

# Improving flipped classroom learning for patients with diabetes mellitus: an exploration into the influence of educational factors

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## Abstract

Patients with diabetes often lack the necessary knowledge, leading to inadequate behavior in preventing wounds. To overcome the limitations of traditional learning methods, it is crucial

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to adopt the flipped classroom approach for effectively educating diabetic patients about wound prevention. This study aimed to explore the relationship between the environment, learning infrastructure, and the flipped classroom learning method among patients with Diabetes Mellitus (DM). Employing a cross-sectional design, the study encompassed patients with DM aged 40-55 years from both genders. A total of 120 patients were selected through purposive sampling techniques. The variables investigated included education factors and the flipped classroom method, which were assessed using a modified questionnaire developed by the researchers and validated for reliability. Data analysis was conducted utilizing Spearman rank analysis. Concerning education factors, 80% of the participants reported having a supportive environment, while 82.5% indicated having access to good learning infrastructure. Regarding the flipped classroom method, 35.8% of the respondents stated that its application in educating patients with DM in the community was effective. There was a statistically significant relationship between the environment and infrastructure and the flipped classroom approach in patients with DM ( $p$ -value<0.05). Enhancing educational factors such as the environment and infrastructure can improve the effectiveness of the flipped classroom method in educating patients with DM. Moreover, promoting health literacy could further enrich the learning experience for diabetic patients, ultimately bettering their behavior and management of the condition. Future research on the flipped classroom learning approach for DM should focus on patient engagement and cultural adaptation to improve overall patient outcomes and the effectiveness of the healthcare system.

## Introduction

Diabetes Mellitus (DM) is a chronic metabolic disease characterized by elevated blood glucose or blood sugar levels.<sup>1</sup> Access to affordable treatment and community support, as well as learning opportunities outside the traditional classroom setting, are crucial for the well-being of individuals with diabetes.<sup>2</sup> Learning activities should be tailored to provide a personalized learning experience, fostering ownership, achievement, and creativity among participants.<sup>3,4</sup> The flipped classroom model, which categorizes participants based on their learning styles, is employed in teaching diabetes management, transforming traditional learning into a more interactive approach that enhances patients' understanding of their condition.<sup>5,6</sup> Research indicates that the use of flipped classrooms significantly increases knowledge among patients.<sup>7</sup> This approach emphasizes openness, feedback on experiences, and the collaboration of interdisciplinary groups of learners and experts within the community.<sup>8-10</sup> Four hundred and twenty-two million people worldwide have diabetes, and 1.5 million die annually.<sup>11</sup> Indonesia ranks 6<sup>th</sup> out of the ten countries with the highest number of DM patients, which is expected to increase to 16.7 mil-

lion patients per year by 2045.<sup>12</sup> The prevalence of DM in Central Java was 13.4% in 2019. A preliminary study conducted at the Mranggen III Health Center revealed that at least 64 patients had DM between January and June 2019.<sup>13</sup> In the city of Semarang, only 58% of patients with DM received regular foot care, 55% did not wear appropriate footwear, only 55% used moisturizer once a month, and only 39% practiced foot washing once a week.<sup>14</sup> These statistics highlight a critical gap in self-management practices among diabetic patients, underscoring the urgent need for improved education and support to prevent complications and enhance quality of life for those living with this condition.<sup>15,16</sup>

Flipped classrooms are an endeavor to develop a comprehensive educational program, increase information accessibility, and serve as an important component in expanding access to quality health services for DM patients.<sup>17</sup> This method offers learning approaches that provide in-depth explanations of diseases, symptoms, risk factors, and management, which can aid patients in making informed decisions.<sup>18</sup> Furthermore, flipped classrooms assist patients in comprehending learning materials by employing methods that prioritize discussion, critical thinking, problem-solving, and practical approaches.<sup>19</sup> The findings reveal that the contributions of flipped classrooms significantly impact knowledge acquisition and team effectiveness, playing a pivotal role in the learning context and serving as a significant mediator.<sup>20</sup> Thus, DM patients can take charge of their learning and engage when they desire, according to their schedule and personal preferences.<sup>21</sup> Components such as motivation, metacognition, help-seeking behavior, time management, and learning strategies are involved in self-directed learning. The results indicate a positive relationship between student motivation and academic achievement, with students demonstrating high self-efficacy and intrinsic value tending to achieve strong academic performance.<sup>22,23</sup>

This strategy can increase motivation and foster a sense of responsibility towards understanding and managing DM. Additionally, learning materials provide opportunities for patients to pose more in-depth and relevant questions when interacting with health professionals or fellow patients.<sup>24</sup> This notion is supported by research demonstrating an improvement in developing self-learning strategies and engaging in deep and active learning.<sup>25</sup> Some experts argue that a flipped classroom places students at the center of the learning process. This system enables students to independently access knowledge sources outside the classroom, such as recorded teaching videos and online teaching materials, with in-class time devoted to practice.<sup>26,27</sup> However, patients with vision, hearing, or other impairments may face challenges in fully utilizing these learning materials.<sup>28</sup>

