchasing skills are an

essential function in a person's daily life [5]. For individuals with intellectual disabilities, the ability to earn, budget, and spend money is crucial to develop individual's autonomy or independence in life [5]. Therefore we need innovation in mathematics learning that is suitable for them.

Researchers have tried to find alternative strategies to improve numerical skills or basic math mathematical skills. For example, [6] conducted research, and the results of their research supported the functional relationship between VSM (video self-modeling) and the performance of math skills of children with intellectual disabilities and autism. [5] have also developed techniques with MPAS (mobile purchase assistance system), which can be useful in improving the independent purchasing skills of children with intellectual disabilities at the secondary school level. Besides, [7] also developed a CRA (Concrete-Representational-Abstract) learning strategy, which has proven effective in learning mathematics materials to solve problems of learners with special needs.

Many innovations in mathematics learning have been discovered and developed by researchers. However, most studies are conducted in western countries such as the United States. Cultural differences can lead to different results if applied in eastern countries. Therefore, the goals of this research is to find out mathematics learning innovations in children with special needs in the Asian region.

2. LITERATURE REVIEW

2.1. The Concept of Children with Special Needs and Its Classification

[8] explained that children with special needs are those who have special temporary or permanent needs, so they need inclusive education. Obstacles can cause special needs or innate or because of problems with economic, political, social, emotional, and behavioral pressures. Furthermore, [9] explained that children with special needs are those who have differences with the average child their age or children in general. The differences experienced by children with special needs occur in several things, namely the process of growth and development that experiences obstacles or deviations either physically, mentally, intellectually, socially, or emotionally. Thus it can be explained that children with special needs are children who have different obstacles and needs from other children. These distinct disorders include physical, mental, intellectual, social, or emotional specificities.

The classifications are mentioned through [10] classifies children with special needs into children with special needs, consisting of blind; deaf; speech disorders; mental retardation; physical disabilities; emotional disturbance; experiencing learning difficulties; the slow learner, autistic; has motor problems; being a victim of abuse of narcotics, illegal drugs, and other addictive substances; has other constraints or obstacles." So it can be seen that children with special needs are not only children with physical disabilities; children who have intellectual and social weaknesses as well as children with special needs. According to [11] children with special needs are grouped into nine, namely blind, deaf, mental retardation, physical disabilities, emotional disturbance, children with disabilities exceptional learning, slow learner, special intelligence and special talents, and autism.

2.2. Mathematics Learning Concepts for Children with Special Needs

2.2.1. The Definition of Mathematics

According to [12], mathematics is a universal science that underlies the development of modern technology, has an essential role in various disciplines, and develops human thinking skills. Strong mastery of mathematics from an early age is needed to master and create future technology. According to [13], Mathematics is the substance of the field of study that supports problem-solving in all areas of life. According to [14], Mathematics is defined as the science of numbers, the relationship between numbers, and the operational procedures used in solving problems regarding numbers. These statements illustrates that mathematics is concerned with learning, especially concerning numbers and the operations that help solve these numbers. However, mathematics is not only limited to numbers because mathematics will train students to form a systematic and rational mindset (critical thinking skills), be able to solve problems, and accustom students to be careful and diligent. Based on the definitions above, mathematics is a science with the ability to think logically, analytically, structured, creatively, thoroughly, so that learners can solve problems in daily life both theoretically and functionally.

2.2.2. Mathematics for Children with Special Needs

Barriers and obstacles in specific modalities that prevent them from learning mathematics are required in learning to be modified in a concrete and functional direction, or by mediating messages through sensory functions. This modification is a

special form of service. Mathematics is fundamental in everyday life, such as at home, and in society, mathematics or calculation will always be used. For example, a child going to the market and he will use the money; the use of money will involve math concepts and skills. For this reason, the skills to use mathematical concepts must be taught to every child, as well as children who have particular problems.

The use of calculations or the use of mathematical symbols to solve problems in life has vast implications in mathematics. National Council of Supervisors of Mathematics (NCSM) through ten basic skill areas included in the mathematics curriculum, namely problem solving, use of mathematics for daily activities, preparedness for the rationality of results, estimation, precise numeracy skills, geometry, and measurement, reading symbols and interpreting, compiling tables, charts, and graphs, use of mathematics for production and computer readability [15]. These ten skill areas are needed for all children, including children with special needs for problem-solving, use for daily activities, and numeracy skills. For example, children are taught to estimate meal portions, study time, worship, and rest. All of these activities require a division of time and volume. When division is required to solve the problem by estimating, so it takes a volume with the size/measure of the glass and plate, the time it takes ranges from hours and minutes and is adjusted to the rotation of the sun, all activities that need to be done in everyday life require the use of mathematics.

