An international review of the use of competency standards in undergraduate pharmacy education

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Abstract

Background: Pharmacists are self-regulating health professionals. There is currently international attention on pharmacy education, competency standards, advanced level frameworks and integrated pharmacy programmes.

Aims: To review the programme-wide use of competency standards within undergraduate pharmacy curricula internationally.

Methods: A systematic review of the literature was undertaken between 2000-2013. An iterative process using constant comparative analysis was utilised to theme the final 19 papers. These papers were then characterised based on their programme level use of competency standards.

Results: Of 948 articles identified, 19 were included. Competency standards were used multiple ways in pharmacy programmes including curriculum design, mapping and were reflected in assessment.

Conclusion: Across the globe the profession's competency standards (CS) have been utilised to design, develop and review pharmacy curricular. Use of CS to inform outcome-based education (OBE) in pharmacy programmes provides a quality assurance mechanism and may enhance the accountability and flexibility of the profession for its public.

Keywords: *competency, outcomes-based education, pharmacy, undergraduate, curriculum*

Introduction

Since the introduction of the concept of competence in the 1960s (Brownie, 2011) competency standards (CS) have played an increasingly significant role in the initial and ongoing registration of the practicing health professional. Like all health professionals, the registration of individual pharmacists is centred on their ability to prove their competence to practice.

A transformed Higher Education (HE) landscape has emerged due to a learning emphasized paradigm (Barr & Tagg, 1995), outcomes-based education (OBE) (Spady, 1994), the Bologna harmonisation efforts (Sosabowski & Gard, 2008; Katajavuori *et al*., 2009), increased competency-based training, and ongoing workplace assessment. Sustainability within increasingly stretched health workforces relies on maintenance of quality assurance (QA) of health education and professional practice, and a strategic vision for whole of workforce competency frameworks (Brownie, 2011).

As discussed elsewhere (Whiddett & Hollyforde, 2003; Brown *et al*., 2012; Brownie, 2011) there are many definitions of the terms competence, competencies, and competency, which often leads to confusion and problems with their application (Table I).

Definitions of competency-based terminology (Spady, 1988; Spady, 1994; Barr & Tagg, 1995; Harden *et al*.,

1999; Biggs & Tang, 2007; Brownie, 2011; Brown *et al*., 2012; International Pharmaceutical Federation Pharmacy Education Taskforce, 2012; Stupariu, 2012).

Due to increasing government and employer expectations, there is a movement towards an outcomes-based model of assurance rather than the traditional input-based teaching (Harden *et al*., 1999; Marriott *et al*., 2008). The OBE movement began in the 1980s with the idea that curricula should be developed from the standpoint of desired student outcomes (Spady, 1988; Harden *et al*., 1999; Bradberry *et al*., 2007; Ho *et al*., 2009). Competency-based education and assessment is one example of OBE (Gonczi, 1994; Chappell *et al*., 2000). The outcomes-based model is favoured as QA of tertiary education can be evidenced directly through student performance (outcomes) (Harden *et al*., 1999; Draugalis *et al*., 2002; Anderson *et al*., 2005b; Ried *et al*., 2007; Marriott *et al*., 2008; Australian Pharmacy Council, 2012; Stupariu, 2012; Stupans *et al*., 2014). Accreditation standards for pharmacy programmes demand that outcomes of teaching be the emphasis (Barr & Tagg, 1995; Pharmacy Education R&D Reference Group, 2004; Wilson, 2010; General Pharmaceutical Council, 2011; Smith, 2011; Australian Pharmacy Council, 2012).

The International Pharmaceutical Federation/World Health Organisation (FIP/WHO) and the recent European

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Table I: Definitions of competency-based terminology.

