

# Integrating Prevention of Mother to Child HIV Transmission competencies into the nursing curriculum: Methodological lessons from a university-based undergraduate programme

**Authors:**

Nomafrench Mbombo<sup>1</sup>  
Million Bimerew<sup>1</sup>

**Affiliations:**

<sup>1</sup>School of Nursing, University of the Western Cape, South Africa

**Correspondence to:**

Nomafrench Mbombo

**Postal address:**

Private Bag X17, Bellville  
7535, South Africa

**Email:**

nmbombo@uwc.ac.za

**Dates:**

Received: 04 July 2011

Accepted: 28 Sept. 2012

Published: 14 Oct. 2012

**How to cite this article:**

Mbombo, N. & Bimerew, M., 2012, 'Integrating Prevention of Mother to Child HIV Transmission competencies into the nursing curriculum: Methodological lessons from a university-based undergraduate programme', *Curationis* 35(1), Art. #12, 10 pages. <http://dx.doi.org/10.4102/curationis.v35i1.12>

© 2012. The Authors.  
Licensee: AOSIS  
OpenJournals. This work is licensed under the Creative Commons Attribution License.

South Africa (SA) has the highest number of women infected with HIV and AIDS during pregnancy, which results in more than 70 000 infected babies being born each year AIDS is the major contributor to maternal and child morbidities and mortalities in the country. To combat this, the SA government has developed a national policy to prevent mother-to-child HIV transmission (PMTCT). However, for effective implementation of this policy, there is a dire need for a competent, skilled health worker to render the service. In response to this, the School of Nursing at the University of the Western Cape has integrated PMTCT competencies into the undergraduate Bachelor of Nursing Science curriculum. In this paper, we described teaching and learning approaches used to integrate PMTCT competencies, including the skills laboratory methodology and case-based learning, as well as a portfolio of evidence assessment tool. A quantitative descriptive design was used to analyse data collected from students in regard to assessment of PMTCT competencies achieved. The study used the conceptual framework of Lenburg's competency outcomes and performance assessment model, which focuses on competency development and assessment in a clinical environment. HIV competencies, including PMTCT, should be integrated both theoretically and at service delivery into other nursing and midwifery competencies, including assessment strategies. Provincial policies in provision of antiretrovirals by nurses and midwives become barriers to successful implementation of PMTCT, resulting in limited learning opportunities for students to practice PMTCT competencies. Further research is required to assess an attribute, affect, which is another prong for competencies.

## Introduction

The number of adults aged 15–49 years and children under 15 years living with HIV and/or AIDS rose globally from about 29 million in 2001 to 33 million in 2007 (International Labour Organization 2009). The most recent estimates show that 34 million people are living with HIV and/or AIDS, 2.6 million were infected with the virus in 2011 and nearly 30 million people have died from HIV and AIDS since the early 1980s (Blumenthal 2012). The global proportion of women to men with regard to HIV infection was 50% at the time of this study. An estimated 15.5 million women were living with HIV and AIDs by the end of 2007 (ILO 2009). The sub-Saharan African countries are the most heavily affected in the world, accounting for over 22.4 million people living with HIV and/or AIDS (United Nations Programme on HIV / AIDS & World Health Organization 2009). South Africa (SA) continues to have the highest HIV incidence rate in the region, with an estimated 5.41 million people living with HIV in 2006, which increased to 5.7 million in 2009 (National Department of Health 2010a). The maternal deaths as a result of AIDS were almost half of the causes in previous reports. In the Western Cape Province, HIV testing amongst women who died during pregnancy increased from the 45% in 1999, before dropping tremendously, only to pick up again in 2006 to 88%. In the absence of both cure and vaccine, mother-to-child transmission of HIV accounts for about 70 000 infants being infected annually in SA, whilst many more children who are born uninfected get infected with HIV during breastfeeding (McIntyre & Gray 2000). Vertical transmission of HIV refers to the transmission by a pregnant woman to her unborn child. Over 90% of infections occur through mother-to-child transmission during pregnancy, labour and/or delivery or breastfeeding (WHO 2010). With increased prevention of mother-to-child transmission (PMTCT) interventions, developed countries have achieved a significant reduction of the mother-to-child infection rate, whilst developing countries are still struggling to bring down the transmission rate (Ginsbury *et al.* 2007).

