

*Full Length Research Paper*

## Teaching in pharmaceutical care: A systematic review

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The aim of the work was to systematically review published studies about teaching methods in pharmaceutical care. Literature databases searched included LILACS, PubMed, SCOPUS, EMBASE, and ERIC. Studies published until January 2015 were searched for using the search terms “pharmaceutical services”, “pharmaceutical care”, “medication therapy management”, “learning”, “education” and “teaching” in different combinations. In the initial screening, the search identified 562 articles using the terms chosen; 21 articles met the inclusion criteria. Most of the studies (n = 15, 71.4%) were conducted in North America and only one study was conducted in Brazil. Regarding the teaching methods or learning strategies used in analyzing these studies, simulation was used in eight studies (30.0%), followed by the use of case study and problem-based learning in six articles each (28.5%). Different teaching methods were described; the most common was simulation, followed by clinical cases and problem-based learning. Most of these studies showed positive outcomes with the educational intervention.

**Key words:** Teaching, pharmaceutical care, active learning.

### INTRODUCTION

In recent decades, studies have demonstrated that pharmacists have an important role to play in medication therapy management, whereby they can greatly enhance overall patient health outcomes (Buurma et al., 2004; Dyck et al., 2005; Vinks et al., 2006; Lyra Jr. et al., 2007; Balisa-Rocha et al., 2012). In response to these needs, pharmacy profession experienced a fundamental change in its philosophy of practice. The change in orientation is synthesized by the term “pharmaceutical care”, defined by Hepler and Strand (1990) as “the responsible provision of drug therapy for the purpose of achieving defined outcomes that improve a patient's quality of life”.

Pharmaceutical care entails more clinical pharmacy practice, wherein pharmacists focus less on the distribution of drugs and more on patient care (Schneider and Sill, 1995; Li, 2003).

To move in the direction of a more patient-focused practice, pharmacists must first possess competencies that include extensive pharmacotherapy knowledge, written and verbal communication skills, greater problem-solving capabilities, decision-making skills, motivation, and the self-confidence necessary to provide pharmaceutical care (Fisher, 1994; Culbertson, 2008). Furthermore, pharmacists must possess clinical

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knowledge of medication and disease states so as effectively monitor a patient's drug therapy, and to develop relationships with patients that can facilitate discussions about drug-related problems, disease, and other relevant information (Schneider and Sill, 1995; Kassam, 2006a). In response to these changes in the pharmacy profession, a reorientation in pharmaceutical education became necessary for faculties and in postgraduate learning (Kassam, 2006a).

In pharmaceutical care, education is important for students to practice and develop proficiency in the skills, knowledge, and attitudes relevant to achieving the desired performance (Zaremski et al., 2005; Kassam, 2006a; Kassam et al., 2008). Consequently, educational strategies are being developed and rigorously evaluated to facilitate the learning outcomes needed to practice pharmaceutical care (Fisher, 1994; Popa et al., 2002; Sefton, 2004). In this perspective, new teaching methods and/or learning strategies have been incorporated into pharmacy curricula, mainly with the aim of changing the current model of learning/teaching. These methods require a learner-focused approach, that is, an approach that seeks to value the student as an active subject in the teaching process, who is co-responsible for the construction of knowledge in different learning scenario (Venturelli, 2003; Silva and Delizoicov, 2008). Problem-based learning, role-play, the use of clinical cases, and simulated patients are examples of these methods.

In this sense, the purpose of this systematic review was to describe the type of methodologies used in the teaching of pharmaceutical care.

## METHODOLOGY

The present review was written in accordance with some of the criteria of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) declaration of methodology (Moher et al., 2009).

### Eligibility criteria

Studies that addressed teaching methods used in pharmaceutical care or medication therapy management course were considered eligible. The outcomes of interest were the types of methodology used and the outcomes achieved.

### Information sources

The databases EMBASE, Education Resources Information Center (ERIC), LILACS, PubMed and SCOPUS, were reviewed for original articles published until January 2015. The descriptors used were "pharmaceutical services", "pharmaceutical care", "medication therapy management", "learning", "education", and "teaching" in different combinations.

### Search strategy

A preliminary search was conducted, wherein the descriptors in the

titles or abstracts of papers found were examined. However, a preliminary reading of random abstracts identified many studies that were not related to the theme, which justified a restriction in search terms. Thus, articles were selected in which the descriptors "learning", "education" and "teaching" occurred in the title of the article and the other descriptors in either the title and/or abstract, which increased the likelihood of the articles being relevant. The following is an example of the strategy that was used to search a PubMed databases: (learning[ti] or education[ti] or teaching[ti]) and ("pharmaceutical care"[tiab] or "pharmaceutical services"[tiab] or "medication therapy management"[tiab]). In addition, a manual search of relevant references in all included studies was performed.

### Study selection and data collection process

Two reviewers independently have made a manual sorting through titles, abstracts, and full text and selected the articles for inclusion in this review. The degree of concordance between the two reviewers was evaluated using the kappa statistic ( $k$ ). The kappa-measured agreement was based on the specifications of the specialized literature:  $k < 0.10$ , no agreement;  $k < 0.40$ , weak agreement;  $k = 0.40$  to  $0.75$ , good agreement; and  $k > 0.75$ , excellent agreement (Hosmer and Lameshow, 1989). At the end, the disagreements were resolved by consensus.

Articles repeatedly indexed in two or more databases were taken into consideration only once. Reviews, meta-analyses, and editorials were excluded. Those that were not written in English, Spanish, or Portuguese were also excluded. If the abstract or the full text were not available, attempts to contact the authors to obtain the full text were made.