Term	Definition
Competency	Single item of knowledge, skill or professional value (Brown *et al.*, 2012)
Competence	Full repertoire of competencies (Brown *et al.*, 2012)
Competencies	Knowledge, skills, behaviours and attitudes(International Pharmaceutical Federation Pharmacy Education Taskforce, 2012) that an individual accumulates, develops and acquires through education, training and work experience (Brown *et al.*, 2012) OR Behaviours that individuals demonstrate when undertaking job-relevant tasks effectively within a given organisational context (Whiddett and Hollyforde, 2003).
Core competencies	Core competencies are considered to be essential competencies. They may exist within a workforce role or span across different workforce roles (Brownie, 2011).
Competency Framework/ Standard	Complete collection of competencies that are thought to be essential to performance (Brown *et al.*, 2012).
Performance	Effective and persistent behaviour (Brown *et al.*, 2012)
Performance Assessment	Is a type of assessment that requires students to actually perform, demonstrate, construct and/or develop a product or a solution under defined conditions and standards. Performance assessments imply active student production of evidence of learning - not multiple choice, which is essentially passive selection among pre-constructed answers (Garavalia, 2002).
Career frameworks	Include a number of clearly defined levels at which a role could be performed, from initial entry level roles to more expert level roles or specialist level roles. A career framework can be used to aid workforce flexibility, provide a common currency to map employees' competence portfolios, and to identify areas of transferability to other job roles. This allows progression in directions that may not have been identified through traditional routes (Brownie, 2011).
Competency-based career frameworks	Group competencies under domains (headings for classifying related competencies) in order to enable practitioners or workers to be assessed, to move up a career pathway or have their skills and learning recognised for lateral movement. Such domains may or may not be aligned with remuneration (Brownie, 2011).
Competency-based education and training	Competency-based education and training focuses on the ability of the students and practitioners to deploy skills, attributes and knowledge to perform specific tasks and, more broadly, a clinical or health care role or function (Brownie, 2011).
Educational Frameworks	Educational frameworks are carefully designed structures for enclosing and supporting sets of concepts, values, assumptions, roles, competencies and/or practices. They are a useful way of arranging curricula and expected learning outcomes. A framework provides the providers and or participants a guide in respect to the content and standard of what is to be taught, learned, assessed, demonstrated and/or practised (Brownie, 2011).
Outcomes-based education (OBE)	There are three well known definitions of outcomes based education. One arose in a scheme for disadvantaged. One version is used as a tool to benchmark institutions and for accountability from a managerial viewpoint. The third is solely concerned with enhancing teaching and learning. Ideally this is implemented using constructive alignment (Biggs & Tang, 2007). (Spady, 1994): 'Outcomes-Based Education (OBE) means clearly focusing and organising everything in an educational system around what is essential for all students to be able to do successfully at the end of their learning experiences. This means starting with a clear picture of what is important for students to be able to do, then organising the curriculum, instruction, and assessment to make sure this learning ultimately happens' (Harden *et al.*, 1999): 'In outcome based education, the learning outcomes are clearly specified and decisions about the content of training and how it is organized, the educational strategies to be adopted, the teaching methods, the assessment procedures, and the educational environment are made in the context of the stated learning outcomes.'
Outcomes-based teaching and learning (OBTL)	OBTL is a convenient and practical way of maintaining standards and of improving teaching. Standards are tested up from and teaching is tuned to best meet them, assessment being the means of checking how well they have been met' (Biggs & Tang, 2007).
Traditional input-based teaching	Traditional: A term used to describe educational planning and implementation based on subject matter categories and organisational arrangements that have characterised education systems for the past century (Spady, 1994). Traditional input based teaching is opposite to OBE. "Inputs" such as how many hours students spend in class, or what textbooks are provided. Teacher focus (Instruction paradigm) rather than student learning (Learning Paradigm) focus (Barr & Tagg, 1995). Relies on traditional grade point average scores as a measure of teaching (Spady, 1994).
Indicative syllabus	Indicative syllabus (which was commonly used in input based education) whereby a set list of topics are required to be included in a pharmacy degree curriculum before the programme will be accredited (Marriott *et al.*, 2008). The UK Pharmacy Education Indicative Syllabus was developed and published by the Royal Pharmaceutical Society of Great Britain (RPSGB) in 2002 (Australian Pharmacy Council, 2012).