South Africa is amongst the top five countries in the world in terms of HIV infection and has an antenatal HIV prevalence rate of about 30%. President Zuma's speech on AIDS in the Nation

Council of Provinces on 29 October 2009 (Treatment Action Campaign 2009) has reiterated the devastating impact of HIV and AIDS on the nation. SA's response to AIDS received a powerful boost with the President calling for a major movement to cut the then current HIV infection rate by half and increase access to antiretroviral treatment. In response to the pandemic, the WHO, United Nations Children Fund (UNICEF), United Nations Programme on HIV/AIDS (UNAIDS) and United Nations Population Fund (UNFPA) (2007; cf. UNAIDS 2009) suggest a maximisation of existing human resources, a strengthening of human capacity-building and an integration of PMTCT into maternal and child health services. For SA, the 2011 PMTCT policy (NDOH 2011) takes this into account. In response, the University of the Western Cape (UWC) School of Nursing developed a competency-based PMTCT training manual for undergraduate midwifery, in which the PMTCT competencies were integrated into the existing midwifery content. This paper describes the teaching and learning methodologies that were applied in the integration of PMTCT competencies into the undergraduate curriculum.

## Problem statement

South Africa has the highest number of women infected with HIV and AIDS during pregnancy; as a result many babies are born infected (WHO 2010). HIV and AIDS is the major contributor to maternal and child morbidities and mortalities in the country. With this rate (30.2%) of infection, it is unlikely SA can meet Millennium Development Goal (MDG) targets by 2015 (NDOH 2011) and is one of only 12 countries in the world in which child health outcomes have deteriorated since the year 2000. The maternal mortality ratio currently is 20 times higher than the target ratio we are to meet in 2015. This is owed mostly to HIV infection and AIDS during pregnancy and childbirth. To address this major problem and to ensure effective implementation of the PMTCT policy, there is a dire need for a competent, skilled health worker to render the service.

## Aim of the study

The aim of the study was to evaluate students' clinical performance on PMTCT competencies integrated into the curriculum and to determine the effectiveness and relevance of the PMTCT training programme.

## Study questions

The following questions were generated to direct the study toward achieving its aims and to guide development of PMTCT competencies for midwives:

- What are the essential competencies and outcomes for PMTCT to be integrated into midwifery curriculum?
- What are the indicators that define those competencies?
- What is the most effective approach to learn these competencies?
- What is the most effective way to demonstrate that midwives have achieved these competencies?

## Significance of the study

Midwifery curricula are undergoing changes, with an emphasis on the use of evidence-based approaches to teaching and learning that promote adult learning and competency-based education (International Confederation of Midwives 2011). For proficiency and to meet the vocational needs, a midwife's performance assessment should include knowledge, behaviours, skills practise, critical thinking and decision-making skills, and interpersonal communication skills. Training midwives on PMTCT competencies is a contribution to achieving MDGs 4, 5 and 6 on promoting child and maternal health and prevention of HIV. These health outcomes are key strategic outputs in the South African national service delivery agreement (NDOH 2010b). Almost 90% of maternal deaths and 60% of deaths in newborn babies could be prevented when midwives possess the appropriate skills to save women and children (ICM 2011). The saving mothers' reports on maternal mortality identified substandard management care and a lack in competencies, as health workers related factors contributed to the avoidable maternal deaths (NDOH 2007).

