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Precision in Special Education : Insights from a Systematic Review on Data-Based Decision Making

Afifah Nurul Karimah*, Farida Kurniawati
Master of Profession in Educational Psychology, Faculty of Psychology,
Universitas Indonesia.
*Corresponding Author. Email: afifah.nurul21@ui.ac.id

Abstract: This research aims to identify the types of special needs that benefit from Data-Based Decision Making (DBDM), the stages of its implementation, and the challenges teachers face in executing DBDM effectively. This research used a qualitative approach, with a systematic literature review method using the PRISMA (Preferred Reporting Items for Systematic Review and Meta-analysis), systematically analyzing relevant articles from the Sage Journal and Wiley Online database scopus indexed published between 2013-2023. A total of 54 articles were initially identified, and through a thorough screening process, 5 articles were included for in-depth review. The data analysis technique for this research used a content analysis approach. The implementation of Data-Based Decision Making (DBDM) supports special needs students facing academic (e.g., reading and writing difficulties) as well as emotional or behavioral challenges. While Curriculum-Based Measurement (CBM) and Mastery Measures with clear decision rules are often used for academic difficulties, DBDM for behavioral issues is more complex due to the diversity of behaviors and required tools. Teachers are encouraged to apply DBDM, provided they develop skills in assessment selection, data processing, and analysis to adjust interventions effectively. Successful DBDM requires strong support from various school stakeholders. The review highlights the need for specialized training for teachers to enhance their competence in applying DBDM for diverse special needs students.

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Introduction

Data-Based Decision Making (DBDM) is a process that supports decision-making based on student data to enhance student outcomes and the success of teaching practices (Bruhn et al., 2020). According to Gullo (2013), DBDM assists teachers in designing effective interventions by using student data as a reference. This process includes gathering, analyzing, and interpreting data to ground educational practices in the field (Espin et al., 2017). DBDM process must use principles of educational psychology. The integration of educational psychology principles into Data-Based Decision Making (DBDM) is essential for tailoring data-driven practices to the unique needs of special needs students (Mandinach, 2012).

In the context of inclusive education, data serves as evidence for learning program effectiveness (Wilcox, Fernandez Conde, & Kowbel, 2021). The implementation of inclusive education must be tailored to student needs, with DBDM as an approach to ensure that students receive appropriate support. By regularly reviewing student data, adaptive learning platforms can pinpoint areas of both strength and difficulty for each student. This allows

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educators to offer specific resources and materials tailored to support individual students' needs and abilities (Papadopoulos & Hossain, 2023).

DBDM for special needs students aligns closely with the goals of precision teaching in education. DBDM enables educators to make informed decisions on selecting, adapting, and modifying interventions to meet individual student needs (Cook, Kilgus, & Burns, 2018). However, although inclusive education is increasingly recognized, many teachers still do not utilize a data-based approach to design teaching for special needs students. When teachers attempt to gather data on the progress of special needs students, the data is often not used to plan teaching strategies or identify appropriate programs, even though DBDM is proven to enhance student performance (Wilcox, Fernandez Conde, & Kowbel, 2021). Research indicates that academic achievement for special needs students improves significantly when teachers employ DBDM, compared to those who do not (Fuchs et al., 2014 in Bruhn et al., 2020). Teachers often face challenges in establishing effective decision rules when working with data on special needs students. Research on the use of data-decision rules for mildly special needs students suggests that applying structured decision rules, such as the 'minimum celeration' rule, positively impacts student growth (Neal, 1981).

Special needs students encompass not only those with intellectual deficits but also those facing emotional and behavioral challenges (Poch et al., 2022). Other studies reveal that DBDM application also improves responses to interventions among students with academic and behavioral issues (Stecker, Fuchs, & Fuchs, 2005 in Bruhn et al., 2018). According to Gischlar, Hojnoski, & Missall (2009 in Ruble et al., 2018), teachers of special needs students require skills in data collection and analysis to apply progress monitoring, enabling effective interventions. However, research by Jung et al. (2018) found limited detailed explanations of the instructional modifications teachers make based on student data, even though the core of DBDM is individualized, modified teaching. Espin, Forster, & Mol (2021) state that the optimal potential of DBDM implementation can only be achieved if teachers can use data as a source for instructional decision-making. Teachers require specialized training to apply DBDM effectively (Datnow & Hubbard, 2015).

