RESEARCH

Impact of Student Pharmacists Teaching a Diabetes Self-Management Education and Support Class

Kendra R. Manigault, PharmD, Jill M. Augustine, PharmD, PhD, MPH, Maria Miller Thurston, PharmD

Mercer University, College of Pharmacy, Atlanta, Georgia

Submitted April 16, 2019; accepted August 9, 2019; published March 2020.

Objective. To evaluate student pharmacists' knowledge of diabetes and self-perceptions of aptitude and confidence before and after teaching a diabetes self-management education and support (DSMES) class.

Methods. Students enrolled in an advanced pharmacy practice experience (APPE) in ambulatory care were randomly assigned to the intervention group (taught a DSMES class) or control group (did not teach a DSMES class) between June 2016 to April 2018. Students self-assessed their aptitude and confidence using a 14-item pre- and post-intervention survey instrument. Additionally, participants completed a 10-item diabetes knowledge evaluation at baseline and during week three or four of the APPE.

Results. Forty-six students participated in the study (26 students in the intervention group and 20 in the control group). Students in the intervention cohort demonstrated a significant improvement in their knowledge score (81.8% post-intervention vs 68.4% pre-intervention). Students in the control cohort did not experience a significant change in knowledge scores from pre- to post-intervention evaluation (70.0% vs 74.1%). The intervention cohort achieved a significantly greater improvement in confidence scores compared to the control group (11.8 vs 6.7 increase in scores, respectively).

Conclusion. A student pharmacist team-taught DSMES class resulted in significant improvement in diabetes knowledge, aptitude, and confidence. Student pharmacist participation in a DSMES class may improve knowledge and enhance confidence, while offering an opportunity to advance the pharmacy practice model in ambulatory care.

Keywords: diabetes, student pharmacist, knowledge, confidence, teaching

INTRODUCTION

Pharmacy as a profession today is striving towards attainment of provider status, as the services that pharmacists can provide have expanded well beyond the role of dispensing medications.[1] Therefore, there is a clear need within schools and colleges of pharmacy to train confident and competent future practitioners to take the lead in providing novel patient care services. Such services often involve direct interaction with patients as well as providing consultative and educational services to patients as part of the interdisciplinary team.[2] Furthermore, the Accreditation Council for Pharmacy Education (ACPE) Standards 2016 supports the development of clinical knowledge and incorporation of experiences with a "patient care emphasis" within advanced pharmacy practice experiences (APPEs).[3]

Corresponding Author: Maria Miller Thurston, Mercer University, College of Pharmacy, 3001 Mercer University Dr., Atlanta, GA 30341. Tel: 678-547-6253. Email: thurston_mm@mercer.edu

There are 30.3 million people living with diabetes in the United States.[4] Patients with diabetes benefit from pharmacy-provided information to improve their disease state control and health outcomes. The American Diabetes Association's (ADA's) *Standards of Medical Care in Diabetes 2019* guidelines cites diabetes self-management education and support (DSMES) as a key element of diabetes management. The guideline recommends that health care professionals be involved in providing patient-centered DSMES to all patients living with diabetes.[5] Additionally, the ADA guidelines endorse pharmacists as an integral provider of DSMES.

Students within Mercer University College of Pharmacy traditionally complete their diabetes coursework within the Endocrinology module during their third professional year, as well as in the first-year Clinical Skills and Simulation Laboratory. Additionally, students have the opportunity to participate in a diabetes elective during their third-professional year. Fourth-year students completing a traditional five-week faculty-precepted ambulatory

care APPE receive a diabetes topic discussion during week one of the APPE block and are heavily engaged in patient/provider interactions involving patients with diabetes throughout the remainder of the rotation. Although there are ample opportunities for students to provide education in a one-on-one setting during the APPEs for the study site, no experiences are currently provided that are focused on educational teaching and facilitation in the small group format. On average, students are involved in the care of 15-30 patients with diabetes per month, during which they deliver direct patient education. Teaching the DSMES class (intervention in this study) allowed student pharmacists to actively apply their knowledge of diabetes and communication skills previously gained within the classroom and introductory experiential settings in a small-group classroom setting with actual patients. Additional practice providing patient education potentially enhances student ability and confidence in providing DSMES.