## Rationale for the study

The PMTCT competency-based training was integrated into existing midwifery curricula as a requirement for midwives to be trained on PMTCT. Innovative approaches to teaching and learning were used because of the large numbers of students the university admits every year. It was impossible to expose all students to skills practise at real settings to render them competent before they attend real patients. A competency-based approach to build the skills of midwives is an effective approach in producing well-rounded students who are competent in knowledge, practice, attitude and critical reasoning skills. The methodologies suggested can be replicated to teach any competency beyond PMTCT.

## Conceptual framework

The International Confederation of Midwives (ICM) (2011) suggests that:

The essential competencies for basic Midwifery practice undergo continual evaluation and amendment as the evidence concerning health care and health practice emerges and evolves, and as the health care needs of childbearing women and families change. (ICM 2011:2)

The study used the competency outcomes and performance (COPA) framework from Lenburg's (1999) model to integrate PMTCT competencies into undergraduate curricula. Lenburg (1999) suggests that it is essential for competence-based education to begin with the end in mind and that the main focus should always be on the outcomes; processes are important when the outcomes of the competencies are considered first. The model focuses on competency development in an outcomes-based curriculum and how these competencies are applied and assessed in a practical environment. The model is based on four essential questions that provide the framework. These are same research questions the study used throughout, as listed in the 'Study questions' section above.

According to the COPA model, competencies should clearly define the exact skill needed and should also include eight core practice competency categories that define how the practice should be. The eight core competencies are applicable universally in education and in clinical practice and could be customised to fit the context (Lenburg 1999). The process of identifying PMTCT competencies was participatory, involving stakeholders such as educators, clinicians, policymakers and PMTCT programme managers. A PMTCT competency-based training manual was developed as a guide for lectures and learners. However, a discussion of the details on the participatory methodology applied in the development of these competencies is beyond the scope of this paper. The following are PMTCT competencies identified and integrated with midwifery competencies (NDOH 2011):

- provider-initiated HIV counselling and testing (HCT, formerly called VCT)
- management of antiretroviral treatment (ART)
- baby feeding options management
- polymerase chain reaction (PCR) testing.

The COPA model's core practice competencies were selected to underpin all the above PMTCT competencies. According to Lenburg (1999), the eight core competencies are applied simultaneously in actual practice and are often discreet but can be adapted to fit specific settings, clients, employees and types of students. The core competencies, which are similar to the South African Qualifications Authority critical outcomes, underpin PMTCT competencies as follows:

- Communication skills, including talking, listening to and interacting with clients, as well as history taking and reporting, and writing skills.
- Critical thinking skills, including problem-solving, decision-making and prioritising.
- Human caring and relationship skills, including ethics, cultural aspects, client advocacy and human rights.
- Management skills, including accountability and responsibility.
- Safety and protection skills, including universal HIV precautions.
- Teaching skills, including health promotion and health education.
- Knowledge integration skills, including using other sources of knowledge from disciplines such as Social Science and Natural Science.

These competencies enabled the student to address the affect and holistic provision of PMTCT beyond gross motor skills.

According to Lenburg (1999:10), the competency outcomes should answer the following question: 'What is the student expected to be able to do in cognitive, gross motor and affective or psychomotor performance as a result of the course?' She suggests one should ask whether the student will be able to write about or actually perform the skill based on the knowledge. For this group of students, knowing was not the end outcome, the focus was a student engaging in PMTCT activities both at simulated and at clinical real settings using the knowledge. The indicators on this model are defined as, 'the set of single, discreet, observable

behaviours that are mandatory for the designated skill at the targeted level of practice' (Lenburg 1999:14). They are not steps in a procedure. She suggests that they must include actions and behaviours that are essential for documenting competence. These should be what the student must perform and what should be quantified, not what is considered ideal or good to know.

For PMTCT competencies, each student was expected to conduct 10 pre-test and 10 post-test HIV counselling cases, 10 rapid finger prick HIV tests, 10 dual antiretroviral (ARV) therapy sessions, 10 intrapartum ARV prophylaxis and 10 neonatal ARV prophylaxis procedures, 10 infant feeding options counselling sessions and 10 PCR tests. These are suggested in the PMTCT policy and provincial protocols to measure implementation of PMTCT. Owing to the limited exposure of students to child health settings during this period of data collection, the PCR testing and infant feeding counselling are not included in this report.

