A systematic literature review of data-driven decision making: professional development program and its impact in enhancing teachers efficacy

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Article Info	ABSTRACT
	This article aims to collect, evaluate, integrate, and present the discussed articles to understand how professional development programs can enhance teachers' efficacy in implementing data-driven decision-making (D3M). Currently, many teachers have not applied D3M in their classrooms, even though D3M can help teachers develop effective teaching methods in class. One reason for this is the lack of teachers' efficacy in applying D3M. Therefore, this article includes several articles focused on professional development programs to improve teachers' efficacy in implementing data-driven decision-making in the classroom. This article uses a systematic literature review, specifically the PRISMA model, to select articles that meet the inclusion criteria based on the aforementioned topic. The findings show that the dimensions of efficacy, namely mastery experience, vicarious experience, verbal persuasion, and physiological and emotional states, are influenced when a program is designed with a focus on the content to be discussed, uses active learning methods, aligns with existing policies, offers sufficient duration, and fosters collective participation. Mastery experience can be enhanced through the content provided, active learning, and the appropriate duration of training. Verbal persuasion can emerge through the active learning process. Meanwhile, vicarious experience can be created through active learning methods, collaborative participation, and long program durations. When these three dimensions are met, individuals' physiological and emotional states will also improve. Learning through active learning and program duration are crucial aspects for enhancing teachers' efficacy after receiving a professional development program. Thus, professional development programs can be an effective way to increase teachers' efficacy in implementing D3M.

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Introduction

Data-Driven Decision Making (D3M) is a practice that uses data to do decision-making in making instructional strategies, not only using intuition (Provost & Fawcett, 2013). D3M is a cyclical process. There are 5 stages in implementing D3M: 1) Identifying the problem that needs to be solved; 2) Searching for and interpreting the data; 3) Converting existing data to information; 4) Transforming the information into decision to solve the existing problem; 5) Evaluating the implemented decision (Schildkamp, 2019; Mandinach & Gummer, 2016,

Lai & Schildkamp, 2016). In the educational setting, D3M is used to adjust teaching methods for students by providing teachers with student data, enabling them to tailor their teaching methods accordingly. This is because teachers can obtain student performance data and analyze it to develop appropriate instructional strategies that support the learning process. Consequently, teachers can improve their teaching methods, leading to better student engagement and understanding during the learning process (Jiang et al., 2024). The implementation of D3M in adjusting teaching methods has been shown to improve student achievement (Reeves & Chiang, 2018). In addition, data is also used to monitor teachers' performance, diagnose areas that need improvement, and make informed decisions to enhance the quality of education (Schildkamp, 2019). Given the complexity of the stages, it is essential for teachers to possess the knowledge, skills, and ability to interpret data effectively.

In some countries, policies regulate the use of data-driven decision making in the context of education, one of which is in the United States. The use of data was initially governed by the No Child Left Behind (NCLB) policy and later by the Every Student Succeeds Act (Mandinach & Schildkamp, 2021). Meanwhile, in Indonesia, the government provides various platforms for collecting school data, such as the National Education Report Card (Rapor Pendidikan Nasional) and One Data Indonesia (Satu Data Indonesia). However, ICSEI (2011) reports that many school stakeholders face difficulties in using the D3M method due to challenges in data use, not using data effectively, or even not using data at all. In addition, research conducted by Nurzen (2022) and Dunn et al. (2012) revealed that the obstacles to implementing D3M in schools include the unavailability of necessary data, lack of support from involved parties, cultural issues, and insufficient competency of resources such as schools and teachers. The lack of teacher competence in implementing D3M in the classroom is due to insufficient training on data literacy (Nnorom et al., 2023). Based on research conducted by Abrams et al. (2021), it is known that one of the key factors in enhancing teachers' efficacy in implementing D3M is data literacy skills. Although schools have abundant student data, this data is rarely used in decision-making for school improvement (Robinson et al., 2002). Nevertheless, the use of data can help teachers enhance their competence, improve student achievement and effectiveness, and foster overall school improvement (Lai & Schildkamp, 2016; Dunn et al., 2012).