To successfully teach a patient, a health care provider must first become knowledgeable and proficient in the topic themselves.[6] There is evidence that a variety of educational experiences (eg, certificate programs, elective courses, APPE "patient navigator" training, diabetes-focused APPEs) can positively impact a student pharmacist's knowledge, attitudes, and/or skills associated with diabetes or other chronic conditions.[6-16] However, we found only one study that evaluated students confidence with diabetes knowledge and education after teaching a DSMES class.[6] While that study, which was conducted by Shrader and colleagues, was similar in design to ours, it involved third-year pharmacy students within an elective service-learning course rather than fourth-year APPE students. Additionally, the study did not include a control group or a comprehensive measure of change in student knowledge (only one question involving perceived confidence in knowledge was assessed). Therefore, we concluded that additional investigation was warranted involving hard measures of student knowledge as a result of facilitating a DSMES class.

This study involved the implementation of a DSMES class taught by fourth-year student pharmacists to provide education to patients of Wellstar Atlanta Medical Center outpatient clinics living with diabetes. The purpose of this study was to implement a student-led DSMES class and assess: student knowledge of diabetes before and after teaching the class, and student self-perceptions of aptitude and confidence before and after teaching the class. The researchers hypothesized that students who had the additional experience of teaching a DSMES class during their APPE would gain greater knowledge, abilities, and confidence compared to students completing traditional rotation activities.

METHODS

Students assigned to the ambulatory care APPE between June 2016 to April 2018 at the Wellstar Atlanta Medical Center outpatient clinic where the investigators served as clinical faculty members were included in this study. The student pharmacists were randomized to a control group (traditional APPE activities) or intervention group (traditional APPE activities plus student-led DSMES class) according to their assigned rotation block. The assignment to the control or intervention group was done in an alternating fashion to ensure equal distribution of groups throughout the year. One to two APPE students taught a single DSMES class during their APPE, with a total of 15 classes taught from August 2016 through April 2018. Classes were held during weeks three or four of the APPE. Approximately three to five patients were invited to attend each DSMES class. Patients were referred to the class by the student(s) who saw them during a scheduled visit or by other clinicians. Diabetes self-management education and support classes were taught at a large metropolitan academic medical center within an internal medicine clinic.

The DSMES class was conducted in-person and lasted approximately two hours. Each class used the *US Diabetes Conversations Map* Kit (Healthy Interactions), which is endorsed by the ADA.[7] The US *Diabetes Conversations Map* is an interactive educational program with tools (ie, a large colorful map board, patient question cards, conversation cards, and action plan/goal setting worksheets) that are used to direct patient-practitioner conversations in small groups of three to 10 participants. This map had been successfully used by other student pharmacists to deliver a DSMES class for patients.[6] Prior to the study, the investigators completed the training required to be approved facilitators for the course. For the purposes of this study, the "On the Road to Better Managing Your Diabetes" map, which provides a general overview of diabetes, was used in the student-led DSMES class.

Students in the intervention group of the study were introduced to the *US Diabetes Conversations Map* Kit following their traditional diabetes topic discussion. Students were provided with the relevant class materials (ie, the *Conversations Map*) as well as information on the benefits of DSMES. Students were asked to prepare for the teaching of the class on their own time. Approximately one to two hours were required for group preparation among the students. One hour prior to the scheduled class, the clinical faculty members hosted an "on-time training" session for the students in which student questions were answered, the delivery process was outlined,

and final instructions were provided. Class set-up also took place during that time. The class then began, and for the next two hours, students led discussion and answered patient questions in accordance with the *US Diabetes Conversations Map Program*. During the class, clinical faculty study investigators were available to clarify points of student uncertainty or omission. After each class, surveys were completed as described below.