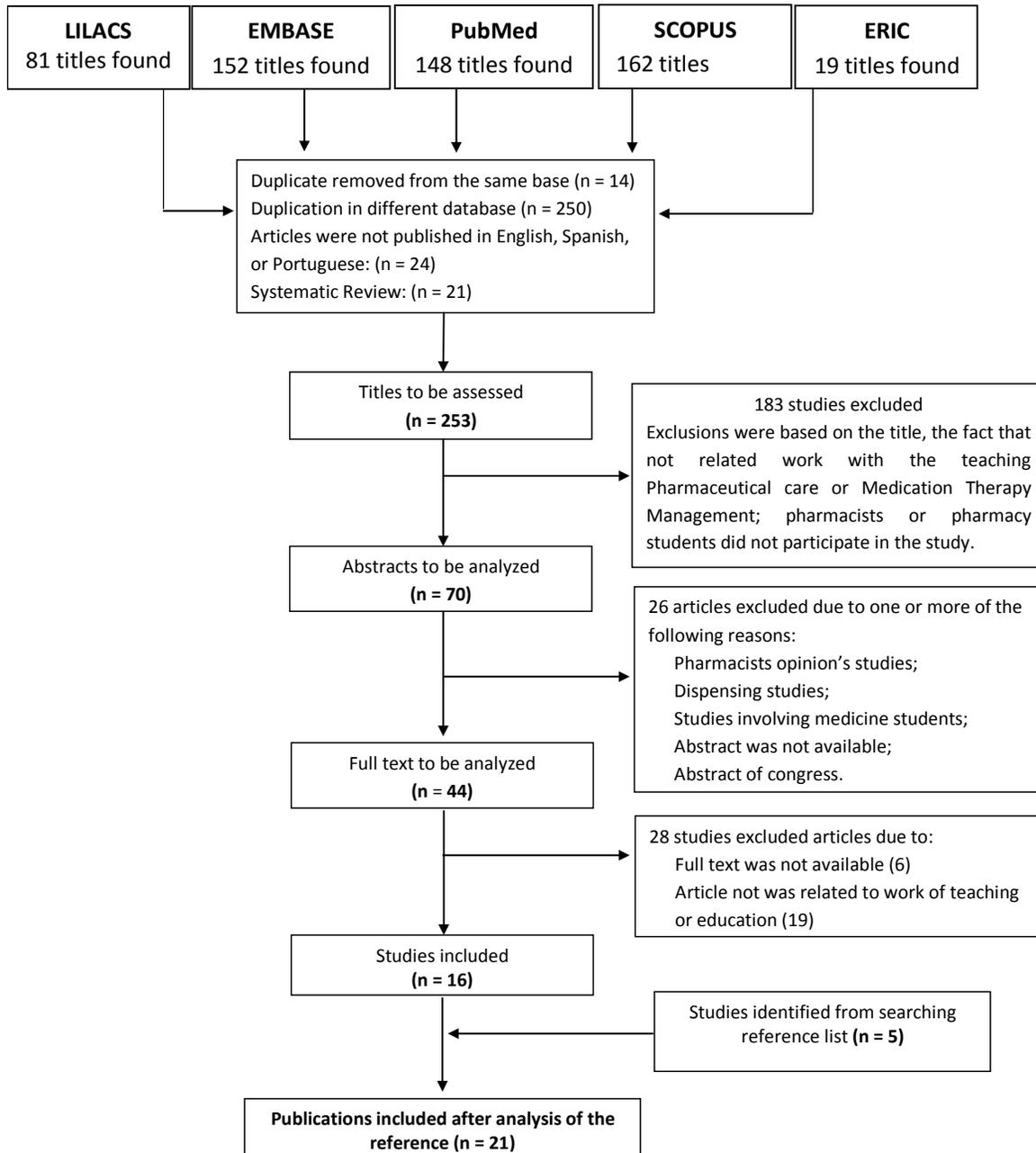
### Data items

The articles satisfying the inclusion criteria for data extraction were carefully examined regarding the following variables: study location (setting/country); formation degree; sample size (number of students or pharmacists); school year; educational intervention; method used for participant assessment in course; and outcomes variable. Furthermore, articles conceptualized pharmaceutical care was analyzed; the responsibilities of pharmacist in the patient care process and limitations or biases of the study were described.

## RESULTS

Figure 1 illustrates the progressive selection and the number of articles in each stage. The initial screening using the keywords identified 562 titles, 14 of them indexed in the same database and 250 of them indexed simultaneously in two or more databases. Twenty four articles were published in another language and 21 consisted of systematic reviews. 183 citations were excluded on the basis of the title because they did not focus on the teaching of pharmaceutical care. Screening of the abstracts of the articles reduced the number of studies to 44. The full-text versions of the remaining articles were obtained and carefully reviewed. Twenty-eight articles were dropped from the screening process, because the full text was unavailable or the study was not related to the work of teaching or education.

An analysis of the references of the 16 selected articles was performed and 5 studies were search in reference



**Figure 1.** Flow diagram for the review process.

list, totaling at the end of the selection process 21 publications included in the systematic review (Kocla-Kimble and Batz, 1994; Wislande, 1994; Lee et al., 1998; Reutzel et al., 1999; Chambers et al., 2000; James et al., 2001; Ramam-Wilms, 2001; Bertolo et al., 2003; Lam, 2005; Kassam, 2006a, b; Ross et al., 2007; Culbertson, 2008; Kassam et al., 2008; Zolezzi and Blake, 2008; Benedict, 2010; Chiang et al., 2010; Strohfeltd and Grant, 2010; Cone et al., 2013; Limberger, 2013; Galal et al., 2014). The concordance between the two review authors

was considered excellent ( $k = 0.9987$ ,  $k = 0.9851$ , and  $k = 0.9893$ , respectively) in 3 steps of the selection process of articles.

In this review, most of the studies ( $n = 15$ , 71.4%) were conducted in North America (Kocla-Kimble and Batz, 1994; Wislande, 1994; Lee et al., 1998; Reutzel et al., 1999; Chambers et al., 2000; Ramam-Wilms, 2001; Lam, 2005; Kassam, 2006a, b; Ross et al., 2007; Culbertson, 2008; Kassam et al., 2008; Benedict, 2010; Cone et al., 2013; Galal et al., 2014). Only one study was conducted

in Brazil (Limberger, 2013). All selected studies were published after 1990. Only one study was written in Spanish and only one in Portuguese, the others were in English.

Most of the studies were directed for undergraduate students of pharmacy ( $n = 14$ , 66.7%) (Fisher, 1994; Wislande, 1994; Schneider and Sill, 1995; Culbertson, 2008; Chambers et al., 2000; Ramam-Wilms, 2001; Lam, 2005; Kassam, 2006a, b; Ross et al., 2007; Kassam et al., 2008; Martínez-Sánchez, 2009; Benedict, 2010), while only 19.0% were courses of continuing education to pharmacists ( $n = 4$ ) (Kocla-Kimble and Batz, 1994; Lee et al., 1998; Reutzel et al., 1999; Chiang et al., 2010) and the others ( $n = 3$ , 14.3%) were education programs for postgraduate pharmacists (Lam, 2005; Zolezzi and Blake, 2008; Strohfeltd and Grant, 2010). Educational interventions were used in the pharmaceutical care courses from the first until fourth year of an undergraduate pharmacy degree program. Sample size in the analyzed papers varied from 15 to 574 students or pharmacists.

In the present study, only two studies discussed the pharmaceutical care concept (James et al., 2001; Kassam et al., 2008). Fourteen studies (66.7%) reported several responsibilities of the pharmacist in the process of patient care. Among them, the most frequently cited were: determination of patient's drug-related needs (indication, effectiveness, safety, adherence) and identifying drug therapy problems, in ten articles (Wislande, 1994; Reutzel et al., 1999; Chambers et al., 2000; Ramam-Wilms, 2001; Bertolo et al., 2003; Kassam, 2006a, b; Culbertson, 2008; Limberger, 2013; Galal et al., 2014), followed by obtaining of patient data as the reason for the encounter, demographics, medication experience, and other clinical information (Wislande, 1994; Galal et al., 2014) and development of care plans (James et al., 2001; Cone et al., 2013).