PharQA provide pharmacy educators internationally with a solid foundation for curricula reform and review. Useful documents include:

· Good Pharmacy Education Practice 2000 (GPEP) (International Pharmaceutical Federation, 2000)
· Policy of Quality Assurance of Pharmacy Education 2009 (International Pharmaceutical Federation, 2009)
· A Global Competency Framework 2012 (International Pharmaceutical Federation Pharmacy Education Taskforce, 2012)
· PharQA Framework (Atkinson et al., 2014)

Further, the FIP GPEP (International Pharmaceutical Federation, 2000) clearly states that assessment and quality assurance is key to guarantee student capabilities and '*educational programmes and curricula should be designed to be consistent with their respective required educational outcomes*' (International Pharmaceutical Federation, 2000: p.4). It would be difficult to achieve this recommendation without an OBE approach to pharmacy education.

By examining international pharmacy educators' experiences to date through appreciation of the barriers, enablers and lessons learnt, a smoother transition to outcomes or competency-based education for pharmacy educators may be realised.

Methods

The literature review (Grant and Booth, 2009) followed the PRISMA Guidelines (Liberati *et al*., 2009) (Figure 1) and was both extensive and systematic. The review aimed to characterise and tabulate all of the papers which described a higher education setting and programme-wide use of the CS in pharmacy programmes.

Four databases (Scopus, IPA and CINAHL, Proquest ERIC) were systematically searched. Relevant pharmacy journals included in the search are shown in Table II. Given the significant overlap in most databases, the authors are confident the relevant pharmacy education journals were captured by the four databases utilised and included in the review.

As detailed in Table III, combinations of search terms were utilised to search the literature. The limitations placed around the searches were the years 2000-2013 and articles written in English. All types of literature were reviewed, including reports, theses and journal publications.

Table II: Justification for the choice of databases for literature search

Journal	Proquest ERIC	Scopus	IPA/CINAHL	Embase	Informit
American Journal of Pharmaceutical Education	■	■	■	■	■
Pharmacy Education (UK)		■	■	■	■
Pharmaceutical Journal		■	■	■	
Journal of Pharmacy Practice		■		■	
Journal of Pharmacy Practice & research		■		■	
International Journal of Pharmacy practice		■	■	■	
Pharmacy Practice		■	■	■	
Advances in Health Sciences Education	■	■		■	
International Journal of Teaching and Learning in Higher Education	■				
Education for Health	■	■	■	■	
Assessment and Evaluation in Higher Education	■	■		■	
Journal of Learning design					
Medical Teacher	■	■		■	
Medical Education			■	■	
Annals of Pharmacotherapy			■	■	
Pharmacogenomics	■	■		■	
Archives of Pharmacy Practice	■	■			
Pharmacy World & Science			■	■	
Research and Development in Higher Education		■			
Currents in Pharmacy Teaching & Learning		■		■	

Grey shading indicates that Journal is referenced in the corresponding database.

Table III. Review search terms and databases reviewed

Database	Term/s
Scopus	(TITLE-ABS-KEY("education") AND PUBYEAR > 1999) AND (TITLE-ABS-KEY("pharmacy") AND PUBYEAR > 1999) AND (TITLE-ABS-KEY("competency standards") AND PUBYEAR > 1999)
	((TITLE-ABS-KEY("pharmacy") AND PUBYEAR > 1999) AND (TITLE-ABS-KEY("competence") AND PUBYEAR > 1999) AND (TITLE-ABS-KEY("education") AND PUBYEAR > 1999)) AND (TITLE-ABS-KEY("undergraduate") AND PUBYEAR > 1999) AND (TITLE-ABS-KEY("curriculum") AND PUBYEAR > 1999) AND (LIMIT-TO(LANGUAGE, "English"))
	(TITLE-ABS-KEY-AUTH("Framework")) AND (TITLE-ABS-KEY("education") AND PUBYEAR > 1999) AND (TITLE-ABS-KEY("competence") AND PUBYEAR > 1999) AND (TITLE-ABS-KEY("pharmacy") AND PUBYEAR > 1999) AND (LIMIT-TO(LANGUAGE, "English"))
Proquest Eric	pharmacy AND education AND competen* AND undergraduate (Search 1)
	Pharmacy education AND Competence NOT cultural
	"pharmacy education" AND competence AND undergraduate "pharmacy education" AND competence AND undergraduate AND (stype.exact("Conference Papers & Proceedings" OR "Scholarly Journals" OR "Reports" OR "Dissertations & Theses" OR "Standards & Practice Guidelines" OR "Evidence-Based Medical Resources") AND la.exact("English"))
	pharmacy AND education AND competen* AND undergraduate (Search 1)
	"pharmacy education" AND competen* AND undergraduate (Search 1b)
	pharmacy AND education AND competen* AND undergraduate (Search 1c)
	pharmacy AND education AND practice standard AND undergraduate (Search 2)
	pharmacy AND education AND framework AND undergraduate (Search 3)
	ft(undergraduate) AND ft(competen*) AND ft(education) AND ft(pharmacy)
	"pharmacy education" AND competence AND undergraduate "pharmacy education" AND competence AND undergraduate AND (stype.exact("Conference Papers & Proceedings" OR "Scholarly Journals" OR "Reports" OR "Dissertations & Theses" OR "Standards & Practice Guidelines" OR "Evidence-Based Medical Resources") AND la.exact("English"))
IPA+ CINAHL with full text+ medline	Pharmacy education AND competence
IPA+ CINAHL with full text	"Pharmacy education" AND competence
IPA+ CINAHL with full text	pharmacy AND education AND competen* AND undergraduate (Search 1)
	pharmacy AND education AND practice standard AND undergraduate (Search 2)
	pharmacy AND education AND framework AND undergraduate (Search 3)