Demographic data (ie, age, gender, race, history of taking a diabetes elective, and pharmacy work experience including practice setting) were collected for all students in the study. Students in both groups completed a 10-question assessment to evaluate their knowledge of diabetes (Table 2). The knowledge assessment was developed to cover the main learning objectives of the DSMES class, including the pathophysiology of diabetes, dietary restrictions around diabetes, ADA guidelines for blood glucose levels, signs and symptoms of hyperglycemia and hypoglycemia, and nutrition support and physical activity guidelines for persons with diabetes. The questions were graded using a rubric on which the correct answers and the number of points assigned to each question were specified. Each question was worth 10 points: three questions had a single correct/incorrect response, five questions had a two-part response (each part was worth five points), and two questions had a three-part response (each part was worth three and one-third points). To ensure grading consistency, the same investigator graded all assessments, with a second lead investigator reviewing the grading for quality assurance.

Along with the knowledge assessment, a 14-item aptitude/confidence questionnaire was administered. Respondents were asked to self-rank their perceived aptitude/confidence using a four-point scale that ranged from 4=strongly agree to 1=strongly disagree. Aptitude/confidence questions were created based on concepts emphasized in the "On the Road to Better Managing Your Diabetes" map and literature review.[6,7,12,13] Each question addressed a learning objective and also correlated with a knowledge survey question. For example, one knowledge question asked students about the amount of physical activity recommended for patients with type 2 diabetes, while the matching aptitude/confidence question asked respondents about their "confidence in [their] ability to counsel a patient with type 2 diabetes on physical activity."

The pre-intervention surveys (knowledge and aptitude/confidence) were administered to both the control and intervention groups during the first week of the APPE, prior to patient care experience and before completing a diabetes topic discussion. Both post-intervention surveys were administered during week three or four of the five-week rotation. Students in the intervention cohort completed post-intervention surveys immediately after teaching the group education class; students in the control group completed the post-intervention surveys at a similar time as students in the intervention group. Students were provided with an anonymous code to enter on the survey instrument so that the responses collected before and after the class could be paired for analysis. Student responses were captured and stored electronically using SurveyMonkey (SurveyMonkey, San Mateo, CA).

Total knowledge scores were compared between the intervention and control groups using *t* tests. Comparisons were made between the total knowledge score and for each question individually. Changes in students' aptitude and confidence were analyzed using Wilcoxon signed rank tests. An *a priori* alpha level of .05 was used to determine significance. This study was reviewed and approved by the university's institutional review board.

RESULTS

Forty-six students completed the questionnaires: 26 (56.5%) in the intervention group and 20 (43.5%) in the control group (100% response rate). Table 1 describes participant demographics. There were no significant differences in demographic characteristics between the groups, with the exception of race ($p=.005$). The majority of participants in both groups were female (72%), aged 26-30 years (54.3%), and self-identified as Caucasian (39%). Most (84.7%) of the participants in both groups had not taken the diabetes elective offered to third-year student pharmacists) nor had a previous teaching experience within a patient education class (93.4%). For previous pharmacy experience, over half of the participants in both groups had 3-5 years' experience and 64% (n=29) had previous community/retail work experience.

The intervention group experienced a significant improvement in their overall knowledge score from the pre- to post-intervention assessment (68.4% to 81.8%, respectively, $p<.001$), whereas there was no significant change in the overall knowledge score of the control group from pre- to post-intervention (70.0% to 74.1%, respectively, $p=.48$) (Table 2). When looking at specific questions, there were significant improvements in scores for 4.5 questions (4 whole questions and a part of an additional question) for the intervention group and only 1 question for the control group. The only question on which both groups experienced a significant knowledge gain was question 5, parts a and b, which asked students to "List the recommended fasting (part a) and the postprandial (part b) glucose goals for a patient with type 2 diabetes per the American Diabetes Association (ADA)."

