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The Effect of Competency-Based Education on Medical and Nursing Students' Academic Performance, Technical Skill Development, and Overall Satisfaction and Preparedness for Future Practice: An Integrative Literature Review

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The Effect of Competency-Based Education on Medical and Nursing Students' Academic Performance, Technical Skill Development, and Overall Satisfaction and Preparedness for Future Practice: An Integrative Literature Review

Abstract

Purpose: This article provides an integrative review of competency-based education (CBE) in medical and nursing programs and examines the effect of CBE on students' academic performance, technical skill development, and overall satisfaction and preparedness for future practice.

Background: In recent decades, CBE has increasingly been discussed in medical and nursing education programs. The impact of the CBE curriculum on learning outcomes including academic performance, technical skill development, overall satisfaction, and preparedness for future practice has not been fully elucidated.

Method: A review of the literature was conducted, and multiple databases were searched for studies that analyzed the impact of CBE on learning outcomes in medical and nursing program learners.

Results: The overall trends in feedback showed that CBE was well-received by students, with high satisfaction scores reported. CBE was also shown to be equally or more effective than the traditional didactic model in developing students' competencies and improving academic and clinical performance.

Conclusion: Our comprehensive review of the literature suggests that competency-based education can be an effective framework that potentially outperforms traditional educational approaches on outcome measures related to clinical knowledge, technical skill, and/or clinical judgement.

Keywords

competency-based education, competency-based curriculum, competency-based learning, outcome-based education, outcome-based learning, outcome-based curriculum, nurses, medical students, nursing, medicine, learning outcomes, academic performance, technical skill development, preparedness for practice

Introduction

Competency-Based Education (CBE), also known as outcome-based education, has seen many phases in modern history: invention, implementation, rejection, and revival (Morcke, Dornan, & Eika, 2013). Its revival in the 1980s brought about both mainstream advocacy and critique of CBE. When the Soviet Union launched the Sputnik I in 1957, the sentiment in the USA was that the latter had lagged behind in the space race, for which the educational system was held accountable. This prompted mass funding into the educational system, as well as federal intervention, eventually leading to the birth of CBE and its implementation in schools (Hodge, 2007). The influence of psychologists such as Pavlov and Skinner was visible in the behaviourist orientation of early CBE. Ralph W. Tyler (2013) argued that curriculum ought to be designed with reference to explicit objectives that fostered changes in the behaviour of students. By the mid-1970s, this behaviourist curriculum model of CBE was subject to harsh criticism. Lawrence Stenhouse argued that while learning objectives concerning factual knowledge and simple skills made sense, the development of values, insight, and judgment could not be accomplished through behavioural objectives alone (Stenhouse, 1975). Affect (e.g. attitudes, emotions, and values) could not always be assessed objectively, but that did not make them unimportant. In short, by attempting to highlight students' learning over measuring outputs or outcomes, Stenhouse emphasized education over training.

CBE was revived in the 1980s. While it was still based upon the behaviourist and competency principles, this revival acknowledged the importance of affect; but rather than regarding them as directly observable outcomes, affects were described as preconditions for outcomes, or “goals” (Spady, 1994). In 1999, a pivotal year for the competency framework, the Medical School Objectives Project (MSOP) of the Association of American Medical Colleges (AAMC) advocated for CBE in a report (Morcke, Dornan, & Eika, 2013). The same year, the Accreditation Council for Graduate Medical Education (ACGME) as well as the American Board of Medical Specialties agreed upon six competencies (Albanese et al., 2008). In Canada, the CanMEDS competency framework was published a year prior in 1998 (Neufeld et al., 1998). Rather than stressing the process of medical education, CBE emphasized the type of doctor produced, which was a new approach in medicine. CBE had only two requirements: (1) that the learning outcomes were identified, made explicit, and communicated to all concerned; (2) that the educational outcomes desired for learners should be the overriding issue in curriculum decisions. The 2000s showed that it was possible to define learning outcomes and meet the first requirement. Indeed, even schools with vastly different teaching styles could reach a consensus on learning outcomes (Simpson et al., 2002).