The literature was evaluated with respect to the question: *"What is the extent of use of CS within undergraduate pharmacy curricula?"*. Following identification of nine key articles, the references from the papers were snowballed to yield ten additional relevant papers. The reviewer then grouped the papers under themes. The development of the themes was an iterative process, with no pre-identified themes decided upon prior to review commencement. This technique is similar to constant comparative analysis and has been employed by others, including Reeve *et al.* (2013).

Of the 948 papers identified and screened, 19 were included in the review (Figure 1).

Figure 1: PRISMA systematic style review technique and search results
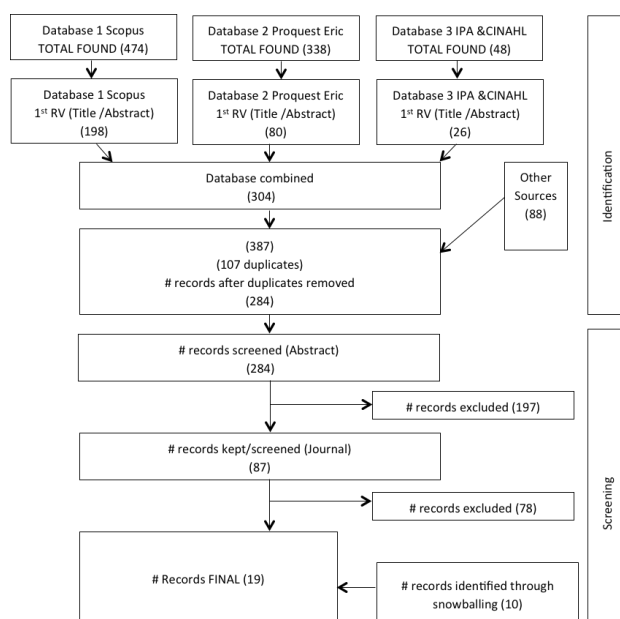
Results

The articles included in the final summary were published between 2001 and 2012. The search was carried out in February 2013. The justification of the 2000-2013 date range for the literature search can be seen in Figure 2.

Figure 2: Number of publications per year for competency based assessment in pharmacy education
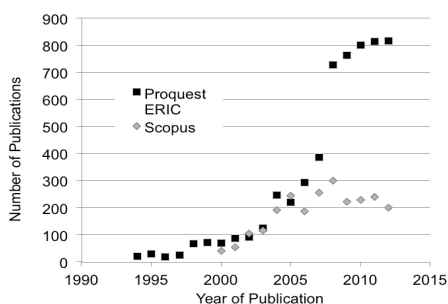
Although the initial search identified a broad representation internationally, the majority of the final papers (twelve of nineteen) arose from the United States of America (US), two arose from New Zealand (NZ), two from Ireland, two from Belgium and one from Thailand.