One critical competency for implementing D3M is teacher efficacy. Dunn et al. (2011) define teacher efficacy in implementing D3M as a teachers' confidence in applying D3M in their classroom practices. In implementing D3M, teachers also require self-efficacy, which is the belief in their ability to support student learning through D3M (Bruce et al., 2010). Teachers with high efficacy are generally more adaptable to learn and implement new teaching practices and show greater persistence when encountering challenges (Tschannen-Moran et al., 1998). Yan and Cheng (2015) found that self-efficacy has a positive relationship with an individual's intention to engage in an activity. This means that when a teacher has not implemented D3M for the previously mentioned reasons, it could be due to their low efficacy and lack of data literacy skills. When a teacher has low self-efficacy, they often struggle to manage the classroom, implement effective instructional strategies, and enhance student engagement, making teaching methods in the classroom ineffective (Wang et al., 2016). Ineffective teaching, in turn, negatively impacts students' academic performance (Çibukçiu & Shaqiri, 2024). According to Wang et al. (2016), professional development focusing on coaching and mentoring can improve teachers' self-efficacy. This aligns with research by Baysal and Mutlu (2021), which found that professional development programs can enhance teachers' classroom efficacy and recommend that teachers participate in such programs. Therefore, teachers need to enhance their efficacy through professional development program. This can help teachers to effectively implement the teaching methods they provide to students and improve the implementation of D3M in class.

There are four ways to shape teachers' efficacy: 1) mastery experience (success in applying the D3M method in the classroom); 2) vicarious experiences (observing others applying the D3M principles); 3) verbal persuasion (encouragement from others (e.g., school principal) to boost the teacher's confidence); and 4) physiological and affective emotional states (e.g., managing anxiety) (Bandura, 1997). Teacher efficacy is also shaped by feedback and specific experiences (Gist & Mitchell, 1992). Additionally, Tschannen-Moran and McMaster (2009) mention that professional development programs can enhance teachers' efficacy. Based on that research, it is known that the best programs to enhance teachers' efficacy are those incorporating verbal persuasion, vicarious experience, and mastery experience. They did not further investigate the dimensions of physiological and affective emotional states, so these dimensions were not examined in depth. Nonetheless, Tschannen-Moran and McMaster believe that, in fact, training participants experienced some form of emotional response, either positive or negative, as a result of the training.

Based on the explanation above, this study is expected to provide new insights and solutions to the challenges teachers face in implementing D3M in the classroom. The approach is to map out the aspects of professional development programs to create effective training that enhances teachers' self-efficacy in implementing D3M,

which has not been systematically addressed in previous studies. With improved teacher self-efficacy, it is hoped that it will positively impact student performance in the classroom.

Method

This study used Systematic Literature Review (SLR), which is a systematic way to collect, evaluate, integrate, and present articles that has been found based on research questions (Pati & Lorusso, 2018). PICO is used to define the research question. A clear research question is the first step in conducting valid research (Eldawlaty et al., 2018). PICO is an acronym for Participant, Intervention and Comparison (if available), and Outcome. In this study, P refers to teachers, I refers to the professional development program on data-driven decision making, and O refers to the improvement of teachers' self-efficacy. Based on the determination of PICO, the research question is formulated as "How can a professional development program enhance teachers' efficacy in implementing data-driven decision making?". Articles that include methods to enhance teachers' efficacy through training programs were identified through a systematic database search. The searching process using Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) (2020). The diagram that contains criteria and inclusion process shown in Figure 1.
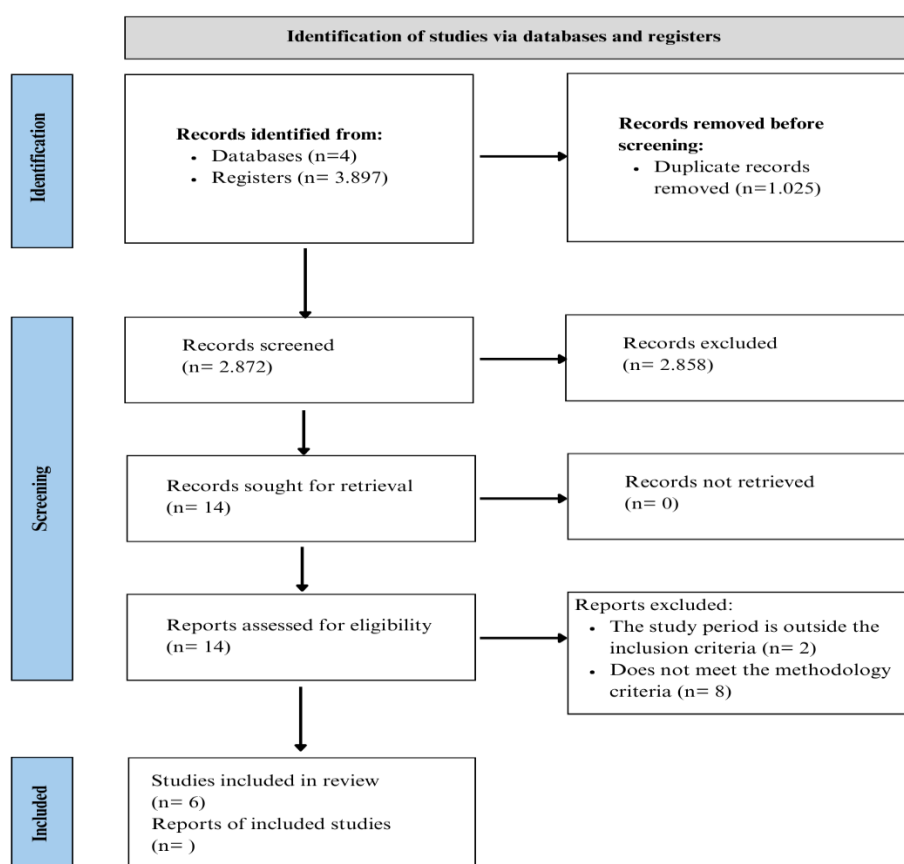
Figure 1. PRISMA Flow Diagram