The flipped classroom approach represents a shift from traditional classroom learning to outside-the-classroom learning during face-to-face meetings.<sup>29</sup> This approach demands personal motivation and discipline from patients to consistently engage with learning material, particularly when they may feel less challenged or isolated.<sup>30</sup> Nevertheless, several obstacles hinder the application of flipped classrooms in DM patients within the community, including limited technology accessibility requiring digital literacy skills, time constraints, diverse learning styles, and the need for family and environmental support. The absence of direct supervision can also diminish the effectiveness of this approach.<sup>31,32</sup> Conversely, the use of a flipped classroom facilitates learning from anywhere and encourages more active, interdisciplinary learning in specific health topics, demonstrating a significant impact.<sup>8,33</sup>

Another obstacle to the use of a flipped classroom approach in DM patients within the community is the low level of medical literacy and inadequate environment and infrastructure.<sup>34</sup> DM

patients require support from their family and surrounding environment to comprehend and apply information in a flipped classroom approach, as a lack of support can impede learning effectiveness.<sup>35</sup> This lack of support may lead to difficulties in understanding complex information, variations in learning styles, and limited cognitive abilities.<sup>36</sup> This study aimed to examine the correlation between educational factors and the flipped classroom method in DM patients.

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## Materials and Methods

### Research design

This research employed a cross-sectional approach to analyze the factors influencing the use of the flipped classroom method in DM education.

### Study participants

Researchers investigated DM with a sample size of 120 respondents, following the rule of thumb for sample size calculation based on 24 indicators. The study employed nonprobability sampling, specifically a purposive sampling method. Inclusion criteria involved participants aged 40-55, both genders, diagnosed with DM, having a specific level of consciousness, and possessing the ability to read, write, hear, and see well. This targeted approach allowed researchers to focus on a relevant subgroup for their objectives. The study's design aimed to provide valuable insights into the selected population's characteristics and experiences.

### Variable, instrument, and data collection

Independent variables consisted of demographic factors (age, gender, education, occupation, and length of diabetes) and the education factor (environment and infrastructure). The dependent variable consisted of the flipped classroom method in foot care education (educational materials and educational methods). The environment was assessed as the physical surroundings influencing the learning process. Infrastructure was evaluated as the available resources supporting educational activities. The flipped classroom method in foot care education consisted of educational materials that included the quality and effectiveness of the materials used in foot care education. Educational methods were perceived to be effective in teaching approaches within the flipped classroom model. The research instrument questionnaire for educational factors and flipped classroom used a structured set of questions utilizing a 4-point Likert scale (4 = strongly agree, 3 = agree, 2 = disagree, 1 = strongly disagree). The data collection process involved the distribution of the validated questionnaire to participants. Participants were asked to provide responses based on their experiences and perceptions regarding demographic factors, environmental conditions, infrastructure, and the effectiveness of the flipped classroom method in foot care education. Responses were recorded using the 4-point Likert scale. The collected data were then subjected to analysis to explore relationships and patterns among variables, providing insights into the impact of demographic and environmental factors on the success of the flipped classroom approach in foot care education. Data was collected in September until November 2022 in the Health Center in Semarang, Indonesia.

### Data analysis

Data analysis aimed to explain and describe the characteristics and relationships between research variables. Research data on

**Table 1.** Characteristics of respondents (n=120).

| Characteristic of respondents |                             | Frequency | Percentage |
|-------------------------------|-----------------------------|-----------|------------|
| Age                           | Adult (36-45 years)         | 35        | 29.2       |
|                               | Early elderly (46-55 years) | 85        | 70.8       |
| Gender                        | Male                        | 52        | 43.3       |
|                               | Female                      | 68        | 56.7       |
| Length of Diabetes Mellitus   | Under 5 years               | 75        | 62.5       |
|                               | Over 5 years                | 45        | 37.5       |
| Education                     | Elementary education        | 68        | 56.7       |
|                               | Middle education            | 35        | 29.2       |
|                               | High education              | 17        | 14.1       |

independent and dependent variables was on an ordinal scale, so a frequency distribution was used. Bivariate analysis was used to determine the relationship between educational factors and the flipped classroom. The analytical test used to determine the relationship between these two variables was ranked Spearman with a significant level of 5%.

### Ethical clearance

The research received ethical approval from the Health Research Ethics Commission, Faculty of Nursing, Universitas Islam Sultan Agung, based on ethical certificate No.390/A.1-KEPK/FIK-SA/VIII/2022. Informed consent was taken before collecting data. During the research, the researcher paid attention to the ethical principles of information to consent, respect for human rights, beneficence, and non-maleficence.