2.3. Innovation toward Innovative Mathematics Learning on Students with Disabilities

According to [16], innovation is an idea, practice, or object that is considered new, which is created by the individual or group for particular adjustments. Innovations can be in the form of products, events, or methods that are considered new to a person or group, both inventions and discoveries [17]. [18] stated that innovation is an idea, action, or something new in a particular social context to solve existing problems so it can be concluded that innovation learning is an effort to make changes in learning through understanding and constructing knowledge so that it can transfer information by improving and generating new or non-existing ideas. The purpose of learning innovation is to encourage students to develop critical thinking skills in solving learning problems.

According to [19], several aspects affect the scope of learning innovation, namely newness, reinvention, relative advantage, compatibility, complexity, trial ability, and it can be observed (observability). Newness, namely new findings that previously did

not exist in a particular society and social system, whether produced by each individual or group in the form of a process or product. Reinvention, namely the invention of recycling or renovation of learning innovations that are modified according to the needs of students as users or consumers to make it easier to capture or receive information. Relative advantage, namely the results that can increase the point of view of the attractiveness of students in using these innovations. Compatibility, namely the results of learning innovation products that are following student needs, will be more readily accepted by students and implemented in the learning process. Complexity is a product that is readily accepted by students so that it is easy to apply and use. Trial ability, every result of learning innovation that will be applied by students is tested first, so that it can be seen the results or the value of the benefits of the product for the learning process. If observed (observability), the benefits and drawbacks of an innovative product are carefully observed when testing the product. Based on some of the previous theories, it can be concluded that innovation in mathematics learning for children with special needs is a new or unprecedented idea or thought, whether produced individually or in groups, is a product, method, and strategy in learning. The mathematics learning process that has been adapted to the conditions of children with special needs so that the learning process creates a sense of interest and enthusiasm for students in acquiring new mathematics.

3. RESEARCH METHODOLOGY

The researcher used a literature review as a research methodology. The stipulation of articles is based on inclusive criteria and predetermined exclusive criteria. The inclusion criteria set are research conducted in the last ten research (experimental design), and full text. A series of exclusive criteria discuss mathematics learning innovations for children with special needs and have been implemented for more than ten years.

Article searches were carried out on ERIC, Proquest, and hand search (DOAJ, JSTOR, and Google scholar) using several keywords, namely mathematic learning or math instruction or math learning or innovation in math learning or math delivery program or math instructional design and student with special needs or special children or special student or special needs learners or students with special education needs or students with disabilities. Article stipulation is carried out in four stages. First, search for articles using keywords in the predefined article database and select articles with the same title. Second, choose an article by considering

the title. Third, choose articles based on the abstract. Fourth, select articles by considering the content of the text.

4. RESULT

The results of the article discovery process were carried out in four stages, namely as follows. First, search for articles using keywords in the predefined article database. The result obtained 522 articles. The selection of articles with the same title resulted in 16 articles so that the total articles used without the same title were 506 articles. Second, choosing articles by considering the title, the result is 33 articles. Third, choosing articles with abstract consideration obtained 14 articles. Fourth, selecting articles by considering the content of the text then obtained three articles. Also, searching for additional articles by hand searching found three articles that matched the inclusivity and exclusivity criteria. Based on the keywords, exclusive-inclusion criteria, and the method of determining articles previously described, six articles have been published in peer-reviewed journals. One article was published in 2014, 2017, 2018, 2019, and two articles were published in 2016. Besides, six studies were conducted in Malaysia to examine the effectiveness of the method and in Indonesia to examine the effectiveness of the media. The research subjects used in these six articles were deaf learners, children with learning difficulties, and children with mental retardation. A summary of the findings is presented in Table 1.

[20] examined the effectiveness of the Magic Finger Teaching Method (MFTM) and children's perceptions of MFTM. MFTM is a teaching method that focuses on manipulative techniques and the active involvement of children in calculating the multiplication results of facts that can be applied to deaf children. MFTM was created by focusing on the active involvement of children in learning multiplication. This study used a pre-test, post-test, and questionnaire with 70 children as subjects, 35 children as the experimental group, and 35 children as the control group. The results showed that the post-test mean score between the experimental group and the control group was significant ($t = 2.032$, $df = 68$, $p \leq 0.05$, $N = 70$). There is a difference in the mean score between the MFTM recipient group (mean = 40.00, $sd = 19.60$, $n = 35$) and the group receiving the mean of conventional teaching methods = 30.57, $sd = 19.21$, $n = 35$ at post-test. The findings from the t-test analysis showed that MFTM had a significant effect on the multiplication factor of deaf children achievement, while conventional learning methods had no significant effect on the achievement of multiplication facts among them. The findings from the questionnaire found that children

with hearing impairment have a high level of perception of MFTM in the dimensions of interest, self-confidence, persistence, and motivation in learning multiplications.