At the same time, nursing education too had begun a shift towards competency-based curricula (CBC) (Pijl-Zieber et al., 2014). In fact, in recent decades, CBC has become a core paradigm for preparing nurses in Africa for contemporary practice needs (Muraraneza, Mtshali, & Mukamana, 2017). The basis behind this was the agreement that the overarching purpose of nursing education is to produce a competent practitioner (Chapman, 1999). The Centre to Champion Nursing in America (CCNA) identified the Competency Model as a viable nursing academic progression model for transforming the educational system and meeting the demand for more highly educated nursing professionals (Sroczyński et al., 2017). Not unlike medicine, the CBE approach is appealing to nursing education as it explicitly outlines the abilities and skills required to be a competent practitioner. The licensing bodies for nurses recognized that they needed to

convey to the educational institutions the competencies they expected students to achieve for future practice, and agreed that a curriculum designed to meet these competencies should form the basis for accreditation in university courses (Cameron, 1989).

This renewed interest in competence as a central tenet of education begs the question – what is competence? Ten Cate and Scheele (2007) define competence as a holistic term that refers to an overall capacity or ability to do something successfully. Successful achievement of competence can range from meeting minimum standards to demonstrating independent practice. Another view of competence defines it as the “command of pertinent knowledge and/or skills”, while a competent person “not only possesses the requisite competences but is able to use them” to make contextually appropriate decisions and judgements (Eraut, 1994). Anema and McCoy (2009) believe that successful CBE implementation ensures graduates have the essential knowledge, skills, and attitudes to enter the workforce. The difference between competencies and outcomes can be highlighted in the words “need” vs. “want”. An outcome is defined as skills and qualities we *want* students to have, whereas a competency is defined as skills and qualities we *need* healthcare professionals to have to care for patients safely and effectively (Albanese et al., 2008).

The measurement of competence has been described as the “*Achilles heel*” of CBE (Marginson, 1995). Competence has been found to be difficult, if not impossible, to measure; yet this measurement of competence is the essence of any competency-based approach to education (Marginson, 1992). Marginson (1992) insists the outcomes of education must be transparent, observable, and measurable. A related problematic idea is determining at what level of performance a student should be deemed competent (Watson, 2002). Additionally, general competencies tend to be vague and thus fail to define the essential requirements for safe nursing practice. Another concern is the possibility for a student to pass their competencies but not be competent in any of the fundamental skills for safe nursing practice. The National Education Framework posits that competency statements to evaluate performance should be described in concrete terms to avoid confusion and ambiguity; furthermore, procedural skills should also have a stronger presence as part of competencies to better complement the intellectual skills and practices (National Education Framework, 2008).

Even beyond the measurement of competence, there exist further limitations and challenges with the competency-based approach to health professions education. Ashworth and Morrison (1991) argue that the notion of competence was too broad and included qualities such as attitudes, motives, personal interests, perceptiveness, receptivity, maturity, and aspects of personal development. Watson (2002) agreed that competence is poorly defined and difficult to measure. Bradshaw (2000) disagreed with Simpson et al. (2002) in saying that there was no consensus by which health professionals could “judge what they know, what they should know, and what they don’t know”. There is also a certain confusion regarding the words “competence” and “competency”. Woodruffe (1993) defines competence as the aspect of a job that an individual could perform and competency as the behaviour behind that performance; but, he concedes that the two closely-related concepts can be blurred or used interchangeably. In the nursing profession, concerns exist over whether competence can justly address the artistic and humanistic aspects of the professional (Chapman, 1999). The basis of this argument is that psychomotor and/or technical aspects of practice that can be repeatedly demonstrated are easier to measure (and are thus deemed more valuable as a result of this measurability). Another issue

concerns the possibility of professionals being trained merely to meet minimum competency standards, which could lead to these professionals being ill-equipped to deal with more complex or multi-faceted clinical situations. However, Hunt et al. (2012) have found that clinical failure on the grounds of clinical incompetence is quite rare. Malone and Supri (2012) also suggest that uncritical application of CBE to the medical curricula may not achieve the intended aims.

Some argue that CBE bridges the academic setting with the practice setting and results in a better understanding of the knowledge and skills students require to succeed in work and life (Johnstone & Soares, 2014). CBE brings about a redesign not just of the academic system within an institution, but also of its administration and financial system. This process has the potential to bring about a new curriculum that optimizes both quality and affordability. It also emphasizes standardization of learning outcomes, albeit occasionally at the cost of individualization; that is, that the one-size-fits-all model that CBE endorses does not cater to individual student needs (Hodges, 2010).