To learn these competencies most effectively, the COPA model suggests a paradigm shift to change from being a lecturer to becoming the engaging facilitator who uses multiple approaches focused on the student at the centre of learning and practice. The whole purpose of competency-based education is to prepare the midwife for professional and personal competence in work and in life, and to build her or his confidence on critical thinking and communication (Lenburg 1999). The PMTCT competencies were integrated into the midwifery competencies. Midwifery curricula are centred on the reproductive cycle, namely, prenatal (before pregnancy), antenatal (during pregnancy), intranatal or intrapartum (during labour or delivery), postnatal or postpartum (after labour or delivery) and neonatal (the newborn stage up to six weeks post-delivery). To accommodate the student's clinical placement at the time of conducting this study, this paper is not reporting on the PMTCT integration on pre-pregnancy with specific reference to sexual health and family planning. The importance of integrating HIV including PMTCT is not debatable; it is a complex process to implement at a service delivery level (Doherty *et al.* 2009; Israel & Kroeger 2003).

Each of the four PMTCT competencies was integrated into each pregnancy stage (antenatal, intranatal and postnatal) and during neonatal care. For example, for HCT competency, a student would be expected to counsel a woman pre-pregnancy, as well during antenatal care, intranatal care and throughout the reproductive cycle, irrespective whether HCT was undertaken with the same woman in previous stages and irrespective of the woman's previous HIV status. The aim is to nurture HIV-negative clients as well, so they remain negative throughout the pregnancy. The same principle also applies for the other competencies. For the ART management competency, the student has to assess the woman throughout the pregnancy stage to determine eligibility to initiate ART for HIV-infected women if need be. If ART was initiated prior pregnancy, the student has

to manage this, supporting the woman for adherence and early identification of complications. Teaching and learning approaches were integrated (Lenburg 1999) and followed a case-based approach and skills laboratory method to acquire knowledge, skill, attitude and clinical experience.

The case-based approach is defined as a teaching and learning strategy that stimulates ideas through complex problem analysis of actual hypothetical situations. It provides a means of applying theoretical principles to practice. Clinical-based cases can provide a rich basis for developing students' problem-solving and decision-making skills: the core practice competencies endorsed by the COPA model. For the analysis of case discussion, the student involvement develops on at least three distinct levels. At the first level, the student explores a problem by sorting out relevant facts, developing logical conclusions and presenting these to fellow students and the instructor. On the second level, students can be assigned roles in the case and take perspectives that require them to argue for specific actions or characters' point of view, given their interest and knowledge. On the third level, students take the initiative to become fully involved, topics are addressed well (Chikering & Gamson 1987; Gordon 1994).

Students were given cases from different sources to learn and practise, including the use of simulated tailor-made patients at skills laboratory. The cases covered all aspects related to PMTCT competencies (knowledge, skill and attitude) integrated into the reproductive cycle. Students also brought individual stories of an HIV-positive pregnant woman and discussed these in class in a small group using a PMTCT training manual as a guide to resolve the problems.

Wagner and Ash (1998) suggest that the complexities of health problems require educators to do better in order to prepare their students for the real world of nursing. Innovative ways of teaching and learning about the real world of nursing in a cost-effective, efficient and high quality manner are needed to prepare nurses for working in a safe and efficient manner. Providing lecture content in a traditional way, combined with limited clinical and technical knowledge, is inadequate to prepare nurses. Research suggests that learners value a facilitative approach that includes collaboration and involvement in activities, interaction with course content and with one another (Melrose 2004; Schmidt 1999). Mitchell (2009) found that medical students approaching qualification perceived that their exposure to clinical skills is inadequate and that they are ill-equipped to carry out a range of clinical procedures. Inadequate skills result in poor communication between the healthcare provider and patient, which leads to patient dissatisfaction and reduces adherence to treatment recommendations. In response to this, Maastricht University initiated a skills laboratory methodology (SLM) in the 1980s, with the aim of bridging the gap between theory and clinical practice for medical students. The purpose of the skills laboratory is to allow students to explore things by themselves and it provides students with the opportunity to acquire skills and competencies in a simulated environment (White & Ewan 1991). It allows them to take responsibility