[21] examined the effectiveness of Interactive Mathematics Learning Media (IMLM) in mastering the mathematical, conceptual understanding of probability. This study applied a post-test only experiment with a control group design, namely 36 deaf children in VIIth grade of JHS. The Mathematical Concept Understanding (MCU) data were collected using essay tests and analyzed using a one-sided t-test with a significance level of 5%. The results of the analysis show that there is a difference in the average score of MCU abilities between the use of interactive media in helping learning compared to conventional learning in deaf children. Children in the experimental group were more motivated and more involved in learning because IMLM had accommodated their particular needs, namely the principles of face orientation and visual representation compared to conventional learning. Thus, it can be concluded that IMLM has a significant effect on the MCU.

[22] examined the effectiveness of the use of weighing media on the mastery of the concept of weight measurement in students with mental retardation in VIIth grade of JHS. The research design used in this study was the Single Subject Research (SSR) with the A-B-A model and used a unit score. The research subjects were children with mental retardation in VIIth grade of JHS-Special Education-C Kedungkandang Malang. The study was conducted for 17 sessions, namely five baseline phase 1 session, seven intervention phase sessions, and five baseline phase 2 sessions. Data collection methods are observation and tests. The result of the calculation of the percentage overlap between the baseline-1 phase and the intervention phase is 0%. Meanwhile, the intervention affects increasing target behavior because the overlap percentage is below 90%. Thus, it can be said that the use of weighing media affects the mastery of the concept of weight in mentally retarded children.

[23] researched the development of interactive PowerPoint learning multimedia and tested the effectiveness of power points in mathematics learning. This research is a research and development study that consists of three stages, namely preliminary studies, product development, and product effectiveness testing. The research subjects were 90 children with learning difficulties divided into three groups, namely 30 children in the experimental class, 30 children in the control class, and 30 children in the experimental class. Data collection was carried out through questionnaires, interviews, and tests, then

analyzed descriptively qualitatively, and T-test to examine the effect of the product. The trial results showed that the quality of multimedia was excellent, as indicated by an average score of 4.32. In terms of product effectiveness, the posttest mean score of the experimental class was 77.94, higher than the control class (73.94), who did not use learning media. The t-test results showed an increase of 14.27 (21.88%). This means that interactive multimedia learning from power points can improve mathematics learning achievement for mentally retarded children.

[24] examined the effectiveness of the snakes and ladders game in influencing the increase in the material ability to use money in mentally retarded children. Research using experimental re-treatment design (Time Series Design) is an experimental design that only uses one group of subjects, and measurements are carried out repeatedly. The research subjects were nine children with mental retardation class IV SD-LB Widya Bhakti Semarang. The results showed that the mean score for the pretest was 4.2222, the first post-test was 5.8889, the second post-test was 7,000, and the third post-test was 8.3333. Thus, it can be concluded that there is an effect of the game of snakes and ladders on increasing the material capability of currency.

[25] examined the effectiveness of providing remedial learning using the media number puzzle to improve the ability to recognize numbers 1 - 5 in mentally retarded children at TKLB SLB Negeri Semarang. This research is a single group experimental study with a time-series design. The sample of this study amounted to 3 children who were taken from the entire population based on predetermined characteristics. The study was conducted six times consisting of the first day of the pretest, and the next five days of treatment and posttest. The pretest and posttest questions are in the form of children's worksheets in the form of picture cards containing numbers and amounts, which are commonly called "loto" cards or flashcards. The results showed that there were differences in the score of the pretest and posttest, which had an increase, namely before being given treatment, a low average score was obtained, namely one, and the score after treatment was three, which means that children can recognize numbers independently. This can be concluded if the number of puzzle media is proven to be effective in increasing the ability to recognize numbers in mentally retarded children.

Based on the explanation above, all of these studies show that media and methods are effective in increasing the ability of material for children with special needs. In addition, research is dominated by learning media because there are five studies on

media and one research on mathematics learning methods for children with special needs.

5. DISCUSSION

Mastery of math skills is essential because it is beneficial and helps people solve problems in their life. On the other hand, children with special needs experience obstacles in mastering various abilities, including in mastering and developing mathematical abilities in themselves. There have been many mathematics learning innovations that have been discovered and developed by researchers, especially in western countries such as the United States. Cultural differences can lead to different results between eastern and western countries so that literature searches in the Asian region can reflect innovations in mathematics learning in the eastern region.

The classification of children with special needs is divided into nine of them, namely 1) blind, (2) deaf, (3) mental retardation, (4) physical disabilities, (5) emotional disturbance, (6) children with disabilities exceptional learning, (7) slow learner, (8) special intelligence and special talents, and (9) autism [11]. The research subjects in the articles that became literature were two articles of deaf children, three articles of mentally retarded children, and children with learning difficulties in one article. Thus, not all classifications of children with special needs are included in this discussion. Research in the Asian region is dominated by mentally retarded children, then deaf, then children with learning difficulties.

