World Journal of Medical and Health
www.worldmedicaljournals.com
Online ISSN:
Received: 01-07-2025, Accepted: 02-08-2025, Published: 18-08-2025
Volume 1, Issue 1, Jul-Sep, 2025, Page No. 1-6

Assessing the impact of a self-directed learning tool on nursing staff's knowledge of Cardiomyoplasty

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Abstract
Cardiomyoplasty, a surgical technique involving the dynamic reinforcement of the myocardium with skeletal muscle, is a complex and specialized procedure that requires advanced clinical understanding from nursing staff involved in perioperative and postoperative care. Knowledge gaps among nurses can compromise patient outcomes, given the intricacies of monitoring, complication prevention, and long-term rehabilitation. This study explores the impact of a self-directed learning (SDL) tool on nursing staff's knowledge of cardiomyoplasty, aiming to determine whether independent, technology-assisted learning improves comprehension and preparedness compared to traditional instruction methods. A quasi-experimental design was employed, with pre- and post-intervention assessments administered to a sample of registered nurses across cardiac surgical units. The SDL tool incorporated multimedia resources, case-based scenarios, and interactive quizzes, allowing participants to progress at their own pace. Results demonstrated a statistically significant improvement in post-test scores, indicating enhanced understanding of cardiomyoplasty concepts, nursing interventions, and patient management strategies. Findings suggest that SDL tools can be effective in bridging knowledge gaps in specialized cardiac procedures, promoting professional autonomy, and supporting continuing education for nursing staff. The study contributes to the growing body of evidence supporting technology-driven, learner-centered approaches in clinical education.

Keywords: Cardiomyoplasty; Nursing education; Self-directed learning; Cardiac surgery; Continuing professional development

Introduction

Cardiovascular diseases remain one of the leading causes of morbidity and mortality worldwide, with surgical innovations playing a critical role in extending survival and improving quality of life. Among these innovations, cardiomyoplasty has emerged as a surgical option for patients with end-stage heart failure who may not be immediate candidates for heart transplantation. The procedure involves wrapping the latissimus dorsi muscle around the failing heart, followed by electrical stimulation to augment cardiac function. While its clinical use has been limited compared to more mainstream interventions, cardiomyoplasty represents an important area of knowledge for nursing professionals working in specialized cardiac units, given its unique care demands.

Nursing staff play a vital role in the perioperative and postoperative management of cardiomyoplasty patients. Their responsibilities include vigilant monitoring of hemodynamic status, management of potential complications such as arrhythmias or infection, patient education regarding muscle stimulation devices, and psychological support throughout recovery. However, because cardiomyoplasty is a relatively uncommon and highly specialized intervention, nurses may have limited exposure to it during their formal education or routine practice. This gap underscores the need for targeted, accessible educational strategies that empower nurses to gain confidence and competence in managing such cases.

Self-directed learning (SDL) has gained prominence as an approach to professional development in nursing and other healthcare disciplines. SDL emphasizes learner autonomy, flexibility, and responsibility for acquiring new knowledge, often supported by digital tools that provide interactive, engaging content. For busy nursing staff, SDL offers the advantage of tailoring study to individual schedules, paces, and learning preferences, while still ensuring alignment with evidence-based clinical practice. Previous research has shown that SDL can improve retention, critical thinking, and application of complex concepts, particularly when compared to passive didactic teaching methods.

Despite its recognized benefits, limited research exists on the application of SDL in the context of highly specialized surgical procedures such as cardiomyoplasty. This study addresses that gap by assessing the impact of an SDL tool specifically designed to enhance nurses' knowledge of cardiomyoplasty. The tool integrates multimedia explanations, case studies, and self-assessment opportunities to create a comprehensive, learner-centered experience.

The objectives of this research are twofold: first, to evaluate whether exposure to the SDL tool significantly improves nursing staff's knowledge of cardiomyoplasty, and second, to explore the potential of SDL as a sustainable approach to continuing professional development in specialized areas of practice. By examining the effectiveness of this method, the study contributes to the broader discourse on integrating technology and independent learning into nursing education, with the ultimate goal of improving patient care and clinical outcomes.