The search for articles was conducted on 3rd June 2024 in 4 electronic databases, which are ScienceDirect, Sage Journal, SCOPUS, dan JSTOR. We used the key words "Data-Driven Decision Making", "Data-Based-Decision Making", "Teachers Efficacy", and "Intervention". We conducted the article search twice, with the first one using the keyword "Data-Based Decision Making," and the second one using the keyword "Data-Driven Decision Making". Meanwhile, "Teachers Efficacy" and "Intervention" were always mentioned in both searching processes. The search was also conducted using the Boolean method, where the word "AND" was used between each keyword. This method was employed to ensure that the research obtained was specific and relevant to the keywords used in the study. During the article search process, journal filters were used to specify the articles retrieved. The filters applied included a publication range from 2013 to 2023, and the targeted topic focused on articles discussing the subject from the perspectives of psychology and education.

In addition, to select the articles to be reviewed, inclusion and exclusion criteria were established. The articles included in the review have the following criteria: 1) The research subjects are working as teachers because they

are facing challenge in implementing D3M in school; 2) The studies are peer-reviewed and published between 2013 - 2023; 3) The research discusses interventions implemented to enhance teachers' efficacy in carrying out Data-Driven Decision Making, specifically intervention in the form of training; and 4) It discusses the training process provided to teachers to help them understand the aspects of the professional development program being discussed. Meanwhile, the exclusion criteria are: 1) The research subjects are not working as teachers; 2) The studies are not peer-reviewed and were published before 2013 or after 2023; 3) The types of studies include literature reviews, meta-analysis reports, conferences, and case studies; 4) The research methods are mixed method, qualitative, or quantitative; 5) The research does not discuss training interventions to enhance teachers' efficacy in carrying out Data-Driven Decision Making; 6) It does not discuss the training process provided to teachers. Therefore, articles that do not meet the established inclusion criteria will not be reviewed.

Results and Discussions

This article aims to explore how professional development programs can enhance teachers' efficacy in implementing D3M. Before the articles were reviewed, several articles were identified through the screening process and were evaluated according to predetermined criteria. Out of the many articles screened, only the following articles were reviewed in this paper, as other studies did not meet the specified criteria. Some studies did not address teacher efficacy or data-driven decision-making, while others lacked details about the training process, making them irrelevant to the researcher's question, which aims to explore the dynamics of intervention on teacher efficacy. As a result, six articles discussing teachers' efficacy following intervention are included, as shown in Table 1.