There was a significant improvement in perceived aptitude/confidence for all students (Table 3). The

Table 1. Demographics of Student Pharmacists Participating in the Study

Characteristics	Intervention Group, No. (%) (n=26)	Control Group, No. (%) (n=20)	*p* Value[a]
Gender			
Male	9 (35)	4 (20)	.28
Female	17 (65)	16 (80)	
Age			
20-25 years	8 (30.8)	5 (25.0)	.83
26-30 years	14 (53.8)	11 (42.3)	
31-35 years	3 (11.5)	2 (10.0)	
36-40 years	0 (0.0)	1 (5.0)	
41 or older years	1 (3.8)	1 (5.0)	
Race			
African-American	3 (11.5)	1 (5.0)	.005[b]
Asian	1 (3.8)	11 (55.0)	
Caucasian	14 (53.8)	4 (20.0)	
Latino	1 (3.8)	0 (0.0)	
Other	7 (26.9)	4 (20.0)	
Completed the Diabetes Elective			
Yes	2 (7.7)	5 (25.0)	.11
No	24 (92.3)	15 (75.0)	
Previous teaching a patient education class			
Yes	2 (7.7)	1 (5.0)	.71
No	24 (92.3)	19 (95.0)	
Number of years' experience in pharmacy			
0 years	2 (7.7)	1 (5.0)	.83
1-2 years	9 (34.6)	6 (30.0)	
3-5 years	12 (46.2)	12 (60.0)	
>5 years	3 (11.5)	1 (5.0)	
Previous pharmacy work environment			
Community/Retail	15 (57.7)	14 (70.0)	.38
Hospital	8 (30.8)	2 (10.0)	
Other	1 (3.8)	1 (5.0)	
Not applicable	2 (7.7)	3 (15.0)	

[a] Comparison between the intervention and control groups
[b] An *a prior* alpha level was set at <.05

intervention and control groups had similar pre-intervention perceived aptitude/confidence scores (total perceived confidence score= 38.7 for intervention [out of 56] and 41.3 for control [out of 56], p=.36). Students mostly agreed or disagreed with each aptitude/confidence statement on the pre-questionnaire, but did not strongly agree or strongly disagree. Additionally, both groups had a similar post-intervention perceived aptitude/confidence score (total post-score=50.6 out of 56 for intervention and 48.0 out of 56 for control, p=.18). This means that most of the students either agreed or strongly agreed with each perceived aptitude/confidence statement on the post-intervention questionnaire. However, the mean perceived aptitude/confidence scores (11.9 points) of those in the intervention group improved significantly more compared to the mean score of those in the control group (6.7 points, p=.0026). The aptitude/confidence question that students ranked themselves the highest on was confidence in their ability to counsel patients with type 2 diabetes on self-monitoring blood glucose goals.

DISCUSSION

While evidence exists that demonstrates the benefit of incorporating student pharmacists into the teaching of a DSMES class, our study was the first conducted with APPE students that included a knowledge assessment in addition to a confidence evaluation and established a control group for comparison.[6,16,19] This study also used the *US Diabetes Conversation Map Program* to teach the class and offers evidence that this resource can be used successfully by student pharmacist facilitators to enhance their confidence in and perception of diabetes knowledge

Table 2. Comparison of the Average Pre- and Post-knowledge Scores Between the Intervention and Control Groups