Purpose

This article provides an integrative review of competency-based education in medical and nursing programs and examines the effect of CBE on students' academic performance, technical skill development, and overall satisfaction and preparedness for future practice.

Methodology

The following databases were included in the search strategy: Ovid databases (including Medline, Embase, PsycINFO, and HealthSTAR), ERIC, CINAHL, and Cochrane. The search strategy combined the intervention terms (competency-based learning OR competency-based education OR competency based learning OR competency based education OR outcome-based learning OR outcome-based education OR outcome based learning OR outcome based education) with the relevant population groups (medical education OR medical students OR nursing education OR nursing students). The results were limited to those published in English between 2000-2017.

The initial search yielded 114 results. The abstracts and titles of these results were manually reviewed using the following criteria:

1. The paper targeted populations of medical students or nursing students;
2. The paper investigated CBE learning outcomes pertaining to academic performance, technical skill development, and/or overall satisfaction and preparedness for practice;
3. The paper conducted an experiment or shared observational data on the impact of CBE on the learning outcomes, especially if compared to another cohort.

Based on these criteria, 103 results were excluded. 11 papers were analyzed in full for this integrative review.

Table 1: Summary of CBE Articles with Key Findings

Author (s) and Year	Participants	Design	Key Outcomes
Antonoff et al. (2012)	Senior medical students from the University of Minnesota Medical School (United States) transitioning into surgical residency (n=62) took part in this study.	Students either participated in a comprehensive preparatory CBE-based course or served as matched controls. Their performance was assessed through pre- and post-course surveys, knowledge tests, and technical examinations. Confidence and skill acquisition in 32 specific, job-related tasks was also measured.	CBE course participants demonstrated a marked improvement in task-specific confidence in all 32 tasks from the beginning of the course to the end. They also outperformed their matched peers in all 32 tasks. Written and technical skill examinations showed improved scores for the CBE course participants, and there was a strong correlation between confidence and competence in all tasks.
Castel et al. (2011)	Study participants were immigrant primary care physicians (n=28) employed by the Israeli military.	A 3-year competency-based continuing medical education program was developed and delivered to participants. Pre/post multiple choice examinations, objective structured clinical examinations (OSCE), and end-of-program evaluations were administered for curriculum evaluation.	Learners performed significantly better in the annual post-tests compared with the pre-tests and improved their OSCE scores. Program graduates also performed better on work-based assessments as compared to nonparticipants. Ninety percent of program graduates rated overall satisfaction is very good or excellent.
Dijkstra et al. (2015)	Study participants were consultants (n=330) consisting of medical specialists, surgical specialists, and supportive specialists in the Netherlands.	This study evaluated student perceptions of training programs in postgraduate medical education (PGME) that had introduced competency frameworks. A questionnaire was distributed to participants. Respondents rated how well their training program had prepared them for practice, the extent to which educational innovations were implemented, and how much attention was paid to CanMEDS competencies. They also answered questions on the learning environment and general self-efficacy.	The response rate was 43% (143/330). The learning environment was found to be the strongest predictor of preparedness for practice, followed by attention to competencies. Educational innovations were not directly related to preparedness for practice. Attention to competencies was also found to mediate the relationship between educational innovations and preparedness for practice.