Population groups included staff, undergraduate students, graduates, newly registered pharmacists, preceptors and whole schools or colleges of pharmacy.

Two general classifications of the use of CS within pharmacy curricula arose from the review – use in curriculum (including design, mapping and review), and assessment. Of the 19 studies, 90% used CS in curriculum and 50% used CS in curriculum mapping. These processes were reported to be largely driven by pharmacy school accreditation requirements. Nine articles (50%) that described a global use of CS to design, map or review curriculum also made reference to using CS-based assessment in their undergraduate pharmacy programmes. The documented assessment methods based on competencies could be grouped into: self-assessment, experiential placements, annual testing, acceptance testing and portfolios.

Thirteen of the papers (68.4%) described a registration upon graduation programme, described in the US literature as the Doctor of Pharmacy (PharmD), where students are eligible to practice at the conclusion of their degree. The remaining 6 (31.6%) referred to Degree plus professional registration, which is common in the United Kingdom (UK), Australia and NZ, where the internship or practice component is largely separate and occurs following university graduation (Brailsford, 2014). Of the programmes that described registration upon graduation, 70.6% utilised CS for curriculum mapping and 100% for curriculum design activities.

Quality Assurance and Accreditation of Pharmacy Curricula

Gallagher (Ireland) (2010) reported there is much attention in the education literature on the role of professional competency training of undergraduates and the implications for the fitness-to-practice requirements of graduates. Kelley and Demb suggest '*models for assessment that can fulfil both accountability and improvement agendas*' (Kelley & Demb, 2006: p.1) are preferable.

As noted by Hill *et al.* (2006) competency-based assessment measures students' performance against previously defined standards. Hill *et al.* describe the use of assessment rubrics and regular staff feedback combined with the student checklists for final year on placements. These were received well by all stakeholders and also enabled the educators to evaluate their curriculum (Hill *et al.*, 2006).

Curriculum design, mapping and review

The programme-wide use of CS included benchmarking (Kelley *et al.*, 2008), reduction in student attrition,

Table IV: Summary of results for papers describing a programme-wide use of competency standards in undergraduate pharmacy education.

Author/Year	Country	Type of study	Population	Registration upon graduation Programme	Curriculum		Assessment		
					Curriculum design	Mapping & Review	Self Assessment & Experiential Placement	Annual Test, OSCE & Acceptance Test	Portfolios
Plaza *et al.* (2007)	US	Descriptive	St, U	Y	▓	▓			
Kairuz *et al.* (2010)	NZ	Mixed Method	G,P, NR	N	▓				
Malcolm & Hibbs (2012)	US	Qualitative	U	Y	▓			▓	
Meszaros *et al.* (2009)	US	Qualitative	U	Y	▓				
Kirkpatrick & Pugh (2001)	US	Qualitative	St, U	Y	▓	▓			
Kelley *et al.* (2008)	US	Mixed Method	U	Y		▓			
Petit *et al.* (b) (2008)	Belgium	Descriptive	St, U	N	▓				▓
Hill *et al.* (2006)	US	Qualitative	U	Y	▓		▓		
Kapol *et al.* (2008)	Thailand	Qualitative	SoP	Y	▓				
Kairuz *et al.* (2007)	NZ	Qualitative	G, P	N	▓		▓		
Bradberry *et al.* (2007)	US	Report	NA	Y	▓				
Conway *et al.* (2011)	US	Discussion	St	Y	▓				
Gallagher (2010)	Ireland	Discussion	NA	N	▓		▓		
Monaghan & Jones (2005)	US	Quantitative	NA	Y	▓	▓			
Anderson *et al.* (2005)	US	Descriptive	US SoP	Y	▓		▓		
Kelley & Demb (2006)	US	Quantitative	St, U	Y	▓	▓			
Petit *et al.* (a) (2008)	Belgium	Eval. & Discussion	St, U	N	▓				
McMahon & Henman (2007)	Ireland	Descriptive	St, U	N			▓		▓