for their own learning, enabling them to discover things for themselves whilst learning the skill. The importance of allowing students in the SLM to work through problems by themselves and arrive at their own conclusions cannot be overestimated. Nursing skills are best illustrated through visualisation by means of graphics, drawings, photographs, videos or DVDs and computer-based simulation. According to the Maastricht model of SLM, there are four phases and these were followed to teach the gross motor skills of each PMTCT competency. These phases are:

- Visualisation: the student is oriented through videos and visualises the skill before she or he is taught.
- Guided practise: the skill is demonstrated at a skills laboratory. Students are given an opportunity to practise it guided by the lecturer. A simulated environment with tailor-made patients is created especially to practise the aspect of interpersonal skills. Tailor-made patients are healthy people appointed by the university to act as patients. In this case, the 'patients' are programmed and play as pregnant women, some with an HIV-positive status, and are 'manoeuvred' to play different emotional circumstances. During the guided practise, students can come anytime to the lab to practise under the guidance of the tutor.
- Independent or self-directed learning: students practise the skill in their own time and pace at a skills laboratory and they also take videos of themselves practising to peers which they can show to the lecturer later for feedback. Practising in different contexts is also a requirement for SLM. Students were placed at 19 health facilities offering PMTCT programme in the Cape Town metropolitan area. They practised under clinical supervisors and were mentored by UWC-trained preceptors.
- Evaluation: when the students were ready, they were assessed using a portfolio of evidence on a case study of an HIV-positive woman.

Prevention of Mother to Child Treatment competencies were taught step by step following the SLM phases. The framework suggested by the COPA model on the effective way to learn the competencies has been followed by using case-based learning approach to teach the theory and the SLM to teach the practical aspect of PMTCT competencies (Table 1).

The fourth question proposed by the COPA model is the issue of assessment of competencies. In the competency-based assessment, the student is guided throughout their learning, each choosing their own time, pace and space to learn the skill, followed by a scheduled time to demonstrate and confirm their competence therein. This resonates with the SLM. The formative assessment selected offered the opportunity to provide students with constructive feedback on being competent, as well as an opportunity for coaching. A required portfolio of evidence allowed students to document own learning. A criterion-referenced formative method was used to assess PMTCT competency, where the students' performance was judged against the

**TABLE 1:** Teaching prevention of mother-to-child HIV transmission competencies using the skills laboratory methodology.

Phases	HCT	ART	Infant feeding option management	PCR
Visualisation	Students view a video of a client being counselled for HIV pre-test and post-test and demonstration of the skills by clinical facilitator.	Students view a video or DVD on how to interpret CD4 count result, how to initiate the antiretroviral treatment or HAART and adherence to the treatment.	Students view a video of infant feeding option skills and management, and demonstration of the skills by clinical facilitator.	Students view a video of PCR testing skills and demonstration of the skills by the clinical facilitator.
Guided practise	Guided by lecturers, students conducted HCT skills in a simulated laboratory with the assistance of clinical facilitator. Immediate feedback and correction of mistakes are made.	Guided by lecturers, students conducted management of ART skills in a simulated laboratory with the assistance of clinical facilitator. Immediate feedback and correction of mistakes are made.	Guided by lecturers, students conducted infant feeding option management skills in a simulated laboratory area with the assistance of clinical facilitator. Immediate feedback and correction of mistakes are made.	Guided by lecturers, students conducted PCR testing skills in a simulated laboratory with the assistance of clinical facilitator. Immediate feedback and correction of mistakes are made.
Independent practise	Independently, students practised HCT skills with and without peer group in a simulated laboratory. Peer evaluation occurs naturally. Students are assigned to health facilities to practise the skills in real life situations under direct supervision.	Students practise the skills independently or with peer in a simulated laboratory. Peer evaluation naturally occurs. Students are assigned to health facilities to practise the skills in real life situations under direct supervision.	Students practise the skills independently or with peer in a simulated laboratory. Peer evaluation occurs naturally. Students are assigned to health facilities to practise the skills in real life situations under direct supervision.	Students practise PCR testing skills independently or with peer in a simulated laboratory. Peer evaluation occurs naturally. Students are assigned to health facilities to practise the skills in real life situations under direct supervision.