This research addresses an urgent need to enhance educational outcomes for special needs students through DBDM practices. Special needs students often face unique academic and behavioral challenges that require tailored interventions. However, without proper data and decision rules, teachers may struggle to provide effective support. The primary purpose of this research is to identify types of special needs benefiting from DBDM, outline stages of DBDM implementation to provide a clear process for educators, and highlight challenges in implementing DBDM. By understanding the barriers teachers encounter, this research aims to inform training and support systems that can mitigate these challenges. Although DBDM is widely applied in general education, its application in special education—especially for various types of special needs, such as emotional and behavioral challenges—has been less explored. This research also brings a new understanding of the stages of DBDM implementation and the unique challenges faced by teachers.

Research Method

This research used a qualitative approach, with a systematic literature review method using the PRISMA (Preferred Reporting Items for Systematic Review and Meta-analysis). PRISMA was employed to analyze literature focused on DBDM practices for special needs students. Potential literature was searched online in electronic databases, specifically Sage Journal and Wiley Online Scopus indexed, using keyword combinations such as data-based decision making, data-based individualization, data-based instruction, special needs student,

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disability/-ies student, struggling student, and at-risk student. The search results were filtered based on titles and abstracts. Abstracts were analyzed to assess the eligibility and relevance of the literature to the research questions. Relevant literature was then read in full according to the set inclusion and exclusion criteria.

Relevant literature was selected and included based on the following inclusion criteria: 1) Literature published within the last 10 years (2013-2023) in the fields of education/special education or psychology; 2) The subject in the literature involves students with special needs; 3) The target of DBDM interventions aims at academic competence or behavioral/social competence. Literature that did not meet the following criteria was excluded from selection: 1) The subject in the literature is not students with special needs; 2) Literature with a meta-analysis or systematic review design was not included; 3) Literature that is not open-access or does not have full text available; 4) Literature that does not answer at least two of the research questions, including the stages of DBDM implementation by teachers and the challenges faced by teachers in applying DBDM.

In this systematic literature review, content analysis was used to systematically code and categorize data from selected articles to identify key themes related to Data-Based Decision Making (DBDM) for special needs students. Articles were screened, and relevant findings were coded based on recurring elements, such as types of special needs benefiting from DBDM, stages of DBDM implementation, and challenges teachers face. These codes were then grouped into broader categories, helping to reveal patterns and insights into DBDM practices. The resulting themes offered a structured understanding of DBDM's effectiveness and complexities, highlighting the need for tailored teacher training and stakeholder support.

Results and Discussion

Based on the search results using specific keywords, a total of 54 journal articles were identified. The search on the Sage Journal database was conducted in three stages: (a) using "data-based decision making" combined with terms like "special needs student," "disability/-ies student," "struggling student," and "at-risk student," yielding 7 articles; (b) "data-based individualization" with the same terms, yielding 3 articles; and (c) "data-based instruction" with these terms, yielding 24 articles. Similarly, on the Wiley Online database, three stages were followed: (a) using "data-based decision making" with the same terms, yielding 5 articles; (b) "data-based individualization," yielding 5 articles; and (c) "data-based instruction," yielding 10 articles.

The next step involved screening the titles and abstracts of the 54 articles found. After the initial screening, 9 articles from the Sage Journal database and 3 from the Wiley Online database were identified as relevant to the study's objectives. This screening resulted in a total of 12 articles suitable for further review. Subsequently, these 12 articles were thoroughly examined to apply more detailed inclusion and exclusion criteria. Out of these, 7 articles were excluded for not clearly discussing the stages and challenges of DBDM implementation, especially among teachers, leaving 5 articles for further review. Figure 1 below illustrates the PRISMA-based article selection process.