Key: RV=Review, G=Graduates, St=Staff, SoP School of Pharmacy, U=Undergraduates, P=Preceptors, NR= Newly registered pharmacist, US SoP= All SoP in US, NA= Not applicable, Y=Yes , N=No, OSCE= Observed Structured Clinical Assessment, US=United States, NZ=New Zealand, GREY= documented use of CS, WHITE= no documented use.

curriculum review (Bradberry *et al.*, 2007; Kapol *et al.*, 2008; Petit *et al.*, 2008a; Gallagher, 2010) and mapping; (Kirkpatrick & Pugh, 2001; Plaza *et al.*, 2007; Britton *et al.*, 2008) programme accreditation requirements (Kelley & Demb, 2006; Bradberry *et al.*, 2007) and QA (Kapol *et al.*, 2008; Kairuz *et al.*, 2010; Conway *et al.*, 2011). Plaza *et. al.* (2007) highlighted that curriculum mapping has many potential uses and benefits. The review identified the development of a number of mapping tools which map specifically to CS, ability-based outcomes or performance outcomes. Examples of curriculum mapping techniques from the 19 papers include:

- University of Oklahoma College of Pharmacy's electronic curriculum database, which also acted as a staff sharing centre for information about assessment items and curriculum (Conway *et al.*, 2011).
- Plaza *et al.* (2007) from the University of Arizona, College of Pharmacy (US) used topographical maps to represent their school's data.
- Kairuz *et al.* (2007) utilised their local CS and competency statements (knowledge, skills and attitudes) to provide a framework for development of a new curriculum at the University of Auckland in New Zealand.

Competency-based assessment

The CS were described as being employed in curricula in a variety of forms (Table IV). Some authors from the review suggested competency-based assessment should not rely on one form or instance of assessment (McMahon & Henman, 2007; Mészáros *et al.*, 2009).

Self-Assessment & Experiential Placements

The reviewed papers described competency-based assessment in the form of self-assessment and self-reflection tasks, experiential placement or work-based learning activities.

Other sentiments of the authors of the final 19 papers reviewed include:

- Strong support for competency-based education in pharmacy, suggesting that it had become a new standard for how pharmacy students are educated in experiential as well as didactic pharmacy curriculum (Bradberry et al., 2007).
- Acknowledgement that competency-based education and assessment '*provided the school with data that can be used to evaluate the effectiveness of our*

curriculum in preparing students for practice' and provide data for re-accreditation (Hill *et al.*, 2006: p.10).

· It is not just the content but also the way it is delivered that makes it possible to challenge our students to acquire competencies in self-reflection from as early as first year (Petit *et al.*, 2008b). These are all skills, as Petit *et al*. point out, that are desired by today's employers.

Acceptance Testing, Annual Tests, Programme Level Assessment and OSCEs

The reviewed papers describe specific use of the CS for; annual competence-based assessments, performance-based assessments, ability-based outcome, pre and post course comparisons of competence, OSCEs, student acceptance into placements and the concept of programme level assessment (Table IV). Some authors reported use of CS for both formative and summative styles of assessment (Hill *et al.*, 2006; McMahon & Henman, 2007).

Specific examples from the 19 studies include the following:

· Bradberry *et al*. (2007) (US) recommended a specific focus on credentials, pre-requisites and pre-pharmacy competencies, and an instrument to better assess appropriate preparation prior to admission into the professional programme.

· Meszaros *et al*. (2009) (US) described one specific example of competency-based programme level assessment using three different forms of assessment, known as the Triple Jump Examination (open book exam, closed book exam and OSCEs). This is similar to the concept of the Milemarker.

Portfolios

Petit, Froriers and Rombaut (2008a) (Belgium), reported on the multiple advantages portfolios provide:

· Promotes reflection ("central to two major learning theories: experiential and deep learning")

· Instrument to show development of competencies

· Simulate real-life continuing professional development (CPD) requirements,

· Force development of problem-based learning skills

· Push students into a learning-centred position.

McMahon and Henman (2007) (UK) found that competency-based assessment using portfolios proved to be compatible with, and complementary to, other programme assessment methods. Both students and faculty members found portfolio and the General Level Framework (GLF) checklist very useful for identifying gaps in a student's knowledge and or skills. They were

not alone in this finding, with the academics from the US reporting similar findings (Hill *et al*., 2006; Kelley *et al*., 2008).