Esmaily et al. (2010)	Participants consisted of general physicians (GPs) (n=112) working in 6 cities in the East Azerbaijan province in Iran.	A cluster randomized controlled design was employed, in which participants took part in a continuing medical education program. They were divided into an intervention group (with a CBE approach on rational prescribing) and a control group (with a traditional program on the same topic). The participants' prescribing behaviour was assessed 9 months before and 3 months after their respective programs.	The GPs in the intervention group had a significantly reduced total number of prescribed drugs and number of injections per prescription. They also increased their compliance with specific requirements for a correct prescription. While rational prescribing did improve in some of the important indicators, several others (e.g. antibiotic prescribing) were still suboptimal.
Fan et al. (2015)	Second-year undergraduate nursing students (n=312) from northern and southern Taiwan took part.	This study divided participants into an experimental group (receiving CBE) and control group (receiving traditional instruction) in a medical-surgical nursing course.	Students in the experimental group were found to have significantly higher academic performance in the medical-surgical nursing course when compared to the control group. Required core competencies and metacognitive abilities were also significantly improved in the experimental group.
Hsu et al. (2016)	Sophomore college nursing students (n=213) in northern Taiwan participated in this study.	In this two-group pretest and post-test experimental study, two of the four clusters of participants were randomly assigned to the experimental group for experiencing a CBE course design; the other two groups served as controls, and were given objective-based lectures only. Self-reported assessments by the students as well as knowledge tests administered by the researchers were used to evaluate student performance and satisfaction.	There were significant increases of mean nursing competency scores in both groups from pre-test to post-test. However, no statistically significant difference in mean nursing competency score was found between the experimental group and control groups at post-test. The mean cognitive load score of the experimental group was lower than the control group at post-test. The mean learning satisfaction scores of the experimental groups were higher than the control group.
Iglesias-Parra et al. (2015)	The participants were a sample population of second and third year nursing students (n=194) in Spain.	In this cross-cultural study, participants' satisfaction with a new clinical competency system was assessed.	Participants reported a global satisfaction of 7.47 (range from 1 to 9, with 9 being the highest); 75.67% of the items were equal to or greater than 4 (range from 1 to 5, with 5 being the most satisfied) and the overall mean satisfaction score was 4.05.

Janssen et al. (2005)	Nurses (n=20) in a teaching hospital in Vancouver, Canada participated.	The nurses completed a highly customizable CBE program that catered to the individual's needs. Learning methods included classroom lectures, self-paced learning packages, and preceptorships in the clinical area. Competencies were measured via a standardized perinatal self-efficacy tool and another tool developed by the present researchers.	The scores on both tools showed there were improvements in both perinatal and single-room maternity care-specific competencies, suggesting the CBE program was successful in preparing nurses for a new role in the single-room maternity care setting. This CBE program also demonstrated increased nursing and patient satisfaction in this setting compared with the traditional labour/delivery and postpartum settings.
Succar et al. (2017)	Medical students undergoing an ophthalmology rotation (n=328) in Sydney, Australia took part.	A mixed-methods design included both quantitative (20-item multiple choice test of ophthalmic knowledge) and qualitative (student satisfaction questionnaires) dimensions in evaluating a revised CBE.	The original curriculum saw an improvement of 19.9% from pre- to post-test scores, while the CBE curriculum demonstrated a greater improvement of 31.6% from pre- to post-test scores. At a 12-month follow-up, students in the CBE curriculum scored 11.5% higher than students in the original curriculum. Qualitative feedback from the CBE rotation was obtained and was rated as being highly valued.
Watkins and Moran (2004)	First and second year resident physicians (n=41) in North Carolina, United States were participants.	This was a randomized pre-post comparison study over a 16-month period to assess the effect of a targeted resident physician CBE program on the quality of Pap smears obtained by residents. Participants were randomly assigned to either the intervention cohort or the control cohort.	At baseline, there were no differences in adequacy rates between the intervention and control cohorts. At the post-program evaluation, residents who received the CBE intervention were twice as likely to obtain an adequate Pap smear from patients.
Xue et al. (2015)	Postgraduate students in laparoscopic surgery (n=33) in a university in China participated in this study.	They were assessed before the implementation of CBE (n=16) or after the implementation of CBE (n=17). Specific improvement measures based on five competencies of patient care, medical knowledge, practice-based learning and improvement, interpersonal and communication skills, and professionalism were implemented.	The assessment of the five comprehensive competencies indicated that the CBE group had demonstrated greater competency than the traditional instruction group ($p < 0.05$).

Results

Table 1 above highlights the key findings of the 11 papers.

Four of the studies investigated cohorts of nursing students, four investigated medical students, and three investigated current practicing physicians. All but two papers involved experimental and pre-experimental methodologies which usually consisted of pre-post results and/or comparison of the CBE intervention group with a control group. The remaining two studies used surveys and questionnaires to gauge student satisfaction with the CBE curriculum they experienced.