Table 1 presents the educational interventions, methods of assessment and outcomes measured by the 21 selected studies. Regarding the teaching methods or learning strategies used in analyzed studies, simulation was the most used, in eight studies (30.0%) (Kocla-Kimble and Batz, 1994; Lee et al., 1998; Reutzel et al., 1999; Chambers et al., 2000; James et al., 2001; Benedict, 2010; Cone et al., 2013; Galal et al., 2014), followed by the use of problem-based learning (Wislande, 1994; Ramam-Wilms, 2001; Ross et al., 2007; Culbertson, 2008; Benedict, 2010; Strohfeltd and Grant, 2010) and case study (Ramam-Wilms, 2001; Lam, 2005; Culbertson, 2008; Zolezzi and Blake, 2008; Chiang et al., 2010; Limberger, 2013) in six articles each (28.5%).

The evaluation methods most utilized to assess the students or pharmacists were evaluation of performance in the course or practical assessment, in eight studies (Lee et al., 1998; Reutzel et al., 1999; Chambers et al., 2000; Kassam, 2006b; Ross et al., 2007; Culbertson, 2008; Cone et al., 2013; Limberger, 2013). Other methods

worth mentioning were written examinations (Wislande, 1994; Lee et al., 1998; Reutzel et al., 1999; Ross et al., 2007) and questionnaires (James et al., 2001; Kassam et al., 2008; Chiang et al., 2010; Galal et al., 2014) in four studies each.

Regarding the outcomes of studies, this study was divided in evaluation of participant knowledge, participant performance and participant satisfaction with the course. Eleven studies showed outcomes in the knowledge (52.4%) (Kocla-Kimble and Batz, 1994; Wislande, 1994; Reutzel et al., 1999; Ramam-Wilms, 2001; Bertolo et al., 2003; Zolezzi and Blake, 2008; Benedict, 2010; Chiang et al., 2010; Strohfeltd and Grant, 2010; Limberger, 2013; Galal et al., 2014), and all these studies demonstrated positive outcomes in the improvement of knowledge of the participants.

Performance assessment of participants was conducted in 16 articles (76.2%) (Kocla-Kimble and Batz, 1994; Lee et al., 1998; Reutzel et al., 1999; Chambers et al., 2000; James et al., 2001; Bertolo et al., 2003; Lam, 2005; Kassam, 2006a; Ross et al., 2007; Culbertson, 2008; Kassam et al., 2008; Zolezzi and Blake, 2008; Chiang et al., 2010; Cone et al., 2013; Limberger, 2013; Galal et al., 2014). In these studies, only 1 presented negative outcomes in the performance of the participants (Kassam, 2006a), and 1 was neutral; in other words, student performance did not decline, but outcomes did not improve (Ross et al., 2007). The others showed positive outcomes.

Ten studies also reported the outcomes in terms of participant satisfaction with the course (Wislande, 1994; Chambers et al., 2000; Reutzel et al., 1999; Ramam-Wilms, 2001; Kassam, 2006b; Ross et al., 2007; Zolezzi and Blake, 2008; Benedict, 2010; Strohfeltd and Grant, 2010; Cone et al., 2013). Most studies reported that educational interventions had been well received by students. Details of achieved outcomes are as shown in Table 2.

Finally, it is also worth highlighting that 9 articles reported the limitations of the completed study (Wislande, 1994; Lee et al., 1998; Ramam-Wilms, 2001; Kassam, 2006a, b; Kassam et al., 2008; Zolezzi and Blake, 2008; Chiang et al., 2010; Galal et al., 2014).

## DISCUSSION

Loss of function, social power, and status in pharmacy profession has resulted in a gradual shift in focus away from the technical roles of pure procurement, supply, and distribution of medications, toward disease and patient-oriented approaches to pharmaceutical decision-making and more clinically oriented roles (Edmunds and Calnan, 2001; Bissell and Morgall-Traulsen, 2005). In the broadest sense, in response to these professional needs (Breimer, 2001; Shah et al., 2010), pharmaceutical education in developed countries, such as the United

**Table 1.** Characteristics of the study sample regarding: setting/country, formation degree, sample size and school year.

Reference	Country/Setting	Formation degree	Sample size (students or pharmacists)	School year
Kocla-Kimble and Batz (1994)	USA/University of California	Continuing education to pharmacists	15 Pharmacists	Not applicable
Winslade (1994)	Canada/University of Toronto	Undergraduate students of pharmacy	160 Students	Final year of the baccalaureate program
Lee et al. (1998)	USA/University of the Pacific	Continuing education to pharmacists	34 Pharmacists	Not applicable
Reutzel et al. (1999)	USA/Midwestern University Chicago College of Pharmacy, Drake University college of Pharmacy & Health Sciences and American Drug Stores Pharmacy	Continuing education (CE) to pharmacists	23 Pharmacist	Not applicable
Chambers et al. (2000)	USA/University of Washington State	Undergraduate students of pharmacy	574 Students	First-year and second-year
James et al. (2001)	United Kingdom/University of Brighton	Undergraduate students of pharmacy	91 Students	Not available
Ramam-Wilms (2001)	Canada/University of Toronto	Undergraduate students of pharmacy	120 Students	Third and fourth professional years
Bertoldo et al. (2003)	Argentina/Universidad Católica de Córdoba	Undergraduate students of pharmacy	27 Students	Final year
Lam (2005)	USA/University of Washington School of Pharmacy	PharmD students	24 Students	Final year of study
Kassam (2006a)	Canada/The University of British Columbia	Undergraduate students of pharmacy	122 Students	Fourth year (senior year)
Kassam (2006b)	Canada/The University of British Columbia	Undergraduate students of pharmacy	122 Students	Fourth year (senior year)
Ross et al. (2007)	USA/University of Mississippi	Undergraduate students of pharmacy	The average number of students is 80	Third-professional year
Culbertson et al. (2008)	USA/Idaho State University	Undergraduate students of pharmacy	180 Students	First year through the third year
Kassam et al. (2008)	Canada/The University of British Columbia	Undergraduate students of pharmacy	35 Students	Fourth year (senior year)
Zolezzi and Blake (2008)	New Zealand/University of Auckland	Postgraduate to pharmacists	Not available	Not applicable
Benedict (2010)	USA/University of Pittsburgh	Undergraduate students of pharmacy	107 Students to lectures	Third year
Chiang et al. (2010)	Taiwan/Taiwan Association of Asthma Education and Taipei Medical University Wan Fang Hospital	Continuing education (CE) to pharmacists	105 Pharmacists	Not applicable

**Table 1.** Cont'd

Strohfeldt and Grant (2010)	United Kingdom/University of Reading	Masters of pharmacy degree (MPharm) students	100 Students	Second year
Cone et al. (2013)	USA/University of New Mexico	Undergraduate students of pharmacy	20-30 Students	Second year
Limberger (2013)	Brasil/Centro Universitário Franciscano	Undergraduate students of pharmacy	Not available	Fourth year
Galal et al. (2014)	USA /University of the Pacific	Undergraduate students of pharmacy	40 Students	Not available

**Table 2.** Summary of educational intervention, method used to student evaluation in course and outcomes variables of included studies.