Discussion

Prior to the research there were no known reviews of the use of CS in pharmacy education. The review focussed on papers that adopted a programme-wide perspective; for articles to be included there had to be an entire programme-level use of CS described, for example in mapping, review, QA or planning.

The review found that prior to 2000 there were few publications in pharmacy education surrounding CS and competency-based assessment. This is supported by the finding by Anderson *et al*. (2005a), who found few studies prior to 2000 on the status of assessment in the colleges and schools of pharmacy (SoPs).

Given the recent and increasing attention to PharmD and 'sandwich model' inspired registration upon graduation programmes (Brailsford, 2014) it is interesting to consider the difference in use of CS in programme design and mapping between the registration upon graduation (RUG) programmes and the Degree plus professional registration. All but one paper describing RUG were from the US; the other was from Thailand and specifically reported on movement to the US model to facilitate student exchanges. This is not an unexpected finding as it makes sense that RUG programmes that must deem their students ready for practice on the day of graduation would be more focussed on their profession's CS. Further, Degree plus professional registration programmes are more likely to review their curriculum in line with their educational outcomes (Kelley & Demb, 2006; Association of Faculties of Pharmacy of Canada., 2010; Gallagher, 2010; Conway *et al*., 2011; Australian Pharmacy Council, 2012; Stupans *et al*., 2014). A discussion about these is outside the scope of this paper.

The US made a significant contribution to the published articles identified through this literature review, perhaps partly due to their existing accreditation requirements and active programme QA processes (Bradberry *et al*., 2007; Conway *et al*., 2011). The US representation could also be explained by the author's interpretation of the Centre for the advancement of pharmacy education (CAPE) outcomes being equivalent to CS (recognising that PharmD students register upon graduation). It was surprising there was not a larger representation of European and African pharmacy education reforms and programme-wide reviews using CS given the recent curriculum changes as part of the Bologna process.

Quality Assurance and Accreditation of Pharmacy Curricula

The findings of this review suggest that accreditation requirements and public accountability of SoPs, departments and colleges continue to drive motivations for competency-based education in pharmacy worldwide.

It is therefore essential that SoPs have evidence that their graduates are meeting minimum standards. To ensure continuity and relevance of programmes the CS provide a logical benchmark. With reference to inclusion of the CS, the findings from Hill *et al.* (2006) act as a reminder of the importance that students have clear criteria and rubrics or grids for grading to ensure consistency and provide clear goals or intended learning outcomes from the assessment task.

The keys findings from each of the 19 papers are discussed under each of the themes that emerged from the review of the literature (themes outlined in Table IV).

Curriculum design, mapping and review

Of the key themes that emerged in the review, the most common uses of CS in pharmacy education were curriculum design, mapping and review. This was unsurprising as the review was targeted to discover programme level uses of CS. One can only presume the reported increase in the development of mapping tools is to assist schools with their intensive QA reporting requirements (Britton *et al.*, 2008; Conway *et al.*, 2011).

Competency-based assessment

In agreement with the findings from pharmacy our medical, nursing and educational technology colleagues report that competency assessment is a complex endeavour and all agree that one single assessment method is usually insufficient (Epstein & Hundert, 2002; Van Der Vleuten & Schuwirth, 2005; Baartman *et al.*, 2006; Franklin and Melville, 2013).

Although the Dreyfus Model for medical competence is more commonly cited in health practitioner frameworks today (ten Cate *et al.*, 2010), Miller's pyramid continues to be referenced in the medical education literature (Wass *et al.*, 2001; Epstein & Hundert, 2002; Van Der Vleuten & Schuwirth, 2005; Kelley & Demb, 2006; Yeates *et al.*, 2013). In addition, Kelley *et al.* (US) (2006) included Miller's pyramid in the design of an Instrument for Measuring Professionalism Behaviors (Kelley & Demb, 2006).

Baartman *et al.* (Netherlands) (2006) propose a validated framework: Competency Assessment Program (CAP) to ensure assessment across an entire programme is structured and assessors can be confident when determining the competency acquisition of their students.