CBE and student perceptions/satisfaction

The overall trends in feedback regarding the CBE approach was that CBE was well-received by students. Dijkstra et al. (2015) found that the educational innovations of competency-based postgraduate medical education (PGME) programs were positively correlated with feelings of preparedness for practice. It is important to note, however, that this relationship was mediated by student attention to the competencies during feedback and coaching and varied depending on student ratings of the learning environment (i.e. the correlation between CBE and preparedness for practice was strongest in more positively rated learning environments). Therefore, the learning environment was found to be the strongest predictor of preparedness for practice. Iglesias-Parra et al. (2015) also found that the clinical learning environment, where clinical practice is developed, was a major influence on the level of satisfaction and success for nursing students in a competency-based environment. Interestingly, third-year nursing students, who were assumed to have higher maturity and clinical experience than the second-year students, had more confidence in themselves in the clinical environment, suggesting that confidence outcomes may have more to do with student maturity than with the CBE curriculum delivered. The clinical learning and assessment model in the study suggested high degrees of nursing student satisfaction. Succar et al. (2017) employed both a qualitative design and a quantitative assessment model. The qualitative questionnaires showed that students were highly satisfied with the quality of teaching throughout the competency-based ophthalmology rotation.

CBE and student academic and clinical performance

CBE was shown to be just as or more effective than the traditional didactic model in developing students' competencies and improving academic/clinical performance. In addition to the qualitative satisfaction scores Succar et al. (2017) described, the CBE group in their study demonstrated greater pre- to post-test score improvement in ophthalmic knowledge as compared with the pre- and post-test scores of the control group. No studies found CBE to be an inferior alternative to the traditional approach. Antonoff et al. (2012) found statistically significant improvements in student performance on written knowledge exams across all representative knowledge domains from pre-course to post-course. A follow-up assessment found that the CBE course participants had a statistically significant performance advantage during their residency when compared to non-course peers. Castel et al. (2011) observed that immigrant physicians, in their second and third educational years of the CBE program, did significantly better on the post-test when compared with the pre-test. The CBE program was shown to increase participants' knowledge and skills, as well as performance in practice. Esmaily et al. (2010) found that after a CBE prescription training program, unnecessary prescribing activity was significantly reduced, whereas there was no change in the control condition. While nonsteroidal anti-inflammatory

drugs (NSAIDs) and corticosteroid prescription administration was reduced in the intervention arm, there were no significant differences between the intervention and control in their prescribing practices. Fan et al. (2015) suggested that CBE can improve overall metacognitive capacity as well as promote self-modification and effective learning. These domains are involved in students' ability for critical analysis, helping students to recognize their limitations, change their learning strategy, and achieve their learning outcomes. Hsu et al. (2016) demonstrated no statistically significant differences in mean nursing competency scores between the CBE experimental and control groups at the pre-test or post-test; both groups showed statistically significant increases in their scores from the pre-test to the post-test. While not statistically significant, the CBE experimental group also demonstrated a lower mean cognitive load score as compared with the control group. Janssen et al. (2005) reported that their CBE model was successful in improving self-reported nursing competencies. Watkins and Moran (2004) found that there were significantly higher rates of completing adequate Pap smears in the CBE intervention cohort compared to the control cohort; students who had received the CBE intervention were twice as likely to obtain an adequate Pap smear as compared with the control group. Lastly, Xue et al. (2015) found the CBE teaching group to be significantly improved in five comprehensive competencies compared with that of the traditional teaching group: patient care, medical knowledge, practice-based learning and improvement, interpersonal and communication skills, and professionalism.

Discussion

Our comprehensive review of the literature suggests that competency-based education can be an effective framework that potentially outperforms traditional educational approaches on outcome measures related to clinical knowledge, technical skill, and/or clinical judgment. Benefits of CBE approaches were identified in medical programs, nursing programs, and continuing medical education programs for current practicing physicians. Two of the 11 analyzed studies looked exclusively at student responses to questionnaires regarding their participation in CBE programs and found high levels of student satisfaction with the program as well as high levels of self-reported confidence and competence (Dijkstra et al., 2015; Iglesias-Parra et al., 2015). Succar et al. (2017) found both high levels of student satisfaction and a greater improvement in the experimental group compared to the control group from pre- to post-test scores. The remaining eight studies employed an experimental methodology and found student academic and technical performance to be improved compared to control groups and compared to pre-program performance. All studies are unequivocal in their support for the competency-based approach as a valuable educational framework for medical and nursing program learners.