Reference	Educational intervention	Method used to participant evaluation in course	Participant knowledge	Outcomes Participant performa	Participant satisfaction
Kocla-Kimble and Batz (1994)	Hands-on practice, simulation: role play, and discussion in class	Peer review and feedback	Positive: Self assessment showed increase of levels of knowledge in diabetes care	Positive: Self assessment showed increased levels of confidence in diabetes care, and increased empathy and interest in working with patients with diabetes	"NA"
Winslade (1994)	Problem-based learning	Written examinations with clinical cases	Positive: Self assessment showed increase of levels of knowledge	"NA"	Positive: The majority of students believed the course to be good or very good. Faculty evaluation: the course was enjoyable and student participation and knowledge met or surpassed their expectations
Lee et al. (1998)	Simulation: Role-play, use of interactive videos	Checklist to assess the counseling technique, written examination to evaluate the knowledge	"NA"	Positive: Self-assessment before and after the training program showed significant improved of pharmacist's confidence in patients counseling	"NA"

Table 2. Cont'd

Reutzel et al. (1999)	Didactic lectures, group discussion and simulation: role-play	Self-assessment and final examination (written and practical components)	Positive: Self-assessment with focus group showed that the educational series improve cognitive abilities, refresh old knowledge and provide new knowledge	Positive Self-assessment with focus group showed effect on pharmacists' attitudes, practice behavior and increase of confidence levels	Positive: The educational series was a success in terms improving job satisfaction and morale. The pharmacists liked the realistic cases and the small group format
Chambers et al. (2000)	Peer teaching; Simulation: role play; service learning	Checklist of performance	"NA"	Positive: Scores on skills checklists indicated that students learned technical skills	Positive: Very useful teaching method for reinforcing technical skills and providing better instruction
James et al. (2001)	Simulation: Simulated-patient	Questionnaire designed for students' self-assessment	"NA"	Positive: Self-assessment before and after delivery of the teaching program showed significant increases in the confidence and a statistically significant decrease in perceived level of difficulty when conducting a consultation	"NA"
Ramam-Wilms (2001)	Incorporation of case study, discussion, use of real patients and use of a web site in a problem based learning course	Discussions with timely written feedback; Final oral examinations; Case study seminars with verbal and written assessment, self and peer assessment	Positive: Gradual development of the students' knowledge required to provide pharmaceutical care	"NA"	Positive: all strategies have been well received by students. Most students consider the seminars useful in their practice, and they felt comfortable with their knowledge and skills. The students' evaluation of the website indicated that it is a useful tool to learning and easy to use
Bertoldo et al. (2003)	Seminars and use of real patients	Seminars and discussion of case	Positive: students were able to integrate knowledge to identify, resolve, and prevent drug-related problems	Positive: Students employ communication skills in relationships patient-pharmacist and pharmacist-physician	"NA"
Lam (2005)	Service learning and case study	Formal oral presentations, written case study reports, formal mid-clerkship evaluation and a final evaluation	"NA"	Positive: The students were successful in improving the medication therapy of senior adults through their participation in direct care provision at the medical clinic and community site	"NA"

Table 2. Cont'd

Kassam (2006a)	Service learning (advanced pharmacy practice experiences - APPE)	Reviewing portfolios: The portfolios were meant to facilitate learning through reflection and utilized a uniform and systematic process for documenting in pharmaceutical care	"NA"	Negative: Analysis of student portfolios suggested that the learning environment did not provide students with adequate opportunities to develop pharmaceutical care competencies	"NA"
Kassam (2006b)	Service learning (Clerkship in community pharmacy)	Performance in clerkship	"NA"	"NA"	Positive: the most students expressed that their site "definitely" provided them with the opportunity to engage in pharmaceutical care activities. Students "strongly agreed" that their preceptor encouraged them to use resource materials and to learn on their own, and that their preceptor was readily available to answer their queries
Ross et al. (2007)	Problem-based learning	Assessments of student group performance, a content-based written examination, and examination to test problem-solving skills based upon the presentation of a clinical care scenario	"NA"	Neutral: Overall student performance did not decline, but outcomes definitely did not improve	Positive: The accreditation body, faculty members, students and graduates observed that successful implementation occurred, and recommended an ongoing internal review process to identify any needed curricular refinements
Culbertson et al. (2008)	Problem-based learning and case study	Case study performances evaluated by 4 different clinical faculty members, using a standardized student evaluation instrument	"NA"	Positive: It was useful in identifying students with poor advanced pharmacy practice experiences (APPE) performance	"NA"
Kassam et al. (2008)	Traditional APPE (two 4-week in two different pharmacies) X APPE intervention (one-day of education workshop; a five-day student orientation at the pharmacy site; and 8-week experience in the same pharmacy)	Questionnaire	"NA"	Positive: Students reported statistically significant benefits in terms of the number of comprehensive consultations, skills improvements and attitudes favoring pharmaceutical care principles	"NA"

Table 2. Cont'd

Zolezzi et al (2008)	Web-based course with case study	"NA"	Positive: The students' knowledge of basic mental health concepts and therapeutics were high. Three-quarters of respondents indicated that the course deepened their understanding and enhanced their mental health practice	Positive: Self-evaluation of participants' comfort levels with providing pharmaceutical care increased moderately	Positive: Most of students responded that they would like more teaching in this format
Benedict (2010)	Simulation: virtual patient, discussion boards, lectures and problem-based learning	Written report using subjective and objective patient data and care plan (SOAP)	Positive: 90% of the class improved their SOAP notes. Enhances learning and skills in treating sepsis and septic shock	"NA"	Positive: The teaching approach, combining active- and passive-learning strategies, was well received by students
Chiang et al. (2010)	Lecture, case study and hands-on practice	Questionnaires pre-intervention and post-intervention	Positive: The continuing education program significantly improved pharmacists' knowledge of asthma care	Positive: The continuing education program significantly improved pharmacists' attitudes of asthma care.	"NA"
Strohfeldt and Grant (2010)	Problem-based learning	Feedback from the instructor and a written case study-based examination at the end of the course	Positive: Students' knowledge and skills needed to design a care plan was learned rapidly and the outcomes were usually good	"NA"	Neutral: The students enjoyed the new learning experience, but made negative comments concerning the group allocations and the amount of material taught within the course
Cone et al. (2013)	Simulation: role-play, simulated patient; hands-on practice, collaborative activities that utilize digital tools and service learning	Objective Structured Clinical Examination (OSCE)	"NA"	Positive: analysis of grades showed improvement of performance of students after implementation of course	Positive: Student satisfaction increased significantly with the revised curricula. Curriculum Committee feedback on course content and teaching techniques also improved significantly
Limberger (2013)	Case study and use of web (blog)	Summative: written test examination, participation in class, oral and written reports, web discussion Formative: assessment and feedback of student performance in class	Positive: A better understanding of the subject, higher retention of knowledge about identification of drug related problem	Positive: Students felt more insurance and with high motivation	"NA"