There is much discussion around the need to develop assessment tools '*at the apex of Miller's pyramid*' (Does) (Wass *et al.*, 2001: p.948) and ensure they have been standardised and validated (Cusimano, 1996). To overcome some of the obstacles in competency-based assessment some programmes use a combination of programme assessment and portfolio to assess 'does' level student performance, rather than one summative final examination (Wass *et al.*, 2001).

Self-Assessment & Experiential Placements

Evident in the reviewed papers is that competency-based assessment suits self-assessment and self-reflection tasks, experiential placement or work-based learning activities.

The review findings reinforce the need and importance of a committed and consistent paradigm shift away from teaching-centred practice to learning-centred assessments and curriculum (Monaghan & Jones, 2005; Bradberry *et al.*, 2007; Petit *et al.*, 2008b). Bradberry *et al.* (2007: p.6) reinforced this notion and its origin: '*Learning based models of student development have been driven by the need for students to demonstrate life-long learning skills and enhance professionalism*'.

Acceptance Testing, Annual Tests, Programme Level Assessment and OSCEs

The emergence of annual competence-based and programme level assessment (Kelley & Demb, 2006; Kelley *et al.*, 2008;) (specifically looking at competencies) provides pharmacy educators and students with a powerful gauge for their progress in a programme.

Through programme level (competency-based) assessment, students and academics alike may better realise the relevance of individual programmes to the overall curriculum and aspired final product, and hopefully diminish the reported disconnect between students' and educators' perceptions (Kelley & Demb, 2006). Much work is still required to develop and validate competency-based assessment tools (Hill *et al.*, 2006; Plaza *et al.*, 2007). Hill *et al.* (2006) describe a paradigm shift in the US to ability-based curriculum and the need to develop standardised core assessments for core curricular experiences. Some pharmacy educators have argued that competence (especially skills and attitudes) are problematic to assess; however, they admit utilising multiple approaches to assessing competence (including portfolios, programme level assessment and self-assessment) may provide the solution to some of these issues (Watson *et al.*, 2002).

Portfolios

Portfolios and their electronic cousin, e-Portfolio , support outcome-based education through providing a collection of evidence of an individual student's learning. Reviewed papers from Belgium, US and United Kingdom outlined the many benefits to portfolio or e-Portfolio based learning and assessment.

Portfolios or e-Portfolio provide an ability to integrate content, break down teaching silos and link various assessment tasks, and provide a mechanism for educators and students alike to observe student progress across a year or entire curricula. They also provide rich evidence for programme accreditation requirements (Oliver & Whelan, 2011).

Given the growing popularity of e-Portfolios (Butler, 2006; Oliver *et al.*, 2009; von Konsky & Oliver, 2012;

Shroff *et al*., 2013) in tertiary education, it was surprising that they were only specifically mentioned twice by the pharmacy educators included in this review (McMahon & Henman, 2007; Petit *et al*., 2008a). Although there are SoPs engaging with the tool they may not also be involved in a programme level application of competency standards (Hammer & Paulsen, 2001; Briceland & Hamilton, 2010; McDuffie *et al*., 2010; Lopez *et al*., 2011).

Review Limitations

It is important to note there may be other uses of the CS in pharmacy education worldwide; however, these may be under-reported here as a result of publication bias and over representation of certain regions of the world. In addition, restricting the search to articles published in English may have led to the introduction of bias - specifically, positive findings being more likely to be published in English (Wright *et al*., 2007). These factors make it difficult to generalise the results internationally.

In addition, the authors suggest a future worldwide discussion or shared understanding of education terminologies may help to alleviate confusion in the pharmacy education literature.

Conclusions

Through literature review it was possible to identify and characterise the current use of CS in pharmacy education internationally. CS were found to be used in multiple ways in pharmacy programmes. They are reflected in OSCEs, portfolios, and programme level assessments, but also have a role in curriculum design, review and mapping, QA, benchmarking and acceptance into pharmacy programmes and placements.

Higher education that evidences educational outcomes can further ensure the quality and employability of the final graduate. If future health practitioners are products of OBE, are cognisant of the profession's CS from an undergraduate and are encouraged to be deep level learners and thinkers rather than passive vessels, we can be more confident in self-regulation in the future.

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