Knowledge Question	Intervention Group (n=26)			Control Group (n=20)		
	Pre-test, mean (SD)	Post-test, mean (SD)	*P* value[a]	Pre-test, mean (SD)	Post-test, mean (SD)	*P* Value[a]
1a. Described Type 1 diabetes, including a brief discussion of pathophysiology.	5.5 (1.4)	3.9 (0.9)	.27	3.8 (0.9)	4.1 (0.9)	.27
1b. Described Type 2 diabetes, including a brief discussion of pathophysiology.	5.5 (1.4)	3.3 (0.8)	.35	3.9 (0.6)	3.7 (0.7)	.31
2a. Identify the following statements as fact or myth. -A low carbohydrate diet is the best type of diet for patients with type 2 diabetes. -Fruit has very little effect on blood glucose; therefore it is not extremely important to monitor consumption. -Blood glucose can be lowered with high-fiber foods.	3.2 (0.9)	4.1 (1.1)	.003	3.0 (1.2)	3.2 (1.2)	.67
2b. For each above statement in 2a, provide evidence for why each is true or false.	2.8 (2.0)	3.3 (2.1)	.41	3.4 (1.1)	3.5 (1.1)	.89
3. What is responsible for moving glucose into cells?	7.7 (4.3)	10.0 (0.0)	.01	8.4 (3.8)	8.4 (3.8)	-
4. Which organ is responsible for creating glucose?	5.0 (5.1)	9.6 (2.0)	<.001	6.8 (4.8)	9.0 (3.2)	.10
5a. List the recommended fasting glucose goals for a patient with type 2 diabetes per the American Diabetes Association.	2.5 (2.6)	4.9 (0.5)	<.001	1.8 (2.3)	3.3 (2.2)	.04
5b. List the recommended post-prandial glucose goals for a patient with type 2 diabetes per the American Diabetes Association.	3.7 (2.3)	4.7 (1.1)	.01	2.6 (2.4)	4.3 (1.4)	.006
6a. What is a hemoglobin A1c?	2.8 (0.9)	2.8 (1.0)	.77	2.7 (1.0)	2.9 (0.8)	.48
6b. How often should patients with type 2 diabetes (controlled and uncontrolled) obtain an A1c?	2.1 (1.4)	2.5 (1.3)	.26	2.1 (1.4)	2.7 (1.1)	.15
6c. Describe A1c goals for adults per the ADA (including what factors may warrant more or less stringent goals).	1.8 (1.6)	2.0 (1.4)	.50	2.2 (1.4)	2.1 (1.3)	.80
7a. List three causes of hyperglycemia.	4.1 (1.2)	4.7 (1.1)	.08	4.0 (1.8)	4.1 (1.5)	.87
7b. List three causes of hypoglycemia.	4.0 (1.3)	4.6 (1.1)	.15	3.8 (1.7)	4.1 (1.5)	.57
8a. What is medical nutrition therapy?	3.2 (2.0)	4.3 (1.1)	.01	3.58 (1.7)	4.2 (1.1)	.20
8b. How would you counsel a patient on appropriate eating habits?	2.7 (1.9)	1.6 (1.8)	.01	2.2 (2.0)	2.8 (1.8)	.27
9. How much physical activity is recommended per the ADA for type 2 diabetes patients per week?	8.9 (2.3)	8.2 (2.2)	.23	8.0 (3.3)	8.6 (3.3)	.54
10. List 3 medication options for treating diabetes. Include the medications MOA, drug class, two side effects or contraindications, and 2 clinical pearls	6.9 (2.7)	7.5 (2.3)	0.40	7.0 (2.5)	7.7 (1.9)	.31
Overall	**68.4 (15.5)**	**81.8 (9.6)**	**<0.001**	**70.0 (13.9)**	**74.1 (21.0)**	**0.48**

[a] The *student t* test was used to compare the mean pre-test score to the mean post-test score for each question separately for the intervention and control groups

and skills. Following the student-led DSMES class in this study, students in the intervention cohort exhibited a significant improvement in knowledge scores compared to scores on the pre-intervention assessment. Furthermore, this improvement in knowledge scores was not seen among students in the control group. Additionally, the

Table 3. Comparison of the Groups' Confidence/Aptitude Scores After Teaching a Diabetes Self-Management Education and Support Class