HCT, HIV counselling and testing; ART, Antiretroviral therapy; PCR, polymerase chain reaction testing, HAART, highly active antiretroviral therapy.

standards set. As discussed earlier, students were given a total number of elements they were to achieve and, through the SLM, they were taught how to learn these. The emphasis on producing a portfolio of evidence emphasis was for the students to demonstrate reflection on the work undertaken, fostering integration of theory and practice, identifying their learning needs, as well as presenting evidence of growth and change during the learning process (Lenburg & Mitchell 1991; MacIsaac & Jackson 1994). It also reflects a move away from the teacher at the centre, controlling the assessment, to students at the centre, each playing a self-determining role in the assessment. The students' portfolio of evidence was assessed according to six criteria:

- The students' ability to choose the right clients (HIV-positive, pregnant women), to provide evidence that they have achieved each of the specified learning outcomes and understand the values with regard to PMTCT competencies.
- The students' ability to demonstrate what and how they developed new understanding and skills.
- The students' ability to demonstrate how she or he applied the four PMTCT competencies throughout the four stages of the pregnancy, as well as the confidence that they have mastered the competencies in a variety of situations.
- The students' ability to independently evaluate alternative approaches and the accuracy of the report of her or his work.
- The students' ability to reflect on intentions, actions and attitudinal change with regard to PMTCT.
- The students' ability to organise the portfolio of evidence in a clear and appropriate manner, well laid out in terms of content and rationale as to each item that has been included.

The PMTCT competencies achieved by undergraduate midwifery students based on the portfolio of evidence each student submitted is reported to answer the fourth research question: what is the most effective approach to document that midwives have achieved the required competencies?

## Research method and design

A quantitative descriptive design was used to analyse data collected from students in regard to competencies achieved.

Burns and Grove (2009:237) support that a descriptive design provides a picture of situations as they naturally happen and can 'identify problems with current practice, justify current practice, make judgements and can determine what others in similar situations are doing'.

## Data collection

At the time of data collection, there were 154 third-year undergraduate students attending the midwifery module and who were taught PMTCT competencies for duration of six months. One of the formative assessments for the midwifery module was designed specifically for students to document evidence gathered at clinical placements on PMTCT. A portfolio of evidence was the assessment tool. Of the 154 students, the total number who completed the portfolio per each of the competency indicators were: 134 students for pre-test counselling, 132 students for post-test counselling, 144 for rapid finger prick HIV testing, 121 for dual ARV therapy, 107 for intrapartum ARV prophylaxis and 116 for neonatal ARV prophylaxis.

The instruction for the portfolio was that each student conduct a case by 'adopting' and following up on an HIV-positive pregnant woman during the prenatal, antenatal, intranatal and postnatal stages of her pregnancy, as well as during her neonatal care. Each student was expected at least to have been in contact with the woman in any two of the four stages of her pregnancy and also in neonatal care, the latter being compulsory. For example, some students might have first contact with the woman during labour, postnatal and neonatal but might have never seen the woman during her antenatal period, whilst some might have seen the woman during the prenatal and antenatal stages and then see her again when she comes for her newborn. In the portfolio, the students were to provide evidence on what PMTCT element they provided based on the abovementioned six competency indicators.