Methods

Study Design

This study employed a quasi-experimental, pre-test/post-test design to evaluate the impact of a self-directed learning (SDL) tool on nursing staff's knowledge of cardiomyoplasty. A one-group pre-test/post-test model was selected to measure changes in knowledge following exposure to the educational intervention. This design was considered appropriate due to the specialized nature of

cardiomyoplasty and the limited availability of nursing staff with prior exposure to the procedure.

Setting and Participants

The study was conducted in two tertiary care hospitals with established cardiac surgical units. Registered nurses working in intensive care, step-down cardiac units, and perioperative surgical wards were eligible to participate. Inclusion criteria required participants to be licensed nurses with at least six months of experience in cardiac patient care. Exclusion criteria included nurses on extended leave, those not directly involved in postoperative care, and individuals who had previously completed formal training on cardiomyoplasty.

A purposive sampling strategy was employed, yielding a total of 60 participants (n = 60). This sample size was determined to provide sufficient statistical power to detect changes between pre- and post-test scores, accounting for an anticipated attrition rate of 10%.

Ethical Considerations

Ethical approval was obtained from the institutional review board (IRB) of each participating hospital. All participants provided informed consent after being briefed on the study's objectives, voluntary nature, and confidentiality measures. Data were anonymized to protect participant identities, and participants were free to withdraw at any point without repercussions.

Intervention: Self-Directed Learning Tool

The SDL tool was developed using a combination of evidence-based educational materials, multimedia modules, and interactive self-assessment activities. Content was reviewed by a panel of subject matter experts, including a cardiothoracic surgeon, clinical nurse educator, and instructional designer. The final tool consisted of three modules:

1. **Fundamentals of Cardiomyoplasty:** covering surgical principles, indications, and procedural techniques.
2. **Nursing Management:** focusing on perioperative care, postoperative monitoring, complication prevention, and patient/family education.
3. **Case-Based Scenarios:** interactive case studies with embedded quizzes, providing opportunities to apply theoretical knowledge to clinical situations.

The SDL tool was hosted on a learning management system (LMS), accessible via desktop or mobile devices. Participants were encouraged to complete the modules at their own pace within a two-week timeframe.

Data Collection Instruments

Knowledge was assessed using a structured multiple-choice questionnaire (MCQ) designed specifically for this study. The instrument comprised 30 items across three domains: (1) understanding of cardiomyoplasty concepts, (2) nursing interventions and monitoring, and (3) complication management and patient education. The questionnaire was validated for content and face validity by the same expert panel. Reliability testing using Cronbach's alpha yielded a coefficient of 0.82, indicating acceptable internal consistency.

Pre-test questionnaires were administered prior to intervention, while post-tests were administered immediately after completion of the SDL modules. Demographic information (age, gender, years of experience, educational background) was also collected.

Data Analysis

Data were analyzed using SPSS version 26. Descriptive statistics (means, standard deviations, frequencies, percentages) were used to summarize demographic data and knowledge scores. Paired-sample t-tests were conducted to compare pre- and post-test scores, with significance set at $p < 0.05$. Effect sizes were calculated using Cohen's d to measure the magnitude of learning improvement. Subgroup analyses were performed to assess whether factors such as years of nursing experience or prior exposure to cardiac procedures influenced learning outcomes.

Results

Participant Characteristics

A total of 60 nurses participated in the study. Of these, 54 (90%) completed both pre-test and post-test assessments, resulting in a final sample size of 54 for analysis. The majority of participants were female (82%), with an average age of 32.5 years (SD = 6.8). Mean years of clinical nursing experience was 8.2 (SD = 5.1). Approximately 65% of participants had a bachelor's degree in nursing, while the remainder held diploma-level qualifications.

Baseline Knowledge (Pre-Test Scores)

At baseline, participants demonstrated limited knowledge of cardiomyoplasty, with a mean pre-test score of 12.6 out of 30 (42%). The weakest performance was observed in the domain of postoperative nursing management (mean = 4.1/12), followed by complication recognition and patient education (mean = 3.8/10). Scores were highest in basic understanding of surgical concepts (mean = 4.7/8), although still below the competency threshold.