## Results

The demographic analysis of the study reveals a predominant population of participants aged 46-65, categorized as the early elderly group (70.8%), primarily female (56.7%), with elementary education (56.7%), and having a diabetes duration of less than 5 years (62.5%). Further details of these results are explained in Table 1. From the independent and dependent variables, it was observed that 80% of participants perceived the environment as good, 82.5% perceived the infrastructure as good, and 35.8% perceived the flipped classroom as effective. The study suggests positive perceptions among participants regarding the educational environment and infrastructure, although a comparatively lower percentage recognizes the effectiveness of the flipped classroom method. Further detailed results are provided in Table 2. The Spearman rank analysis test results show that the p-value is < 0.05, indicating a significant influence of the independent variables on the dependent variable. This analysis reveals a statistically significant association between the independent variables and the dependent variable, emphasizing their impactful relationship.

## Discussion

Flipped classrooms offer flexibility and facilitate learning based on the latest evidence, employing interactive and effective teaching strategies within the community. Research findings confirm that both the environment and infrastructure significantly influence the implementation of flipped classrooms in the community (p<0.05). Over the past decade, there has been a growing interest in flipped classrooms, which are widely accepted as an

**Table 2.** Description of research variable.

| Variables         | Frequency | Percentage |
|-------------------|-----------|------------|
| Education factors |           |            |
| Environment       |           |            |
| Less              | 24        | 20         |
| Good              | 96        | 80         |
| Infrastructure    |           |            |
| Less              | 21        | 17.5       |
| Good              | 99        | 82.5       |
| Flipped classroom |           |            |
| Less              | 25        | 20.8       |
| Enough            | 52        | 43.3       |
| Good              | 43        | 35.8       |

interactive pedagogical strategy.<sup>37,38</sup> Empirical evidence suggests that implementing flipped classrooms is more effective than traditional methods and has garnered positive feedback within the educational environment.<sup>39</sup> This approach to learning promotes personal interaction, enhances situational awareness, and fosters the application of critical thinking skills and cognitive education.

Thirty-five point eight percent of the implementation of the flipped classroom in the community was reported to be successful. Support from the home environment, including family support and commitment to learning, plays a crucial role. A study conducted in Oman concluded that the flipped classroom method serves as a valuable tool and a motivational factor for effective learning. Moreover, the flipped classroom method has led to a shift in learning approaches towards more flexible, effective, active, and person-centered teaching strategies.<sup>40</sup> Research conducted in China demonstrated that the flipped classroom fosters active participation and knowledge sharing and contributes to effective student learning.<sup>41</sup> Similarly, research in Switzerland suggests that the flipped classroom can be adapted for online teaching and assessment sessions, emphasizing its utility as a motivational factor for effective learning, understanding, and retention of conceptual and factual content.<sup>42</sup>

Educational factors play a crucial role in influencing the level of independence and engagement of patients in learning. Patients who are independent and actively involved tend to adapt more successfully to the flipped classroom model. Moreover, there exists a significant positive correlation between home environmental factors and an individual's cognitive level.<sup>38</sup> The home environment facilitates flexible implementation of classes, with 80% reported to be supportive, committed, and providing adequate study spaces.<sup>39</sup> Both online and offline learning environments significantly impact learning outcomes, with the home environment for DM patients fostering increased interaction and enthusiasm for studying the

provided material, consequently enhancing their knowledge and skills.<sup>43</sup>

Infrastructure, as an integral part of the home environment, influences comfort, safety, and functionality, with 82.5% of infrastructure in flipped classroom implementation reported to be of good quality.<sup>44-46</sup> This enhances the creation of a comfortable, safe, and conducive home environment. Additionally, research underscores the close relationship between the home environment and infrastructure, emphasizing the importance of a well-equipped home environment in addressing health issues, including those related to DM. Moreover, the rapid dissemination of collective wisdom from leading expert organizations highlights the significance of public health.<sup>46,47</sup>

The level of health literacy plays a pivotal role in enabling DM patients to comprehend the material and undertake appropriate actions based on the provided information.<sup>48</sup> Consequently, additional support is essential, encompassing technical assistance, program enhancements, and healthcare provider engagement.<sup>49</sup> Moreover, ongoing evaluation of the impact of educational factors on the utilization of the flipped classroom method is imperative. However, certain limitations, such as technology accessibility, digital literacy skills, and time constraints, may impede the adaptation of this approach to society.<sup>50</sup> To address these challenges, a creative learning style is required, considering diverse backgrounds, educational levels, and comprehension abilities. Furthermore, family support and active involvement in the process are crucial to bolstering the effectiveness of this approach.

## Conclusions

The success of the flipped classroom learning method in DM education depends on a supportive environment and infrastructure. Essential components include access to digital learning materials, technological resources, and a conducive physical classroom setting. Interactive tools, professional support, and continuous assessment play pivotal roles in enhancing the effectiveness of this approach. Furthermore, incorporating cultural sensitivity and promoting health literacy enrich the learning experience for diabetes patients, ultimately improving their behavior and management of the condition. Future research on flipped classroom learning for DM should prioritize patient engagement and cultural adaptation to enhance overall patient outcomes and the effectiveness of the healthcare system.

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