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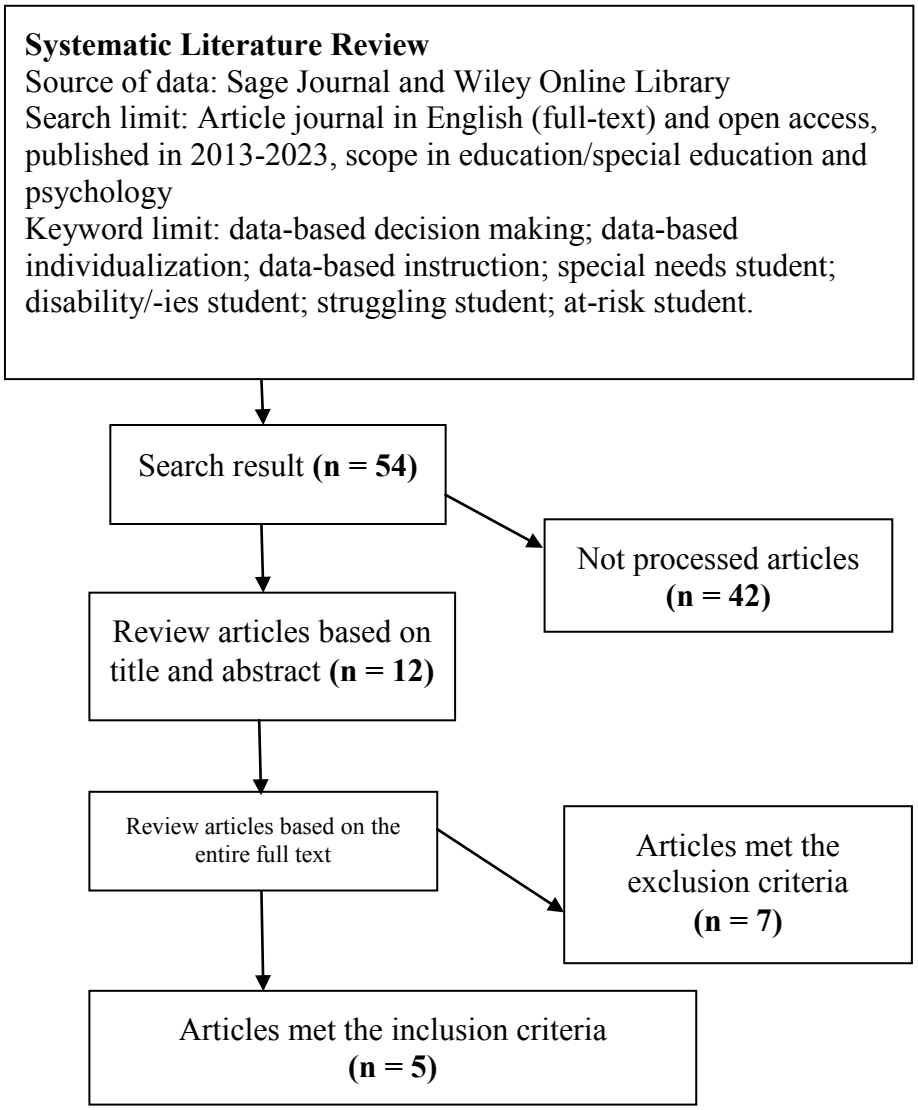

Picture 1. Result of Systematic Literature Review (PRISMA)

Types of Special Needs in DBDM Implementation

In general, findings indicate that DBDM can be applied across a range of special needs, including students with academic challenges and emotional or behavioral issues. DBDM is more frequently implemented for students with learning difficulties, particularly those facing challenges in reading and writing.

Stages of DBDM Implementation

The stages of DBDM implementation found across the five studies generally follow similar steps, including identifying student performance as a baseline, setting goals based on current student performance, monitoring progress through instructional modifications based on student responses, and selecting assessment tools to measure the effectiveness of teaching or intervention. Some studies also include steps such as reviewing information on appropriate interventions for students' specific needs and testing the reliability and validity of the tools used with students.