Tabel 1. Data-Driven Decision-Making Intervention

Title	Author(s)	Intervention Design	Result
A classroom data literacy intervention for pre-service teachers	Reeves & Honig (2015)	The intervention was a 6-hour program designed for pre-service teachers, focusing on enhancing their data literacy skills.	The results of the post-test show that the teachers' efficacy is higher compared to the pre-test.
Effect of an intensive data-based decision making intervention on teacher efficacy	Van der Scheer & Visscher (2016)	Offline intervention The intervention was made based on 3 main sources for developing teachers' efficacy (mastery experience, vicarious experience, and verbal persuasion).	Of the three dimensions of teachers' efficacy, only instructional strategies and student engagement showed a significant effect after the intervention. Meanwhile, the classroom management dimension did not experience a significant effect.
Building pre-service teacher capacity to use external assessment data: an intervention study	Reeves & Chiang (2017)	The intervention described in the article was a 6-hour course-based program aimed at enhancing preservice teachers' ability to use standardized assessment data effectively.	The intervention in this article led to significant growth in teachers's efficacy regarding D3M.
Online interventions to promote teacher data-driven decision making: Optimizing design to maximize impact	Reeves & Chiang (2018)	Online and asynchronous intervention using D5 X 4 (Data in Five by Four) method.	There was an increase in teacher efficacy after the intervention was provided.

Title	Author(s)	Intervention Design	Result
Effect of an asynchronous online data literacy intervention on pre-service and in-service educators' belief, self-efficacy, and practices	Reeves & Chiang (2019)	The intervention was held through an asynchronous online format focusing on D3M. The authors used D5 X 4 intervention.	The results indicated that the intervention effectively enhanced teachers' beliefs in their capabilities to engage in D3M.
Does learning how to use data mean being motivated to use it? Effects of a data use intervention on data literacy and motivational beliefs of pre-service teachers	Wurster et al. (2023)	Online intervention The intervention was held in the middle of semester with 6 hours learning time. The objective of this intervention is to improve teachers' data literacy skill and their motivational beliefs.	The intervention was significantly affecting teachers' efficacy regarding D3M.

Based on the analysis of the journal articles found, it is evident that professional development interventions provided to teachers can enhance their efficacy in implementing D3M in the classroom. Professional development is an opportunity given to teachers to help them improve their knowledge and skills in developing instructional strategies (Borko, 2004). According to research conducted by Schelling and Rubenstein (2023), Reeves and Chiang (2018), Van der Scheer and Visscher (2016), as well as Gilles et al. (2009), it is known that professional development programs have a positive impact on teachers. For instance, teachers may develop a positive attitude towards D3M, have the intention to implement D3M in the classroom, and have higher self-efficacy. In addition, teachers' anxiety when implementing D3M in the classroom will also decrease due to the significant negative relationship between anxiety and self-efficacy. Therefore, as teachers' efficacy increases, their anxiety in implementing D3M will actually decrease (Reeves & Chiang, 2018; 2019).

Professional Development Program to Enhance Teachers' Efficacy
According to Desimone (2009), there are several important aspects that make a professional development program effective, namely content focus, active learning, coherence, duration, and collective participation. In Table 2, each journal article is explained in accordance with an effective professional development program.

Tabel 2. Checklist of Effective Professional Development Program

Author(s)	Effective Professional Development Program				
	Content Focus	Active Learning	Coherence	Duration	Collective Participation
Reeves & Honig (2015)	✓	✓	✓	-	✓
Van der Scheer & Visscher (2016)	✓	✓	✓	✓	✓
Reeves & Chiang (2017)	✓	✓	✓	-	✓
Reeves & Chiang (2018)	✓	✓	✓	-	-
Reeves & Chiang (2019)	✓	✓	✓	-	-
Wurster et al. (2023)	✓	✓	✓	-	✓

Content focus means that the program designed and delivered to teachers focuses on subject matter content. This implies that all the materials or information provided are relevant and related to the topic intended to be taught. In all studies mentioned in Table 1, the training provided in both cases focused on enhancing teachers' ability to implement D3M. However, in the study by Van der Scheer and Visscher (2016) and Reeves and Chiang (2019), the program was aimed at examining its effect on teachers' efficacy. While the other studies have the main objective in examining the effectiveness of the program in order to enhance teachers' understanding and application of D3M in educational context. Additionally, some studies (Wurster et al., 2023; Reeves & Honig, 2015) examined the changes in teachers' beliefs and attitude toward the application of D3M. Nevertheless, the content in the program is designed to focus on enhancing teachers' knowledge and skills regarding D3M. According to Garet et al. (2016), for a professional development program to be effective in improving teachers' knowledge, the content created must focus on the topic to be conveyed. This is because program materials that focus on specific topics are able to enhance teachers' knowledge and skills, improve practical abilities, and even indirectly increase student achievement. Furthermore, a study by Desimone et al. (2002) states that when a program aligns with a specific content area, it provides teachers with clear instructional practices.