Table 2. Cont'd

Galal et al. (2014)	Traditional lectures, team learning, reading assignments, use of audience response systems, simulation and experiential learning	Standardized student evaluation questionnaire. Student's self-reflections of the course.	Positive: Knowledge increased from 12% at the beginning of the course to 81% (p = 0.01) at the completion of the classroom and outreach components	Positive: In response to a Likert scale assessment item regarding their confidence in providing plan assistance to patients, the percentage of students expressing that they somewhat or strongly agreed increased from 3% to 100%	"NA"
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APPE: Advanced Pharmacy Practice Experiences; OSCE: Objective Structured Clinical Examination; SOAP: Subjective and objective patient data and care plan. "NA": Not available

Kingdom, the United States, Australia, Canada, and New Zealand, has evolved over time. Pharmacy education has undergone major change over the past decade with the approval of new standards and guidelines designed to assist pharmacy education institutions develop and maintain academically strong, effective programs that are responsive to changing health care needs.

The National Guidelines for Undergraduate Education in Pharmacy (2002) was published in Brazil which have been included as key aspects in pharmacy education as: evaluation of knowledge/skills application to patient care; fostering of critical thinking/problem-solving skills; skills mastery, communication ability, among others (CNE, 2002). Thus, the focus of pharmaceutical education has shifted from the basic sciences to include clinical and health sciences, including pharmaceutical care (Hassali et al., 2011; Babar et al., 2013).

In this review, all studies were published after 1990, which is consistent with the period of extensive discussion about the definition of the mission, role, and functions of the pharmacist in pharmaceutical care (Hepler and Strand, 1990; Hepler and Graiger-Rousseaux, 1995; Faus-Dáder and Martínez Martínez, 1999; Cipolle et al., 2000). Most of these studies were performed in

the United States, thereby reflecting the historical process of the development of American Pharmacy; since it was there that the concept of the practice of pharmaceutical care was elaborated and systematized.

A bibliometric review of pharmaceutical education literature, performed by Babar et al. (2013) showed few studies from low- to middle-income countries. As a result, members of the International Pharmaceutical Federation (FIP) Pharmacy Education Taskforce, whose objective is to develop pharmaceutical education globally, recently affirmed that a strategy should be used that involves determining local needs, identifying the services required to meet those needs, and articulating the competencies to be achieved by all practitioners for the development of a comprehensive education (Anderson et al., 2008, 2009a, b; Whitmarsh et al., 2010).

Most of these studies did not define the concept of pharmaceutical care. The literature suggests that there is a need to conceptually define the practice in order to distinguish the clinical services offered by pharmacists. According to Hepler and Strand (1990), pharmaceutical care is based specifically on the ability of the pharmacist to assume new responsibilities related to patient care. The three major steps in the patient care process are the assessment of the patient, his/her

medical problems, and any drug therapy problems that have occurred; development of a care plan; and conducting a follow-up evaluation (Cipolle et al., 2004).

Most of these studies in this review used learner-centered method as educational intervention. According to learning theories, the active methods fall into in cognitive or humanistic theories. These are, therefore, methods that value individual differences and allows for a more effective assessment of the actions of the student. In addition, it value the education contextualized, that is, teaching in a close in which knowledge is used, increasing the understanding, retention and learning in adults (Piaget, 1976). In recent years, several active learning methodologies have been based on constructivist and humanist theory and incorporated in health education in order to bridge the gap between theory and real patient experience (Tagawa and Imanaka, 2010; Shrivastava et al., 2013).

The learning strategy most used by reviewed studies was simulations. Most simulation approaches described in the literature involved interaction between the pharmacist (student) and a patient (peer, instructor, standardized patient, actor or virtual patient) for the purpose of acquiring knowledge or developing a particular skill (Parkhurst, 1994; Ellington et al., 2002). In

pharmacy, the role-play technique has been used primarily as a means of helping students develop skills in communication, consultation, and medication history-taking (Ellington et al., 2002; Shah et al., 2004; Rao, 2011).

Other finding was the limited number of studies using virtual patients in teaching pharmaceutical care. Several studies demonstrated the effectiveness of methods using simulations with virtual patients in the promotion of necessary competencies for pharmaceutical care (Fuhrman et al., 2001; Hussein and Kawahara, 2006; Orr, 2007). Furthermore, a systematic review published in 2012 pointed out that the use of virtual patients has the potential to be an innovative and effective educational tool in pharmaceutical education, particularly for optimizing the teaching of pharmaceutical care (Jabbur-Lopes et al., 2012).

Problem based learning (PBL) also was widely used. PBL is a well-known instructional method that has gained popularity in health professional education during the past few decades (Culbertson et al., 1997; Catney and Currie, 1999). In pharmacy, a literature review realized by Cisneros et al. (2002) revealed that there were a substantial number of articles that discussed the implementation of PBL methods in the pharmacy curriculum. Self-directed learning is the central element of the PBL approach, in which small groups of five or six students work together with the support of a facilitator (Wood, 2003). Compared to traditional methods, such as lectures and discussion, PBL is an instructional method that permits a higher degree of inquiry, greater learner control, and active participation (Catney and Currie, 1999).

Evensen and Hmelo (2000) suggested that PBL students might be better problem-solvers and more able to integrate basic science into clinical problems. In this sense, Catney and Currie (1999) concluded that adopting PBL in a pharmaceutical care course would provide an appropriate context for students to begin to develop the skills needed to actively evaluate patient data, identify drug therapy problems, and apply a consistent strategy for clinical problem-solving and care planning. Despite the advantages mentioned earlier, there are also disadvantages connected to PBL as a need of curriculum reform in pharmacy coursework, high costs and staff workload (Strohfeldt and Grant, 2010).

Despite the specific advantages of each teaching method or learning strategy, and in view of the complexity of pharmaceutical care practice, the ideal would be to utilize a range of different teaching methods. According to Gil (2008), the teacher should make sure that the chosen teaching method is the most appropriate to the learning goals and for this a sequence of methods can be used. For example, simulation strategies can be used before the student goes into the real environment of practice, with actual patients. In addition, using different teaching methods has the advantage of accommodating students

with different learning styles. Catholico (2009) affirms that students' learning style, the characteristics and preferences of individual learners in the ways they receive or process information, may help explain, for example, why some teaching methods are more or less effective for certain groups of students.