Challenges in DBDM Implementation

Teachers face several challenges when implementing DBDM, often due to a limited understanding of assessment types or difficulties in determining suitable decision rules to

measure students' responses to interventions. Additionally, a lack of skills in interpreting and analyzing data to set goals and modify interventions presents significant obstacles. These challenges demand substantial time and resources, making it crucial to have support from all school stakeholders in the DBDM implementation process. The table below provides a comparative overview of the systematic literature review findings from the five studies that met the criteria.

Table 1. Result of Systematic Review from Selected Article Journal

Study	Participant	DBDM Stages	DBDM Challenges
Filderman, Austin, Toste, 2019.	Middle school students are at risk of reading difficulties.	1. Selected assessments through approaches like Curriculum-Based Measurement or Mastery Measures. 2. Established baseline reading abilities. 3. Set data collection frequency. 4. Defined targeted performance goals. 5. Analyzed progress data based on selected assessments.	1. Limited assessment tools to monitor reading progress in middle school students. 2. Students require more time to demonstrate progress, making it necessary to consider motivation, expected improvement levels, and assessment tools used. 3. CBM also involves complex processes for setting performance goals, necessitating decision-making based on multiple data sources.
Austin dan Filderman, 2020.	Students with reading-related special needs.	1. Identified student needs through universal and standardized assessments. 2. Emphasized understanding strengths and weaknesses for progress monitoring using CBM and Mastery Measures. 3. Assessed the reliability and validity of available monitoring tools.	1. Schools often lack the resources to provide necessary assessment tools due to cost or logistical limitations. Additionally, choosing tools requires ensuring they have been tested in populations similar to those of students with special needs.
Poch, Allen, Jung, Lembke, dan McMaster, 2022.	Elementary students with writing difficulties or learning and emotional disabilities.	1. Selected tools based on specific student needs and applied three different assessments. 2. Established a baseline using median scores. 3. Determined scoring metrics. 4. Set long-term goals by referencing standard criteria or peer performance. 5. Ensured high-quality interventions, and monitored	1. The process demands teacher understanding in selecting appropriate tools, requiring three different assessments for baseline establishment. 2. Teachers need knowledge of scoring metrics for measurable long-term goal setting and must interpret data patterns in student progress to gauge the effectiveness of instructional methods.

		progress. 6. Used decision rules to assess intervention effectiveness and adjusted strategies accordingly.	
Washburn, Bailey, Pierce, Stewart, Hawley, Blackman, dan Fenty, 2022.	Students with reading difficulties.	1. Guided teachers in research-based teaching practices and formative/summative assessments, with a focus on stages of reading development. 2. Identified student profiles and selected reading assessments. 3. Analyzed data to establish instructional focus points and various reading development components.	Teachers need time to carefully select and study assessments that best match students' needs. Additionally, they may struggle to identify effective teaching strategies, especially those backed by evidence, and often find it challenging to organize, analyze, and apply data to establish instructional focus areas.
Cumming dan O'Neill, 2019.	Students identified with emotional and behavioral disabilities.	1. Choose evidence-based interventions. 2. Designed a progress monitoring plan. 3. Performed diagnostic assessments through methods like Functional Behavioral Assessment. 4. Adjusted intervention intensity and conducted periodic progress monitoring. 5. Returned to diagnostic steps if no progress was observed.	The process requires involving multiple stakeholders, including school leaders, general and special education teachers, school staff, and external support like counselors. Teachers handling the interventions need specialized skills in managing, collecting, and interpreting data for effective intervention decisions.

The results provide a deeper understanding of how DBDM (Data-Based Decision Making) can be applied across diverse special needs contexts, revealing that while DBDM is effective for academic challenges like reading and writing difficulties, it is less straightforward when dealing with behavioral or emotional issues. This highlights the importance of developing differentiated DBDM models that address the complexities of varying types of special needs. Conceptually, the findings suggest a need to refine DBDM frameworks to accommodate unique challenges and to expand current models to include comprehensive, multi-stage processes for special education contexts. Moreover, this understanding pushes educators and researchers to consider DBDM not just as a generalizable tool, but as one that requires flexibility and specialization.