	Intervention Group (n=26)			Control Group (n=20)		
Confidence Question[a] I am confident in my. . .	**Pre-test, mean (SD)**	**Post-test, mean (SD)**	***P* value[b]**	**Pre-test, (SD)**	**Post-test, mean (SD)**	***P* value[b]**
1. . . . overall knowledge of type 2 diabetes.	2.8 (0.5)	3.5 (0.5)	<.001	3.0 (0.7)	3.4 (0.6)	.005
2. . . . ability to discuss the pathophysiology of diabetes with patients.	2.7 (0.5)	3.6 (0.5)	<.001	2.9 (0.8)	3.4 (0.6)	<.001
3. . . . ability to identify barriers to achieving treatment goals in type 2 diabetes.	2.8 (0.5)	3.6 (0.5)	<.001	3.1 (0.8)	3.5 (0.8)	.008
4. . . . ability to discuss the emotional distress that can occur with type 2 diabetes.	2.7 (0.5)	3.5 (0.6)	.0001	3.1 (0.8)	3.5 (0.6)	.015
5. . . .my ability to discuss triggers which may cause hyperglycemia or hypoglycemia.	3.0 (0.5)	3.7 (0.5)	<.001	3.1 (0.7)	3.6 (0.6)	.003
6. . . . ability to counsel patient with type 2 diabetes on medical nutrition therapy.	2.7 (0.6)	3.4 (0.6)	<.001	2.7 (0.7)	3.4 (0.6)	<.001
7. . . . ability to counsel patient with type 2 diabetes on physical activity.	3.0 (0.5)	3.7 (0.5)	<.001	3.1 (0.8)	3.6 (0.6)	.005
8. . . . ability to educate patients with type 2 diabetes on their diabetes medications.	2.8 (0.6)	3.5 (0.5)	<.001	3.2 (0.8)	3.5 (0.6)	.040
9. . . . ability to instruct patients on proper insulin technique.	2.7 (0.7)	3.6 (0.5)	<.001	2.7 (0.7)	3.4 (0.7)	.002
10. . . . ability to counsel patients with type 2 diabetes on self-monitoring blood glucose goals.	3.0 (0.6)	3.7 (0.5)	<.001	3.1 (0.8)	3.6 (0.5)	.006
11. . . . ability to set individualized goals of therapy for diabetes self-management.	2.5 (0.6)	3.6 (0.5)	<.001	2.9 (0.9)	3.4 (0.8)	.003
12. . . . ability to counsel patients on the importance of a support network to achieve diabetes-related goals.	2.9 (0.6)	3.6 (0.5)	<.001	3.0 (0.7)	3.4 (0.7)	.003
13. . . . ability to provide diabetes self-management education to patients with type 2 diabetes one-on-one.	2.8 (0.6)	3.7 (0.5)	<.001	2.9 (0.9)	3.4 (0.7)	<.001
14. . ..ability to provide diabetes self-management education to patients with type 2 diabetes in a small group.	2.8 (0.6)	3.6 (0.5)	<.001	2.8 (0.8)	3.2 (0.7)	.005
Total	38.7 (4.2)	50.6 (5.5)	<.001	41.25 (9.2)	47.95 (7.6)	<.001

[a] Respondents were asked to indicate their confidence with each statement using a four-point scale, with 4= strongly agree and 1=strongly disagree

[b] Differences in the mean scores between pre-test and post-test were calculated using a Wilcoxon Signed Rank test

intervention group demonstrated a gain in aptitude and confidence related to teaching a DSMES class.

With regard to the knowledge assessment, students in the control group demonstrated a significant improvement in only one content area, that relating to the ADA goals for fasting and postprandial glucose levels. However, students in the intervention group demonstrated a significant increase in knowledge on multiple items, with the majority improving their overall score and the score on only one item decreasing. This suggests that the act of teaching a DSMES class led to an improvement in knowledge among students in the intervention group. The DSMES class curriculum was intentionally designed to incorporate essential elements that patients with diabetes should be familiar with to adequately self-manage their diabetes. The unique design of this patient care learning activity allowed for students to prepare together and to team-teach patients and provided an environment for students to learn from each other. This may have led to an enhanced learning process, as opposed to the traditional counseling model with an individual patient in which there is limited, if any, interaction with other learners. In addition, the repetition associated with group preparation, faculty orientation, and team-teaching allowed for multiple opportunities to reinforce content in addition to standard exposure to

diabetes experiences (ie, patient cases and topic discussion) throughout the APPE.

Regarding the differences in individual questions used in the knowledge assessment for students in the intervention cohort, students were able to better identify which statements were correct or incorrect (fact or myth); however, students were unable to justify why a statement would be labeled as a 'myth.' Background pathophysiologic content that students may have previously learned but forgotten was refreshed by preparing for and teaching the class. Additionally, constant repetition of factual information related to guideline-driven goals led to improved recall of content. Furthermore, knowledge associated with lifestyle-related aspects of diabetes care revealed an improvement in understanding of what constitutes medical nutrition therapy. However, because the focus of the other experiences included as part of the APPE was mostly on pharmacotherapy, students may not have retained information about the lifestyle modification interventions discussed as part of the class. Finally, a dietician may also be present on the health care team, so students may be less inclined to take ownership of this role in diabetes care.