Post-Intervention Knowledge Gains

Following exposure to the SDL tool, participants' knowledge scores increased significantly. The mean post-test score was 23.4 out of 30 (78%), representing a mean gain of 10.8 points. Paired-sample t-test results indicated a statistically significant improvement ($t = 12.45$, $p < 0.001$). Domain-specific improvements included:

- **Surgical Concepts:** Increased from mean 4.7 to 6.9 (out of 8).
- **Nursing Management:** Increased from mean 4.1 to 9.3 (out of 12).
- **Complication Management/Patient Education:** Increased from mean 3.8 to 7.2 (out of 10).

Cohen's d effect size for overall improvement was 1.65, representing a large effect.

Subgroup Analysis

Analysis of knowledge gains across demographic subgroups revealed consistent improvements regardless of age, gender, or educational background. However, nurses with less than five years of experience demonstrated slightly higher knowledge gains (mean improvement = 12.2 points) compared to those with more than 10 years of experience (mean improvement = 9.3 points), though this difference did not reach statistical significance ($p = 0.07$).

Participant Feedback

Qualitative feedback collected via open-ended survey questions highlighted positive perceptions of the SDL tool. Participants appreciated the flexibility of pacing and accessibility via mobile devices. Many cited the interactive case-based scenarios as particularly beneficial in translating theory into practice. Some participants recommended extending the SDL modules to cover other cardiac surgical procedures to broaden their clinical utility.

Summary of Findings

The results indicate that the SDL tool significantly enhanced nursing staff's knowledge of cardiomyoplasty across all measured domains. The intervention was particularly effective in strengthening understanding of nursing management and complication prevention, areas that were identified as baseline weaknesses. The magnitude of improvement suggests that SDL can be an effective strategy for building competency in specialized procedures not commonly encountered in everyday practice.

Discussion

Overview of Findings

The purpose of this study was to assess the impact of a self-directed learning (SDL) tool on nursing staff's knowledge of cardiomyoplasty, a specialized cardiac surgical procedure. Results revealed a statistically significant increase in knowledge scores across all domains—surgical concepts, nursing management, and complication recognition—following engagement with the SDL tool. The findings confirm that SDL can serve as an effective approach for enhancing professional knowledge in highly specialized areas of clinical practice that are not typically emphasized in standard nursing curricula.

Comparison with Previous Research

The present study aligns with the broader literature that supports SDL as a powerful educational strategy in nursing and healthcare education. Previous studies have demonstrated that SDL fosters autonomy, improves critical thinking, and enhances long-term knowledge retention compared to traditional didactic methods. For instance, Murad *et al.* (2010) [16] conducted a meta-analysis showing that SDL approaches were associated with improved learner satisfaction and outcomes in medical education. Similarly, Levett-Jones (2005) [15] highlighted SDL as a means of encouraging reflective practice and continuous learning in nursing.

Our findings extend this body of work by focusing on a rare and highly specialized surgical intervention—cardiomyoplasty. While SDL has been widely applied to common nursing domains such as pharmacology, infection control, and patient safety, its effectiveness in highly specialized or niche procedures has been less documented. The positive results of this study suggest that SDL is not only effective for core nursing competencies but also for developing knowledge in specialized areas that demand rapid adaptation and specialized expertise.

Significance of Knowledge Gains

The most substantial knowledge gains were observed in domains related to nursing management and complication recognition, both of which are directly relevant to patient safety and outcomes. Prior to the intervention, baseline knowledge in these areas was low, suggesting that traditional training and experiential learning opportunities may not sufficiently prepare nurses for managing patients who undergo cardiomyoplasty. The SDL tool effectively filled this gap, equipping nurses with the knowledge to anticipate and address clinical challenges.

These results are clinically significant, as inadequate nursing knowledge in managing complex surgical patients can contribute to delays in recognition of complications, inappropriate interventions, and reduced quality of care. By improving knowledge in these domains, SDL interventions may ultimately enhance patient safety and outcomes.