On a practical level, these findings emphasize the need for robust, hands-on teacher training to develop essential DBDM skills, such as assessment selection, goal setting, data interpretation, and instructional adjustments. Educators need clearer decision rules and accessible, validated assessment tools tailored to special needs education, which would

Vol. 10, No. 4 : December 2024
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Email: jklppm@undikma.ac.id

simplify the DBDM process and increase its effectiveness. Additionally, the complexity and resource demands of DBDM implementation underscore the importance of collaborative support from school stakeholders—including administrators, special education coordinators, and parents—to ensure the necessary resources, time, and professional development are available.

Discussion

The application of Data-Based Decision Making (DBDM) practices is a fundamental strategy for enhancing effective teaching, which directly supports student learning outcomes. Using data enables teachers to set appropriate learning goals, monitor students' progress toward these objectives, and support them throughout the learning process (Hermann & Winter, 2011, in Schildkamp, Lai, & Earl, 2012). DBDM intervention leads to increased student achievement (van Geel et al., 2016). Findings show that DBDM practices have been successfully applied to special needs students related to academic, intellectual, emotional, and behavioral challenges. Fuchs & Fuchs (2007) found that implementing DBDM improves academic performance in areas like reading and math as well as students' behavioral functions. Similarly, Filderman & Toste (2018) highlighted that DBDM is recommended for enhancing instructional intervention intensity for students struggling to respond to standard learning approaches.

Generally, DBDM using the Curriculum-Based Measurement (CBM) approach is essential for students experiencing reading difficulties, as detailed in previous studies. CBM assists teachers in selecting appropriate interventions tailored to students' specific needs. Reading-related learning difficulties have established guidelines for DBDM implementation steps (Wilcox, Fernandez Conde, and Kowbel, 2021). CBM is advantageous because it enables performance monitoring based on norm-referenced skills, often employing standardized tests like the Woodcock Reading Test to compare student performance to grade-level expectations (Stecker, Fuchs, & Fuchs, 2005).

According to Deno et al. (2001), CBM employs two main assessment indicators. The first indicator is for students to read a passage aloud for one minute, with an observer recording the number of words read accurately. The second indicator, known as a maze reading test, involves students reading a passage for 2.5 minutes, with every seventh word removed and replaced with multiple-choice options. Students fill in the blanks, and the observer counts the correct responses. CBM can also provide insights into student differences (academic level differences in class) and track improvements after interventions.

As described by Shinn (2022), CBM serves as a model for intervention-based decision-making not only in reading but also in writing. In assessing writing, students typically have three minutes to write a story based on a provided story starter. The assessment includes counting total words and accurately using vocabulary and grammatical structure. Shinn (2002) likens CBM to a medical thermometer, providing standardized indicators to identify specific issues requiring further intervention. CBM significantly supports data-based decision-making due to its standardized metrics, which help teachers quickly identify issues needing intervention. CBM is particularly effective for frequent progress monitoring due to its ability to capture small changes over time, making it well-suited for academic skills like reading and math (Shapiro, 2008).

Another assessment tool, Mastery Measures, emphasizes tracking performance based on specific targeted skills in the intervention. This is often used in scenarios where educators need to confirm whether a particular skill has been fully learned, which is ideal for situations with well-defined endpoints rather than continuous progress tracking (Shapiro, 2008).

Vol. 10, No. 4 : December 2024
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pp. 1485-1495
Email: jklppm@undikma.ac.id

However, Mastery Measures limit flexibility in instructional planning and assessing students' abilities in broader contexts since they are criterion-referenced rather than norm-referenced (Filderman et al., 2018). For example, targeted skills in reading may include word recognition and decoding. Mastery Measures are ideal for students needing intensive, focused support in highly specific skill areas, such as those without phonemic awareness in reading (Filderman & Toste, 2022).