Overall aptitude and confidence significantly improved for both groups, with a larger increase in confidence seen in the intervention group. The ability questions mirrored the knowledge questions in content, which allowed for correlation and matching between the surveys. Students in the intervention cohort displayed an improved perceived confidence in counseling with patients about different aspects of diabetes management including medication knowledge, nutritional support, and physical activity. The control cohort may have experienced improvements in their perceived abilities related to the traditional APPE experiences previously mentioned.

As with any study, there are limitations to this research. The intervention was developed and implemented by two ambulatory care faculty members for their APPE at one private college of pharmacy. These faculty members only precept a maximum of two students per APPE block, which resulted in a small sample size for the study. However, the number of students included was greater than that in a previously published study of similar design.[6] Nevertheless, it is unclear whether other pharmacy schools with different faculty members and different students would achieve results similar to ours if they implemented a similar study. Also, administering the knowledge assessment immediately after the DSMES class may have heightened students' knowledge scores due to the recency effect. A natural limitation of this study is that students in the intervention group were responsible for teaching a DSMES class to patients, which resulted in students spending more time studying the content. This may have caused students in the intervention group to demonstrate improved knowledge and confidence on the post-intervention assessment, outside of teaching the class itself. The aptitude/confidence results were based on students' self-perceptions. It is unclear whether the students' self-perception was as accurate a measure of their actual ability as a pharmacist or faculty member would have given them. However, because the knowledge questions mirrored the ability questions, the knowledge assessment provided a more objective measurement of the students' abilities. Finally, an unintended significant difference in race represented in the intervention group vs in the control groups was found, but we do not know how, if at all, this influenced the results of this study.

This study aimed to train student pharmacists to be more successful in providing patient education in a small group setting. This teaching ability and confidence can be carried with the students to various practice settings encountered in their future careers in which they would be providing direct patient care. This study allowed for an added pharmacy-specific role for students within the faculty members' ambulatory care clinic so that the APPE students could gain a sense of ownership of and autonomy in their role as future pharmacists. The students can later use these feelings to advocate for their patients and the growth of the profession. It also provided patients with the opportunity to enhance their knowledge and practice of critical diabetes self-management strategies. Additionally, this study allowed for the identification of the strengths and weaknesses of student pharmacists with regards to their diabetes knowledge as well as their aptitude and confidence in providing patient education within a group class model. This information will allow for the development of other experiences in the pharmacy curriculum that improve student pharmacist's confidence and ability to educate patients in a group educational setting. Furthermore, trends in student strengths and weaknesses can become targets for the development of further novel teaching models, both within the didactic and experiential curriculum. Future research can focus on how students' perceived aptitude and confidence relates to the ratings provided by pharmacist faculty members and/or the patients who interacted with them. Additionally, the long-term impact of teaching a DSMES class on knowledge retention and application should be explored.

CONCLUSION

A student pharmacist team-taught DSMES class fostered and promoted diabetes knowledge growth as well as enhanced their perceived clinical teaching abilities. This may lead to students becoming better educators of patients with diabetes in their future careers.

ACKNOWLEDGMENTS

The authors would like to acknowledge the contribution of Adam Gates, Class of 2019 Doctor of Pharmacy candidate, for his assistance with data collection and data analysis. This research was supported by two separate grants from Mercer University College of Pharmacy and Mercer University Health Sciences Center.