Subsequently, active learning becomes one of the important aspects to optimize the effectiveness of the designed professional development program. This is because participants will be asked to observe the trainer or be observed by other participants, provide feedback to each other, and engage in discussions, review the work of other participants, and lead discussions. All six studies aimed to apply aspects of active learning in their programs. Some studies asked participants to discuss with each other. The discussions were based on questions regarding the use of data in the teaching methods provided to the participants. One form of discussion was to give suggestions on each participant's answers to the questions provided (Reeves & Chiang, 2017; Reeves & Chiang, 2018; Reeves & Chiang, 2019). In addition, another method used was to ask participants to analyze and interpret the data provided. Participants were also given the opportunity to discuss their teaching processes with a facilitator, who would then provide ways to implement D3M in the classroom (Van der Scheer & Visscher, 2016). Participants were also asked to directly practice the D3M process, starting from entering data into a provided format to conducting both quantitative and qualitative analyses (Reeves & Honig, 2015). In active learning, researchers aimed to engage participants in directly practicing the D3M material provided. This aligns with the research by Kulachit and Nuangchalerm (2022), which shows that active learning can enhance participants' understanding of the material. Furthermore, Ross et al. (2019) also stated that after implementing a program using active learning, participants' desire to apply the skills they acquired increased.

Another important aspect is the coherence between the topics or materials in the professional development program and teachers' knowledge and beliefs, as well as government policies. Both studies, conducted by Reeves and Chiang and by Van der Scheer and Visscher, were carried out in accordance with the policies established by the governments of the countries where the research was conducted. In the study by Reeves and Chiang, which took place in the US, it was found that both attempted to conduct training that aligned with the No Child Left Behind Act (NCLB), which emphasizes the importance of using data in education. Meanwhile, in the study by Van der Scheer and Visscher, conducted in the Netherlands, the topic of D3M aligned with the policies of the Dutch Inspectorate of Education. This policy emphasizes the importance of education for every child. The institution uses data to evaluate and monitor schools, and to analyze data in order to create policies for each student. The study by Wurster et al. (2023) was based on the Data Literacy Framework for Teachers (DLFT), which is part of the government's policy that emphasizes the importance of data literacy in education. On the other hand, other studies did not explicitly mention the coherence between the designed interventions and local government policies. However, several countries have policies on data literacy in education, including Finland and Germany.

The duration of the professional development program is also one of the aspects that affects the effectiveness of the training. The time required is usually related to the extent of the changes desired in teachers (Shields, et al., 1998). A longer duration allows teachers more time to discuss and delve into the professional development program provided. When comparing several studies, it was found that out of the six studies, only the one conducted by Van der Scheer and Visscher (2016) had a long duration, spanning 1 year (2 semesters). The program had a high impact on teacher efficacy because they had more time to fully understand the concept of D3M implementation. Additionally, a long duration led to a long-lasting effect of the program. Meanwhile, the total duration of the program in other studies ranged between 6 to 7.5 hours. This affected teachers' understanding of implementing D3M in the classroom. This is consistent with the limitations of the study by Reeves and Chiang (2019), where teachers found it difficult to implement D3M due to the short duration of the program. The complexity of the skills required to implement D3M in the classroom means that teachers need more time to understand the concept. Especially when the program is conducted online and asynchronously, participants tend to learn at their own pace. Furthermore, another impact is the lack of real-time interaction, which affects the depth of understanding and engagement among participants. When a professional

development program has a long total duration, it influences teachers' confidence in implementing new strategies (Harmon et al., 2023; Oktay & Eryılmaz, 2020).