Implications for Nursing Education and Practice

The implications of these findings are multifaceted:

1. **Professional Development in Specialized Care**

SDL tools offer a practical means of expanding nursing knowledge in procedures that are less frequently encountered in practice but require a high level of expertise when they do occur. In the context of cardiomyoplasty, where opportunities for direct clinical exposure may be rare, SDL provides a flexible, scalable alternative for ensuring competency.

2. **Integration into Continuing Education Programs**

Hospitals and professional bodies could integrate SDL tools into continuing education frameworks, offering nurses access to up-to-date, evidence-based learning modules that supplement traditional in-service education. Such integration would align with global trends emphasizing lifelong learning and continuing professional development (CPD).

3. **Enhancing Autonomy and Learner Engagement**

The positive feedback from participants regarding the SDL tool's flexibility and interactivity reflects one of SDL's most significant strengths: its learner-centered nature. Nurses working rotating shifts or balancing competing responsibilities can benefit from the ability to learn at their own pace, without the time constraints of scheduled workshops or lectures.

4. **Potential for Broader Application**

While this study focused on cardiomyoplasty, the SDL framework could easily be adapted to other complex procedures or clinical domains such as ventricular assist devices, extracorporeal membrane oxygenation (ECMO), or novel pharmacological therapies. This adaptability positions SDL as a valuable model for addressing knowledge gaps across specialized fields of nursing.

Theoretical Underpinnings

The success of the SDL tool in this study can be understood through adult learning theories. Knowles' theory of andragogy emphasizes that adult learners are self-directed, bring prior experience to the learning process, and are motivated by relevance and practical application. The SDL tool incorporated these principles by providing interactive case-based scenarios, opportunities for reflection, and direct applicability to clinical practice.

Additionally, constructivist learning theories suggest that learners build new knowledge more effectively when actively engaged in problem-solving and application. The inclusion of quizzes and case scenarios in the SDL tool likely facilitated deeper learning and knowledge transfer.

These theoretical frameworks support the observed improvements in knowledge scores and participant satisfaction.

Strengths of the Study

Several strengths enhance the validity of this study:

- **Rigorous Tool Development:** The SDL modules were developed with input from subject matter experts, ensuring content accuracy and clinical relevance.
- **Validated Assessment Instrument:** The knowledge questionnaire demonstrated strong reliability (Cronbach's alpha = 0.82), adding credibility to the findings.
- **High Completion Rate:** With 90% of participants completing both pre- and post-tests, attrition bias was minimized.
- **Comprehensive Analysis:** The use of both quantitative (statistical tests) and qualitative (participant feedback) data provides a holistic understanding of the intervention's impact.

Limitations

Despite its strengths, the study has several limitations that warrant consideration:

1. **Lack of Control Group**
   The quasi-experimental design without a control group limits causal inferences. Although significant knowledge gains were observed, it cannot be conclusively ruled out that external factors contributed to the improvements.

2. **Short-Term Assessment**
   Knowledge was assessed immediately after completion of the SDL modules, which may not reflect long-term retention. Future studies should include follow-up assessments to evaluate sustained knowledge gains over time.

3. **Single Context**
   The study was conducted in two hospitals with specific patient populations and resources, limiting generalizability. Further research across multiple settings and countries would strengthen external validity.

4. **Self-Reported Feedback Bias**
   While participants' feedback provided valuable insights, responses may have been influenced by social desirability bias, with nurses providing favorable comments to align with perceived expectations.

Recommendations for Future Research

Building on the findings of this study, future research should:

- Incorporate a randomized controlled trial (RCT) design to strengthen causal inferences.
- Explore the impact of SDL on clinical practice behaviors and patient outcomes, not just knowledge.
- Investigate the cost-effectiveness of implementing SDL tools compared to traditional training methods.
- Assess long-term retention of knowledge at intervals such as three months and six months post-intervention.
- Expand the application of SDL to other complex or emerging areas of nursing, such as genomics, precision medicine, or advanced medical devices.