It is important that the assessment methods should be consistent with the teaching method and with learning objectives. Assessment plays a key role in the learner-centered teaching approach and must be focused on desired learning outcomes (Harpe and Phipps, 2008). Since the objective in teaching pharmaceutical care is not only memorization of knowledge but also development of skills and attitudes, instructors can provide students with multiple methods of assessment and increase the number of opportunities to demonstrate application of course material. Walczyk and Ramsey (2003) argue that, although traditional testing such as written examinations and questionnaires (which were often used in studies of this review) may form a component of assessment in learner-centered courses, assessments should also include opportunities that represent how course content will actually be used in practice.

Regarding the participants' knowledge, all the studies that reported this issue showed positive outcomes with the educational intervention. Similar results are found in literature which found that students perceived the merits of using active learning as improved application of knowledge and critical thinking (Van Amburgh et al., 2007). An important responsibility in educating student pharmacists via active learning methodologies is instilling in them a commitment to lifelong learning so that as pharmacists they will be able to maintain and expand their knowledge and skills to better serve patients, the profession, and society as a whole (Barclay et al., 2011).

Finally, for the performance and satisfaction of participants, most studies presented increased of confidence and motivation levels of the students in the patient counseling; better communication skills, empathy, attitudes in the patient care, and satisfaction with course. According to Branch (2014), the students' found in the educational intervention a good way in increasing their confidence and prepare them for future practice. It is advisable that pharmacists have appropriate communication skills in order to better serve their patients (Hasan, 2008). Some studies evaluating health professional skills demonstrated that pharmacists have significantly increased their knowledge and skills after receiving educational interventions, as corroborated by this study (Kim et al., 2009; Basheti et al., 2009).

## Conclusion

This paper sets out to systematically review published literature in peer-reviewed journals of education in pharmaceutical care. Many different teaching methods

were described in this study, notably simulation, PBL and case study. Most studies showed positive outcomes with the educational intervention.

## LIMITATIONS

The present study is not without limitations. First, although the search strategy used in this study was helpful in gathering information relevant to our subject, there are some limitations and bias inherent in using databases for primary source collection. Such limitations include difficulty in establishing the correlation between the descriptors and the reliability of search results, particularly regarding the specificity, selectivity, and sensitivity of the descriptors to retrieve references that are relevant to the subject. To circumvent this problem, the databases instituted the use of a standardized vocabulary of keywords in order to standardize and facilitate the search for references in the database. The problem is that the term "pharmaceutical care," is not contained as a descriptor in the vocabulary of these databases, at least according to the definition proposed by Hepler and Strand (1990). This, coupled with the misinterpretation of the meaning of the term or variations in how it is translated, tends to reduce the effectiveness of reference recovery. This problem had been detected in the work of Machuca et al. (2003) and Silva (2009), who chose to combine descriptors such as "pharmaceutical care" and "drug related problem." In addition, the use of others relevant keywords, such as "pharmacy practice" or "course" may have yielded a larger sample.

Secondly, due to lack of access in our country, the researchers did not search the International Pharmaceutical Abstracts (IPA) database, which indexes pharmacy-specific journals that are not included in any other database. Hence, some studies that would have met inclusion criteria could have been left out of the review. Furthermore, since this review used only keywords in English, important publications in other languages may have been omitted. Finally, during the analysis of the articles, it was not possible to estimate the risk of bias in each study, as advocated by PRISMA.

## PRACTICE IMPLICATIONS

Through this review, a series of themes have emerged to address gaps in the current knowledge. First, practical research should be conducted into different programs at different pharmacy schools and universities, in several countries, in an effort to more fully understand the processes involved in planning and implementing new teaching methods, as well as the variables that contribute to successes and challenges in those processes. Furthermore, this additional research should use a combination of both quantitative and qualitative research methodologies to more fully understand the effects of

teaching methods on students.

Second, there is a need for more long term and even longitudinal assessments of the outcomes of pharmaceutical care courses. Often, research is conducted for a length of time that is determined by the experimenter's time and resources, not necessarily the amount of time necessary to provide a thorough investigation into the effects of teaching methods on student learning (Faus-Dáder and Martínez-Martínez, 2009). Thus, studies of continuing education should follow the pharmacist into the profession to fully understand the effects of courses on actual practice.

In response to these gaps, active learning methods will be the basis for implementing a pharmaceutical care course at the College of Pharmacy of the Federal University of Sergipe in Brazil. It is anticipated that the use of active methods as an educational tool will not only facilitate the development of competencies and skills of pharmacy students in pharmaceutical care but will also facilitate the transfer of these skills to the practice setting.

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## Conflict of interest

Authors have none to declare.

## REFERENCES

- Anderson C, Bates I, Beck D, Brock T, Futter B, Mercer H, Rouse M, Wuliji T, Yonemura A (2008). The WHO UNESCO FIP Pharmacy Education Taskforce: enabling concerted and collective global action. *Am. J. Pharm. Educ.* 72(6):127.
- Anderson C, Bates I, Beck D, Brock T, Futter B, Mercer H, Rouse M, Wuliji T, Yonemura A (2009a). The WHO UNESCO FIP Pharmacy Education Taskforce. *Hum. Resour. Health.* 7:45.
- Anderson C, Bates I, Bruno A, Futter B, Rouse M, Whitmarsh S (2009b). Part 4. Pharmacy Education. FIP Global Pharmacy Workforce Report. Wuliji T, ed. International Pharmaceutical Federation. Available at: [http://www.fip.org/pe\\_resources](http://www.fip.org/pe_resources)
- Babar Z, Scahill SL, Akhlaq M, Garg S (2013). A bibliometric review of pharmacy education literature in the context of low-to middle-income countries. *Curr. Pharm. Teach. Learn* 5(3):218-232.
- Balisa-Rocha BJ, Guimarães VG, Mesquita AR, Aguiar PM, Krass I, Lyra Jr. DP (2012). Enhancing health care for type 2 diabetes in Northern Brazil: A pilot study of pharmaceutical care in community pharmacy. *Afr. J. Pharm. Pharmacol.* 6(35):2584-91.
- Barclay SM, Jeffres MN, Bhakta R (2011). Educational card games to teach pharmacotherapeutics in an Advanced Pharmacy Practice Experience. *Am. J. Pharm. Educ.* 75(2):33.
- Basheti IA, Armour CL, Reddel HK, Bosnic-Anticevich SZ (2009). Longterm maintenance of pharmacists' inhaler technique demonstration skills. *Am. J. Pharm. Educ.* 73(2):32.