According to [19], several aspects affect the scope of learning innovation, namely newness, reinvention, relative advantage, compatibility, complexity, trialability, and can be observed (observability). Based on these several aspects, media methods and innovations in the article cover some or all of these aspects.

Innovation can be in the form of a product, event, or method that is considered new to a person or a group, be it an invention or an invention [17]. Based on a study of the results of research published in journals conducted in the Asian region, the researchers conducted the discussion based on Ibrahim's opinion, namely media and methods.

Table 1. The literature of Mathematics Learning Innovation in the Asian Region

Ref.	Country	Subject	Data Collection
20	Malaysia	70 hearing impaired/deaf learners	Test and questioners
21	Indonesia	36 hearing impaired/deaf learners in second grade of junior high school	Essay test
22	Indonesia	Mentally retarded learners in VII th grade of Junior High School (JHS) - Special Education	Observation and test
23	Indonesia	90 children that experience difficulties in learning	Questionnaire, interview, test
24	Indonesia	9 mentally retarded four grade learners in SDLB	Conducting test related to their achievement three times
25	Indonesia	3 mentally retarded learners	Questionnaire, interview, test

Table 2. Types, Results, and Conclusions of Mathematics Learning Innovations in the Asian Region

Auth.	Innovation	Results	Conclusion
20	Method	Deaf children have a high level of perception about the Magic Finger Teaching Method (MFTM) in the dimensions of interest, confidence, persistence, and motivation in learning multiplication	MFTM has a positive impact on the fact of multiplication of achievement in deaf children, while conventional learning methods have no significant effect on the achievement of multiplication facts.
21	Media	Children in the experimental group who use Interactive Mathematics Learning Media (IMLM) are more motivated, more involved in learning compared to conventional learning.	There significant influences toward <i>mathematical conceptual understanding</i> (MCU) in children.
22	Media	The intervention has an effect on increasing target behavior because the overlap percentage is below 90%.	Effect of media use mastery of the weight concept.
23	Media	The posttest mean score of the experimental class was 77.94; higher than the control class (73.94) who did not use multimedia learning media. In addition, the use of media can increase children's scores by 12.74 points or 21.88%.	There was an increase in mathematics learning achievement by using interactive multimedia learning from PowerPoint
24	Media	The results showed that the mean score for the pretest was 4.2222, the first post-test was 5.8889, the second post-test was 7,000, and the third post-test was 8.3333.	The existence of the influence of the game of snakes and ladders on the increase in material ability to use the currency.
25	Media	There is an added value between the pretest and posttest, namely when the pretest has a low average value of 1 and the value after treatment is three so that the child can independently recognize numbers.	The influence of using media puzzles in improving recognition skills numbers.

Research on the method in only one of the six articles used in the literature and conducted by [20] in Malaysia. This study tested the effectiveness of MFTM and the perceptions of children with hearing impairment towards MFTM. MFTM, which focuses on manipulative techniques and the active involvement of children in calculating the product of

multiplication, applies to children with hearing impairment. MFTM was created by focusing on the active involvement of children in learning multiplication in math. Five of the six articles discuss mathematics learning media for children with special needs in Indonesia. The media studied in this study were Interactive Mathematics Learning Media (IMLM) for conceptual mastery of mathematics understanding of probability in deaf children, weighing media for mastery of the concept of

measuring the weight of mentally retarded children in VIIth grade of JHS-Special Education, weighing media for conceptual mastery from the concept of measuring weight for children. Mentally retarded VIIth grade of JHS-Special Education, interactive multimedia power points for learning mathematics, especially time measurement) for elementary school mentally retarded children, snake and ladder games for mastery of currency material for mild mentally retarded children in grade IV SD-LB, and number puzzle media for the ability to recognize numbers 1 - 5 for mentally retarded children in TKLB. The results of research on media and methods for children with special needs can improve abilities in learning mathematics. There are five studies on learning media and research on mathematics learning methods for children with special needs. Thus it can be said that mathematics learning media innovation is more dominant in Asia than method innovation.

6. CONCLUSION

Basic math skills are needed as a provision in carrying out daily life so that everyone needs to learn, including children with special needs. Children with special needs who have various classifications and specific characteristics lead to the need for appropriate mathematics learning. In Asia, innovation in mathematics learning is more dominated by learning media than learning methods. Besides, children with special needs who are usually the subject are mentally retarded children, deaf children, and children with learning difficulties.

AUTHORS' CONTRIBUTIONS

Authors' contribution is increase knowledge about innovation in learning mathematics for children with special needs in the Asian region.

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