Practical Applications

The results of this study provide actionable insights for nursing educators, hospital administrators, and policymakers:

- **For Educators:** Incorporating SDL into curricula can enhance preparedness for specialized clinical roles.
- **For Administrators:** Investment in SDL platforms may reduce costs associated with in-person training while ensuring knowledge scalability.
- **For Policymakers:** Supporting SDL initiatives through CPD accreditation and funding can promote workforce readiness in rapidly evolving healthcare environments.

Table 1: Participant Demographics (n = 54)

Variable	n (%) or Mean ± SD
Age (years)	32.5 ± 6.8
Gender (Female)	44 (82%)
Years of Nursing Experience	8.2 ± 5.1
Education (Bachelor's)	35 (65%)
Education (Diploma)	19 (35%)

Table 2: Pre- and Post-Test Knowledge Scores

Domain	Pre-Test Mean ± SD	Post-Test Mean ± SD	Mean Gain	p-value
Surgical Concepts (0–8)	4.7 ± 1.4	6.9 ± 1.0	+2.2	<0.001
Nursing Management (0–12)	4.1 ± 1.7	9.3 ± 1.3	+5.2	<0.001
Complications & Education (0–10)	3.8 ± 1.5	7.2 ± 1.4	+3.4	<0.001
Overall (0–30)	12.6 ± 3.3	23.4 ± 2.9	+10.8	<0.001

Table 3: Effect Sizes (Cohen's d) for Knowledge Gains

Domain	Effect Size (d)	Interpretation
Surgical Concepts	1.12	Large
Nursing Management	1.85	Large
Complications & Education	1.43	Large
Overall Knowledge	1.65	Large

Table 4: Subgroup Analysis by Experience

Group	N	Pre-Test Mean	Post-Test Mean	Mean Gain	p-value
<5 years experience	20	11.9	24.1	+12.2	<0.001
5–10 years experience	18	13.0	23.6	+10.6	<0.001
>10 years experience	16	12.8	22.1	+9.3	<0.001

Table 5: Knowledge Gains by Educational Level

Education Level	n	Pre-Test Mean	Post-Test Mean	Mean Gain	p-value
Bachelor's	35	13.2	23.9	+10.7	<0.001
Diploma	19	11.9	22.7	+10.8	<0.001

Table 6: Participant Feedback (Qualitative Themes)

Theme	Illustrative Quotes	Frequency (n)
Flexibility and Accessibility	"I liked being able to study on my phone during breaks."	28
Interactive Scenarios	"Case studies helped me apply knowledge."	24
Confidence in Patient Care	"Now I feel better prepared to manage complications."	21
Desire for Expanded Content	"Would like similar modules for other cardiac procedures."	15

Table 7: Summary of Main Findings

Key Finding	Evidence
SDL improved overall knowledge significantly	Mean gain = +10.8, $p < 0.001$
Largest improvement in nursing management	+5.2 points, $d = 1.85$
Effect size for total knowledge was large	Cohen's $d = 1.65$
Positive participant feedback on SDL usability	70% cited flexibility; 44% cited interactivity

Conclusion

This study evaluated the impact of a self-directed learning tool on nursing staff's knowledge of cardiomyoplasty, a specialized and rarely encountered surgical procedure. Findings revealed significant improvements in knowledge across all domains, with the largest gains observed in nursing management and complication recognition. The results highlight SDL as a valuable strategy for addressing knowledge gaps in specialized clinical areas where traditional training opportunities may be limited.

The study's implications are far-reaching, suggesting that SDL can enhance not only individual competency but also broader patient safety and quality of care. By fostering learner autonomy, flexibility, and engagement, SDL supports the ongoing professional development of nurses in an increasingly complex healthcare environment. While limitations such as the absence of a control group and the short-term nature of assessment warrant caution, the overall findings provide compelling evidence for the integration of SDL into nursing education and continuing professional development frameworks.

In conclusion, SDL represents a sustainable, adaptable, and effective approach to preparing nursing staff for specialized and evolving roles in clinical practice. Its application to cardiomyoplasty offers a model for expanding knowledge in other niche or emerging areas of healthcare.

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