- Benedict N (2010). Virtual patients and problem-based learning in advanced therapeutics. *Am. J. Pharm. Educ.* 74(8):1-5.
- Bertolo P, Huespe C, Ascar C, Welter A, Mainardi C (2003). Educar em atenção farmacéutica aplicando enseñanza tutorial. *Pharm. Care España* 5:170-172.
- Bissell P, Morgall-Traulsen JM (2005). *Sociology and Pharmacy Practice*. London Pharmaceutical Press p 226.
- Branch C (2014). An assessment of students' performance and satisfaction with an OSCE early in an undergraduate pharmacy curriculum. *Curr. Pharm. Teach. Learn.* 6:22-31.
- Breimer DD (2001). Future training needs in the pharmaceutical sciences: Academia-Industry. *Eur. J. Pharm. Sci.* 12(4):347-352.
- Buurma H, De Smet PAGM, Leufkens HGM (2004). Evaluation of the clinical value of pharmacists' modifications of prescription errors. *Br. J. Clin. Pharmacol.* 58(5):503-11.
- Catholico RAR (2009). Estratégias de ensino em curso técnico a partir dos estilos de aprendizagem de Felder-Soloman [masters thesis]. Escola de Engenharia de São Carlos da Universidade de São Paulo, São Carlos 53(5):469-484.
- Catney CM, Currie JD (1999). Implementing problem-based learning with WWW support in an introductory pharmaceutical care course. *Am. J. Pharm. Educ.* 63:97-104.
- Chambers SL, Schmittgen J, Allan CR (2000). Evaluation of peer teaching in a pharmaceutical care laboratory. *Am. J. Pharm. Educ.* 64:283-288.
- Chiang YC, Lee CN, Lin YM, Yen YH, Chen HY (2010). Impact of a continuing education program on pharmacists' knowledge and attitudes toward asthma patient care. *Med. Princ. Pract.* 19:305-311.
- Cipolle RJ, Strand LM, Morley PC (2000). El ejercicio de la atención farmacéutica". Madrid: McGraw-Hill/Interamericana p 352.
- Cipolle RJ, Strand LM, Morley PC (2004). *Pharmaceutical Care Practice: The Clinician's Guide 2nd Edition*. McGraw-Hill p 394.
- Cisneros RM, Salisbury-Clennon JD, Anderson-Harper HM (2002). Status of problem-based learning research in pharmacy education: a call for future research. *Am. J. Pharm. Educ.* 66(1):19-26.
- Conselho Nacional de Educação (CNE) (2002). Diretrizes Nacionais para o Ensino da Graduação em Farmácia (National Guidance for the Undergraduate Teaching of Pharmacy, Brazil 2002). *Diário Oficial da União: Brasília, Seção 1* p 9.
- Cone C, Bond R, Pierson J (2013). Teaching critical thinking and problem-solving in a pharmacy self-care lab: A skills-based approach. *Curr. Pharm. Teach. Learn.* 5:342-350.
- Culbertson VL (2008). Pharmaceutical care plan examinations to identify students at risk for poor performance in advanced pharmacy practice experiences. *Am. J. Pharm. Educ.* 72(5):111.
- Culbertson VL, Kale M, Jarvi EJ (1997). Problem-Based Learning: A tutorial model incorporating pharmaceutical diagnosis. *Am. J. Pharm. Educ.* 61:18-26.
- Dyck A, Deschamps M, Taylor J (2005). Pharmacists' discussions of medication side effects: a descriptive study. *Patient Educ. Couns.* 56(1):21-7.
- Edmunds J, Calnan MW (2001). There professionalization of community pharmacy? An exploration of attitudes to extended roles for community pharmacists amongst pharmacists and General Practitioners in the United Kingdom. *Soc. Sci. Med.* 53(7):943-955.
- Ellington AM, Barnett CW, Johnson DR, Nykamp D (2002). Current methods used to teach the medication history interview to doctor of pharmacy students. *Am. J. Pharm. Educ.* 66(2):103-107.
- Evensen DH, Hmelo CE (2000). *Problem-Based Learning a research perspective on learning interactions*. 1st ed. Lawrence Erlbaum Associates: Mahwah New Jersey London p 362.
- Faus-Dáder MJ, Martínez Martínez F (1999). La Atención Farmacéutica em farmácia comunitaria. evolución de conceptos, necesidades de formación, modalidades y estrategias para supuesta em marcha. *Pharm. Care Esp.* 1:52-61.
- Fisher RC (1994). The potential for problem-based learning in pharmacy education: A clinical therapeutics course in diabetes. *Am. J. Pharm. Educ.* 58:183-189.
- Fuhrman Jr. LC, Buff WE, Eaddy M, Dollar M (2001). Utilization of an integrated interactive virtual patient database in a web-based environment for teaching continuity of care. *Am. J. Pharm. Educ.* 65(3):271-275.
- Galal SM, Carr-Lopez SM, Gomez S, Duong V, Mizoshiri C, Ujihara L, Tran TH, Patel RA, Woelfel JA (2014). A collaborative approach to combining service, teaching, and research. *Am. J. Pharm. Educ.* 78(3):58.
- Gil AC (2008). *Higher education methodology*. 4th ed. Sao Paulo Atlas.
- Harpe SE, Phipps LB (2008). Evaluating student perceptions of a learner-centered drug literature evaluation course. *Am. J. Pharm. Educ.* 72(6):135.
- Hasan S (2008). A tool to teach communication skills to pharmacy students. *Am. J. Pharm. Educ.* 72(3):67.
- Hassali MA, Shafie AA, MSd Al-Haddad, Palaian S, Abrika OS (2011). Social pharmacy as a field of study: the needs and challenges in global pharmacy education. *Res. Social Adm. Pharm.* 7(4):415-420.
- Hepler CD, Graiger-rousseau TJ (1995). Pharmaceutical care versus traditional drug treatment: Is there a difference? *Drugs* 49(Sup1):1-10.
- Hepler CD, Strand LM (1990). Opportunities and responsibilities in pharmaceutical care. *Am. J. Hosp. Pharm.* 47:533-543.
- Hosmer DW, Lameshow S (1989). *Applied logistic regression*. Wiley: New York p 392.
- Hussein G, Kawahara N (2006). Adaptive and longitudinal pharmaceutical care instruction using an interactive voice response/text-to-speech system. *Am. J. Pharm. Educ.* 70(2):35.
- Jabbur-Lopes MO, Mesquita AR, Silva LMA, Almeida Neto A, Lyra JR DP (2012). Virtual patients in pharmacy education. *Am. J. Pharm. Educ.* 76(5):92.
- James D, Nastasic S, Horne R, Davies G (2001). The design and evaluation of a simulated-patient teaching programme to develop the consultation skills of undergraduate pharmacy students. *Pharm. World Sci.* 23(6):212-216
- Kassam R (2006a). Evaluation of pharmaceutical care opportunities within an advanced pharmacy practice experience. *Am. J. Pharm. Educ.* 70(3):49.
- Kassam R (2006b). Students' and preceptors' experiences and perceptions of a newly developed community pharmacy pharmaceutical care clerkship. *Pharm. Educ.* 6(3):1-10.
- Kassam R, Poole G, Collins JB (2008). Development of an instrument to assess the impact of an enhanced experiential model on pharmacy students' learning opportunities, skills and attitudes: A retrospective comparative experimentalist study. *BMC Med. Educ.* 8:17.
- Kim SH, Kwak HJ, Kim TB, Chang YS, Jeong JW, Kim CW, Yoon HJ, Jee YK (2009). Inappropriate techniques used by internal medicine residents with three kinds of inhalers (a metered dose inhaler, Diskus, and Turbuhaler): changes after a single teaching session. *J. Asthma* 46(9):944e50.
- Kocla-Kimble MA, Batz FR (1994). Diabetes care as an active learning model of postgraduate education and training for pharmaceutical care. *Am. J. Pharm. Educ.* 58:382-385.
- Lam A (2005). Senior care clerkship: an innovative collaboration of pharmaceutical care and learning. *Consult. Pharm.* 20:55-60.
- Lee AJ, Borham A, Korman, NE, Keeney BE, Mock ED (1998). Staff development in pharmacist-conducted patient education and counseling. *Am. J. Health Syst. Pharm.* 55(17):1792-1798.
- Li SC (2003). An overview of community pharmacist interventions assessing cost-effectiveness and patients' willingness to pay. *Dis. Manage Health Outcomes.* 11(2):95-110.
- Limberger JB (2013). Active teaching-learning methodologies for pharmaceutical education: a report on experience. *Interface: Comunicação, Saúde e Educação* 17(47):969-975.
- Lyra Jr. DP, Kheir N, Abriata JP, Rocha CE, Santos CB, Pelá IR (2007). Impact of pharmaceutical care interventions in the identification and resolution of drug-related problems and on quality of life in a group of elderly outpatients in Ribeirão Preto (SP), Brazil. *Ther. Clin. Risk Manag.* 3(6):989-98.
- Machuca M, Faus MJ, Fernandez-Llimós F (2003). *Método Dáder: Guia de seguimiento farmacoterapéutico*". Granada: Universidad de Granada p 43.
- Martínez-Sánchez AM (2009). How to implement pharmaceutical care in the curriculum? The Cuban pharmacy education experiences. *Lat. Am. J. Pharm.* 28(1):100-102.
- Moher D, Liberati A, Tetzlaff J, Altman DG (2009). Preferred reporting items for systematic reviews and meta-analyses: the PRISMA