The last aspect is collective participation. This aspect emphasizes the importance of collaboration among teachers within the same school, cohort, or department. Its importance lies in giving teachers the opportunity to discuss concepts, skills, and challenges encountered during the professional development program. Additionally, teachers can integrate the insights gained during the program into their instructional practices in the classroom (Lee, 2005). In the studies conducted by Van der Scheer and Visscher (2016) and Wurster et al. (2023), it was found that both emphasized the importance of applying collective participation when designing programs by intervening with several teachers from the same schools. This implementation helped teachers collaborate, share experiences, and learn from each other, thus improving the effectiveness of the intervention. Collective participation can also be fostered by comparing others' work, engaging in discussions, sharing experiences, and providing feedback to one another. However, in the studies conducted by Reeves and Chiang (2018; 2019), collective participation was not implemented because the intervention program was conducted online and asynchronously. This resulted in reduced affective engagement among participants during the program, compounded by its online execution. This aligns with the study conducted by Fütterer et al. (2024), which found that professional development programs conducted online typically reduce the level of engagement among participants. Evert and Stein (2022) stated that collective participation is important to apply during professional development because it significantly helps teachers in implementing newly learned concepts, especially in their school/organization.

The Dynamics of Professional Development Programs with the Improvement of Teachers' Efficacy
A professional development program is one form of intervention that can be provided to teachers to improve their ability to implement D3M in the classroom. However, its implementation must consider aspects that can determine the effectiveness of the program. When a program is effective, there will be many effects or benefits that the program participants, in this case, the teachers, can experience, such as learning new skills, developing leadership abilities, expanding networks, enhancing expertise in their field or career, and increasing self-confidence and credibility (Parsons, 2022).. Additionally, Yoo (2016), stated that professional development can also influence a teacher's efficacy and is even recommended for teachers to participate in it (Baysal & Mutlu, 2021). According to Yoo, the increase in teachers' efficacy levels is due to their acquisition of new knowledge, which is related to the improvement of their teaching efficacy. Additionally, Joyce and Showers (1995) explain that teachers' efficacy can increase because, in professional development, teachers are given opportunities to apply new teaching strategies, engage in peer coaching, and accommodate students with new learning methods effectively. Darling-Hammond et al. (2017) also state that teachers' efficacy can improve when the training provided is collaborative and job-embedded. This means that the intervention program is closely related to the teachers' current work, allowing them to apply newly acquired knowledge or skills to their job.

According to Bandura (1997), there are four dimensions of self-efficacy: enactive mastery experience, verbal persuasion, vicarious experience, and physiological and affective states. Research by Bümen (2009) shows that teachers' efficacy can increase if these four dimensions are fulfilled. Mastery experience refers to an individual's experience that leads them to reflect on and assess their abilities in performing an activity, in this case, teaching. Mastery experience directly influences teachers' self-efficacy because, according to Bandura (1997), when someone succeeds in an activity, it increases their mastery expectation. Conversely, when failure occurs repeatedly, teachers lower their mastery expectations, which in turn affects their self-efficacy. In the articles discussed in this study, teachers are not only given content through seminars but also engage in direct practice of D3M in the classroom (content focus and active learning). Some articles ask teachers to bring data from their current classes and use it for decision-making in instructional strategies.

Moreover, when feedback is provided, teachers can identify areas for improvement and recognize their own progress (Budworth & Chummar, 2018). To cultivate self-efficacy, individuals must face challenges so that they do not expect instant success from continual achievements. This way, individuals develop resilience in their sense of efficacy, which is crucial when encountering failure (Bandura, 1997). With feedback, teachers' performance in implementing D3M will improve (Budworth & Chummar, 2018). It is essential that feedback is not a one-time occurrence, so the duration of the professional development program should be considered to meet teachers' needs. The feedback given also influences the dimension of verbal persuasion. Verbal persuasion refers to verbal reinforcement that convinces an individual that they have the capability to achieve the skills they are learning (Bandura, 1997). While individuals can assess their abilities, when others persuade them that they have more potential, their doubts about their abilities often disappear. One form of verbal persuasion is feedback. It is important that the feedback is provided by someone with expertise in the field (a coach or expert) and that it conveys the message that the individual's progress demonstrates their abilities. In the articles discussed,

feedback is provided during active learning activities. Every time participants complete practical tasks, feedback is given by facilitators who are experts in D3M.