Limitations of Studies Reviewed and Further Considerations

One consistent limitation across all studies reviewed pertained to issues with generalizability, due to small sample sizes and a limited sample pool (i.e. usually only one university/institution was studied). Furthermore, the CBE framework applied and the measurements of competency also varied from study to study, and these differences must be taken into account when evaluating the generalizability of the effectiveness of the CBE paradigm.

Antonoff et al. (2012) employed a pretest-posttest design that required participants to complete the same surveys, knowledge tests, and performance examinations on the first and last days of the course. The follow-up comparisons include control groups, but do not measure the same

outcome variables. Therefore, improvements in participant performance from pre-course to post-course could be due, in part, to previous exposure to the assessment material rather than the effectiveness of the CBE approach alone. Three other studies (Castel et al., 2011; Hsu et al., 2016; Succar et al., 2017) similarly made use of a pretest-posttest design. Antonoff et al. (2012) and Castel et al. (2011) both adopted a single-blind design (i.e. the raters were not aware of CBE course participation status) which helped to limit assessor bias. However, this could not necessarily control for contamination effects between participants of the intervention and control groups.

Dijkstra et al. (2015) delivered a PGME intervention with no comparison group. Education interventions that lack a comparison group will usually favor training over no training, and the effect sizes for such interventions tend to be large (Cook, 2012). Dijkstra et al. (2015) had a low response rate, which may not accurately reflect both the perspectives of all participants and true intervention effects. Esmaily et al. (2010) delivered an intervention educational (CBE) program that was five hours longer than the control program. The increased time for learning experienced by the CBE Intervention group vs. the control group may confound the positive results obtained. Five studies (Antonoff et al., 2012; Dijkstra et al., 2015; Fan et al., 2015; Iglesias-Parra et al., 2015; Janssen et al., 2005) made use of a self-report design. Lastly, four studies (Castel et al., 2011; Hsu et al., 2016; Iglesias-Parra et al., 2015; Succar et al., 2017) included student satisfaction ratings, which should be used with caution. Iglesias-Parra et al. (2015) only assessed student and tutor satisfaction ratings, which are not, by themselves, strong evidence in support of or against CBE.

Limitations of the Integrative Review

This integrative review was subject to limitations as well. While concerted efforts were made to ensure a thorough and comprehensive review of the published literature, it is possible that other illuminating studies of CBE may have been overlooked in databases that were not searched, with other key words that were not used. Furthermore, hand searches, identification of unpublished studies, abstracts or conference presentations, and grey literature searches were not performed. Only papers published in English were examined, making it possible that we overlooked publications in other languages, and our search may not have captured relevant CBE articles that were published prior to 2000.

Implications and Conclusion

This integrative review has examined the role of CBE in medical and nursing educational programs. Current literature suggests that CBE may be a promising direction in health professional program curriculum development. It has been stated in the literature that graduates of a competency-based educational model have the potential to make an impact in the following ways: introduce changes in the workplace, enhance healthcare service management, facilitate student learning in clinical settings, conduct and utilize research, and influence policy based on evidence-based practice (Muraraneza, Mtshali, & Mukamana, 2017). Because different sets of competencies can be determined for each health professional discipline or sub-discipline, the CBE model can be integrated into curricula across the spectrum of health professional programs (Wu, Martin, & Ni, 2017). In response to several problems with the discipline-based curricula, even undergraduate dental education is adapting a CBE approach, with a focus on learning outcomes and authentic assessment (Chuenjitwongsa, Oliver, & Bullock, 2018). It is clear from

the studies reviewed that additional health professional programs anticipate adopting CBE in the coming years and more CBE approaches and interventions will likely be evaluated and published. In light of the competency-based education model becoming increasingly prevalent in medical and nursing educational programs, we recommend further studies that incorporate a longitudinal design to examine and evaluate students' progress in attaining, and maintaining, core professional competencies within the CBE model. CBE holds promise as an effective model in health professional education programs and may provide applications to other professional and non-professional disciplines in higher education as well.

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