REFERENCES

1. Provider status: What pharmacists need to know now. American Pharmacists Association. http://www.pharmacist.com/provider-status-what-pharmacists-need-know-now. Published August 2, 2013. Accessed March 18, 2020.
2. American College of Clinical Pharmacy, Burke JM, Miller WA, et al. Clinical pharmacist competencies. *Pharmacotherapy*. 2008;28(6):806-815. doi:10.1592/phco.28.6.806
3. Accreditation Standards and Guidelines, ACPE - Accreditation Council for Pharmacy Education, ACPE - Accreditation Council for Pharmacy Education. https://www.acpe-accredit.org/pdf/Standards2016FINAL.pdf. Accessed March 18, 2020.
4. 2017 Statistics Report. Data & Statistics. Diabetes. CDC. https://www.cdc.gov/diabetes/pdfs/data/statistics/national-diabetes-statistics-report.pdf. Accessed March 18, 2020.
5. Association AD. 3. Foundations of Care and Comprehensive Medical Evaluation. *Diabetes Care*. 2016;39(Supplement 1):S23-S35. doi:10.2337/dc16-S006
6. Shrader S, Kavanagh K, Thompson A. A diabetes self-management education class taught by pharmacy students. *Am J Pharm Educ*. 2012;76(1):13. doi:10.5688/ajpe76113
7. Healthy Interactions-Conversation map [catalog]. https://healthyinteractions.com/assets/files/HI_Catalog_v01_09_093015.pdf. Accessed March 18, 2020.
8. Johnson JF, Chesnut RJ, Tice BP. An advanced diabetes care course as a component of a diabetes concentration. *Am J Pharm Educ*. 2003;67(1):21. doi:10.5688/aj670121
9. Ryan GJ, Foster KT, Unterwagner W, Jia H. Impact of a diabetes certificate program on PharmD students' knowledge and skills. *Am J Pharm Educ*. 2007;71(5):84. doi:10.5688/aj710584
10. Ryan GJ, Chesnut R, Soule Odegard P, Dye JT, Jia H, Felice Johnson J. The impact of diabetes concentration programs on pharmacy graduates' provision of diabetes care services. *Am J Pharm Educ*. 2011;75(6):112. doi:10.5688/ajpe756112
11. Plake KS, Chesnut RJ, Biebighauser S. Impact of a diabetes certificate program on pharmacists' diabetes care activities. *Am J Pharm Educ*. 2003;67(4):116. doi:10.5688/aj6704116
12. Westberg SM, Bumgardner MA, Brown MC, Frueh J. Impact of an elective diabetes course on student pharmacists' skills and attitudes. *Am J Pharm Educ*. 2010;74(3):49. doi:10.5688/aj740349
13. Rosenthal M, Morales E, Levin S, Murphy LF. Building a team to fight diabetes: pharmacy students' perceptions about serving as patient navigators. *Curr Pharm Teach Learn*. 2014;6(4):595-604. doi:10.1016/j.cptl.2014.04.012
14. Ellis SL, Nuffer W, Turner CJ. Diabetes-focused rotation's impact on student confidence and knowledge. *Curr Pharm Teach Learn*. 2012;4(3):174-179. doi:10.1016/j.cptl.2012.04.009
15. Engelhard C, Lonneman W, Warner D, Brown B. The implementation and evaluation of health professions students as health coaches within a diabetes self-management education program. *Curr Pharm Teach Learn*. 2018;10(12):1600-1608. doi:10.1016/j.cptl.2018.08.018
16. Woodard LJ, McKennon S, Danielson J, Knuth J, Odegard P. An elective course to train student pharmacists to deliver a community-based group diabetes prevention program. *Am J Pharm Educ*. 2016;80(6):106. doi:10.5688/ajpe806106
17. Morello CM, Neighbors M, Luu L, Kobayashi S, Mutrux B, Best BM. Impact of a first-year student pharmacist diabetes self-care education program. *Am J Pharm Educ*. 2013;77(10):215. doi:10.5688/ajpe7710215
18. Garza KB, Westrick SC, Teeter BS, Stevenson TL. Incorporating hypertensive patient education on salt intake into an introductory pharmacy practice experience. *Am J Pharm Educ*. 2013;77(9):199. doi:10.5688/ajpe779199
19. Fazel M, Cooley J, Kurdi S, Fazel M. A co-curricular diabetes-specific elective with interprofessional students and faculty. *Curr Pharm Teach Learn*. 2019;11(2):172-177. doi:10.1016/j.cptl.2018.11.006