To enhance self-efficacy, vicarious experience is also necessary through the assessment of models. This means that individuals compare themselves with others to evaluate their performance in relation to others (Bandura, 1997). This comparison also helps build self-confidence by observing the success of others with similar abilities. When individuals see others succeed in performing a task, it boosts their confidence that they can also succeed in that task. This observational process can be incorporated when the program design uses active learning methods, where participants are asked to observe facilitators or other participants, allowing them to compare their abilities. Additionally, through collective participation, participants can engage in discussions about the training process. They can also share insights gained during the training (Lee, 2005). In this way, participants can support each other in enhancing their self-efficacy. Since the observation process requires time, the program's duration should be considered, as it will influence the experiences of the participants.

When evaluating capabilities, an individual may rely on somatic information from their physical and emotional states. Physical indicators that individuals may experience when their self-efficacy is low could include a racing heart, stress, pain, and other sensations. Moreover, mood also affects an individual's assessment of their self-efficacy (Bandura, 1997). When the other three dimensions of self-efficacy are fulfilled, teachers' physiological and affective states will be positively influenced as they develop a more positive perception of their abilities. With these three dimensions, negative responses that teachers might feel will diminish because they have experienced previous successes, received support from experts, and observed the success of others. Ultimately, teachers will be able to better manage their physical and emotional conditions.

From the previous explanation, it can be understood that well-designed professional development programs have a significant impact on the effectiveness of the programs delivered. Such programs are structured to meet the specific needs of teachers, providing them with the necessary knowledge, skills, and strategies to enhance their teaching practices. When the provided program is effective, it indirectly increases the teachers' efficacy in implementing D3M (Data-Driven Decision Making) in the classroom. This heightened sense of efficacy not only boosts teachers' confidence in their ability to utilize data effectively but also encourages them to engage more deeply with the instructional materials and methods they use. However, it is important to note that an effective program has a design that incorporates active learning methods and has a long duration.

As teachers become more proficient in applying data-driven strategies, they are likely to adopt more innovative and effective instructional practices, leading to enhanced student engagement and learning outcomes. The long-term effect will be the effectiveness in applying instructional strategies in the classroom, which is crucial for fostering a dynamic learning environment. Consequently, this will result in improved student achievement, as students benefit from instruction that is tailored to their needs and grounded in data. Moreover, as teachers continually refine their approaches based on data insights, the overall quality of education in schools will improve, creating a culture of continuous improvement that positively impacts both teachers and students alike. By prioritizing effective professional development programs, educational institutions can create a sustainable framework that not only supports teachers in their professional growth but also leads to significant advancements in educational quality and student success. Given the numerous benefits that can be gained after a professional development program is provided to teachers, practically, this article can serve as a reference for policymakers in organizing professional development programs for teachers in D3M. Policymakers need to pay attention to the aspects of creating an effective program so that the interventions provided can maximize the benefits for teachers, one of which is the improvement of teachers' efficacy in implementing D3M in the classroom.

Conclusions

Based on the results of the systematic literature review, it is known that a professional development program is effective in improving efficacy when the program design considers several aspects. These aspects include content focus, active learning, coherence, duration, and collective participation. This is because each aspect contributes to the improvement of knowledge and skills, thereby influencing teachers' attitudes and beliefs in applying D3M. Among these five aspects, the most important to focus on are designing the program to include active learning and to be implemented over a long duration. This is because these two aspects have a significant impact on the dimensions of self-efficacy, including mastery experience, verbal persuasion, vicarious experience, and physical and emotional states. When these aspects are incorporated, the dimensions of efficacy will be met, which will increase teachers' confidence in implementing D3M in the classroom.

Based on several journal articles discussed in this study, it was found that there are some recommendations that can be made to improve future professional development programs. First, increasing the sample size in research. Several journal articles indicated that the lack of sample size in their studies prevented the results from

being generalized to the intended population (Reeves, 2018; Reeves, 2017; Reeves, 2015; Scheer, 2016). The second recommendation is to add a structured analysis in literature review process. This aims to ensure that the reviewed articles have similar characteristics and to obtain more specific articles. When the analysis is less structured, the interpretation of the results may be influenced because articles with different methods could be included in the review. Next recommendation is to extend the duration of the program. This affects the depth of understanding of teachers, especially when they are learning complex new skills. Lastly, the intervention design should aim to measure the long-term effects of the intervention provided. This means that future research is expected to apply longitudinal studies, where follow-up tests can be conducted to see the persistence of the program's results.

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