- statement. *PLoS Med.* 21:6(7):e1000097.
- Orr KK (2007). Integrating virtual patients into a self-care course. *Am. J. Pharm. Educ.* 71:30.
- Parkhurst C (1994). Assessing and improving students' verbal communication abilities in pharmacy courses. *Am. J. Pharm. Educ.* 58(1):50-55.
- Piaget JA (1976). *The development of thought: equilibration of cognitive structures.* The Viking Press, New York p 175.
- Popa A, Crisan O, Sandulescu R, Bojita M (2002). Pharmaceutical care and pharmacy education in Romania. *Pharm. Educ.* 2(1):11-4.
- Ramam-Wilms L (2001). Innovative enabling strategies in self-directed, problem-based therapeutics: Enhancing student preparedness for pharmaceutical care practice. *Am. J. Pharm. Educ.* 65:56-64.
- Rao D (2011). Skills development using role-play in a first-year pharmacy practice course. *Am. J. Pharm. Educ.* 75(5):84.
- Reutzel TJ, DeFalco PG, Hogan M, Kazerooni PV (1999). Evaluation of a pharmaceutical care education series for chain pharmacists using the focus group method. *J. Am. Pharm. Assoc.* 39:226-234.
- Ross LA, Crabtree BL, Theilman GD, Ross BS, Cleary JD, Byrd HJ (2007). Implementation and refinement of a problem-based learning model: A ten-year experience. *Am. J. Pharm. Educ.* 71:1-14.
- Schneider PJ, Sill BE (1995). Education and training to provide pharmaceutical care. *Int. Pharm. J.* 9(4):156-60.
- Sefton AJ (2004). *New Approaches to Medical Education: An International Perspective.* *Med. Princ. Pract.* 13:239-248.
- Shah MB, King S, Patel AS (2004). Intercultural disposition and communication competence of future pharmacists. *Am. J. Pharm. Educ.* 68(5):1-11.
- Shah VP, Besancon LJR, Stolk P, Tucker G, Crommelin DJA (2010). *The Pharmaceutical Sciences in 2020: report of a conference organized by the Board of Pharmaceutical Sciences of the International Pharmaceutical Federation (FIP).* *Pharm. Res.* 27(3):396-399.
- Shrivastava SR, Shrivastava PS, Ramasamy J (2013). Problem-based learning: constructivism in medical education. *Educ. Health (Abingdon)* 26(3):197-198.
- Silva WB (2009). *A emergência da atenção farmacêutica: um olhar epistemológico e contribuições para o seu ensino.* [doctoral thesis]. Universidade Federal de Santa Catarina. Florianópolis: Santa Catarina, Brazil.
- Silva WB, Delizoicov D (2008). Problemas e problematizações: implicações para o ensino dos profissionais da saúde. *REMPEC - Ensino, Saúde e Ambiente* 1(2):14-28.
- Strohfeldt K, Grant DT (2010). Instructional design and assessment: A model for self-directed problem-based learning for renal therapeutics. *Am. J. Pharm. Educ.* 74(9):1-7.
- Tagawa M, Imanaka H (2010). Reflection and self-directed and group learning improve OSCE scores. *Clin. Teach.* 7(4):266-270.
- Van Amburgh JA, Devlin JW, Kirwin JL, Qualters DM (2007). A tool for measuring active learning in the classroom. *Am. J. Pharm. Educ.* 71(5):85.
- Venturelli J (2003). *Educación médica: nuevos enfoques, metas y métodos.* 2ª ed. Washington, D.C: Organización Panamericana de la Salud / Organización Mundial de la Salud p 307.
- Vinks THAM, De Koning FHP, De Lange TM, Egberts TC (2006). Identification of potential drug-related problems in the elderly: the role of the community pharmacist. *PWS* 28:33-38.
- Walczyk JJ, Ramsey LL (2003). Use of learner-centered instruction in college science and mathematics classrooms. *J. Res. Sci. Teach.* 40:566-84.
- Whitmarsh S, Futter B, Rouse M, Bates I, Anderson C (2010). A case study in terminology: the FIP Pharmacy Education Taskforce. *Am. J. Pharm. Educ.* 74(7):134
- Wislande N (1994). Large group problem-based learning: A revision from traditional to pharmaceutical care-based therapeutics. *Am. J. Pharm. Educ.* 58:64-73.
- Wood DF (2003). ABC of learning and teaching in medicine: Problem Based Learning. *BMJ* 326:328-330.
- Zaremski DG, Boyer G, Vlasses PH (2005). A survey of advanced community pharmacy practice experiences in the final year of the PharmD curriculum at the US colleges and schools of pharmacy. *Am. J. Pharm. Educ.* 69(1):2:10-18.
- Zolezzi M, Blake A (2008). Principles-based learning design for an online postgraduate psychiatric pharmacy course. *Am. J. Pharm. Educ.* 72(5):1-8.