Things to consider when selecting appropriate assessment tools for the two methods above are: CBM allows for continuous adjustment in response to academic challenges (e.g., reading and writing difficulties), while Mastery Measures serve well in instances requiring validation of skill acquisition, such as when confirming that foundational skills are established before moving forward (Shapiro, 2008). The DBDM approach can also be applied to students with emotional and behavioral needs, particularly those requiring Tier 3 support (Cumming & O'Neill, 2019). DBDM, in this context, emphasizes guidelines to intensify interventions, using an iterative process of data-based progress monitoring and evaluation. In contrast to academic-focused DBDM stages, the process for behavioral needs begins with selecting evidence-based interventions before collecting and comparing progress data as a benchmark for intervention adjustments. Bruhn, McDaniel, et al. (2018) stated that behavioral data collection focuses on tracking changes in monitored behaviors.

In contrast to DBDM stages for academic needs, behavioral goals lack standardized benchmarks. Behavioral improvements generally take longer, requiring lower initial targets that are achieved gradually over time (Bruhn, Wehby, & Hasselbring, 2020). Unlike CBM, which has established decision rules, behavioral decision-making rules are complex and challenging due to the variety of tools and behaviors involved. Data collection for behavior often involves systematic observation, behavioral ratings, or measures linked to specific interventions (Bruhn, Wehby, & Hasselbring, 2020). The study by Chafouleas et al. (2012) on using Direct Behavior Rating (DBR) single-item scales highlights a practical approach for tracking behavior change in students. Their findings emphasize the value of sensitive and straightforward tools for monitoring behavior, allowing teachers to make data-driven decisions regarding interventions for students with emotional and behavioral challenges.

Implementing DBDM involves complex processes and requires teachers to develop specialized knowledge, dispositions and skills for special needs students (Mandinach & Summer, 2016). In the context of the DBDM study discussed, perceived control, instrumental attitude, and intention regarding data use also play critical roles in how effectively teachers implement Data-Based Decision Making (DBDM) with special needs students (Prenger & Schildkamp, 2018).

One of the main challenges for teachers is differentiating data-based decision rules to match their students' needs (Filderman et al., 2018). This difficulty also ties closely to teachers' abilities and confidence in analyzing data to make informed decisions (LaLonde et al., 2023). Although DBDM provides numerous benefits for students, teachers often face limitations in data literacy, data accessibility, difficulties in data collection and analysis, as well as time and cost constraints related to DBDM processes (Nurzen, 2022). Collaboration within schools also has the greatest influence on DBDM practices in schools (Schildkamp et al., 2017).

Conclusion

The application of DBDM can be extended to special needs students with both academic (reading and writing difficulties) and emotional or behavioral challenges. For students with reading and writing difficulties, DBDM often utilizes Curriculum-Based

Measurement (CBM) or Mastery Measures approaches with established decision rules. However, for students with emotional and behavioral difficulties, DBDM implementation is significantly more complex due to the diversity of behaviors being addressed, the measurement tools required, and the decision rules applied.

Teachers are encouraged to apply DBDM, provided they develop essential DBDM skills, including assessment selection, data processing, and analysis, to adjust interventions as needed. Successful DBDM implementation requires comprehensive support from various stakeholders within the school.

Recommendation

These findings encouraged teachers to apply tailored approaches that recognize the unique requirements of different special needs categories. Teachers could benefit from a step-by-step guide for implementing DBDM in real classroom settings. Such guidance should include specific decision rules for determining when and how to adapt interventions based on ongoing data, helping teachers apply DBDM with greater consistency and effectiveness.

Policy makers should support the development and implementation of DBDM's standardized training modules for special needs students teachers. Such training modules could be tailored to address different types of special needs, including the introduction of various assessment methods aligned with each student's specific needs. Effective DBDM implementation requires ongoing support and resources, including assessment tools, data management systems, and professional development. Policy-makers should prioritize these resources in school budgets and policies, enabling teachers to access the necessary tools and support for DBDM application. Further research could focus on defining decision rules and establishing step-by-step guidance for applying DBDM across different types of special needs students.

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