## Study population and setting

The students who participated in this study were registered for a four-year Bachelor of Nursing degree and were

studying midwifery in their third year in 2010, with PMTCT forming part of midwifery competencies during the time of the study. They were taught and assessed on PMTCT competencies. The 154 students were placed at health care facilities across the Cape Town metropolitan region. These included midwifery obstetric units and secondary hospitals. In total, 19 health facilities were utilised, with an average of eight students allocated per each facility. At each facility, two dyad students each were allocated to different services, for example, antenatal care or labour ward, and students would rotate as per a roster provided.

## Data analysis

Descriptive data analysis was conducted using the SPSS statistical software programme, version 19. The frequency distribution table and central tendency measurement (mean, median and mode) was used to determine the average performance of the students and the range of scores between the maximum and minimum value. However, in this analysis the mean was not relevant, as most scores were not bunched up in the middle, in other words they were not symmetrical values. Dispersions or deviance were used as this tells a lot about how the variable was distributed. The analysis was based on variables, that is, the abovementioned six competency indicators for PMTCT competencies which were taught to students and which they practised in different contexts, in simulated laboratory and real world settings. These indicators were documented by the students in their portfolio of evidence, which was co-signed by the clinical supervisor from the university and health unit manager where they practiced.

## Results

As indicated above, the total number of students who conducted each of the six competency indicators were as follows: pre-test HIV counselling,  $n = 134$ ; post-test HIV counselling,  $n = 132$ ; rapid HIV finger prick testing,  $n = 144$ ; dual ARV therapy,  $n = 121$ ; intrapartum ARV prophylaxis,  $n = 107$ ; neonatal ARV prophylaxis,  $n = 116$ .

The statistical analysis demonstrates that, for all the variables, the mean was greater than the standard deviation and was statistically acceptable. Although the missing data in this case appeared to be high, this does not mean that students

did not perform the skills. This could simply be a case of a student not having had the chance to get to a patient on one particular skill area at that particular time, but then perhaps having had a chance to perform more on other skill areas. For example, one student may have had the chance to practise more on pre-test and post-counselling, but less on the dual ARV therapy. Another possible explanation for the missing data is that the students may not have had time to conduct all the competencies in that given period of time, because they were at the PMTCT health facility for very short time. If the time for clinical work was increased, the results could be different (Table 2).

## Pre-test HIV counselling

A total of 134 students performed the pre-test HIV counselling competency. Of these, 119 (77.3%) of the students had completed the requirement by conducting 10 pre-test counselling cases each. About 9.7% of the students conducted between two and nine pre-test counselling cases, which was below the required amount. In this particular PMTCT skill area, 13.0% of the students were unable to conduct pre-test counselling at the time of data collection (Table 3).

## Post-test HIV counselling

Out of 132 students who submitted their portfolio for this competency, 115 (74.7%) completed the requirement by conducting 10 post-test counselling cases each. Others had conducted fewer post-test counselling cases (between one and eight) and two students had conducted more than 12 each, which was more than the requirement. In this competency, 22 (14.3%) students did not have the chance to conduct post-test counselling at the time of the data collection period (Table 4).

## Rapid HIV testing

Of the 144 who submitted their portfolio for this competency, a total of 135 (87.7%) students performed the required seven rapid finger prick HIV tests each. A few students had managed to perform more rapid HIV tests than the requirement, whilst some students had performed less than the requirement. The lowest performance in this skill was 0.6%, where students performed only one rapid HIV testing. About nine students did not conduct this skill (Table 5).

**TABLE 2:** The statistical analysis showing mean and standard deviation of all students' performances on prevention of mother-to-child HIV transmission competencies.

Statistic	Pre-HIV test	Post-HIV test	Rapid HIV test	Dual therapy	Intrapartum ARV prophylaxis	Neonatal ARV prophylaxis
Valid	134.000	132.000	144.000	121.000	107.000	116.000
Missing	20.000	22.000	10.000	33.000	47.000	38.000
Mean	9.620	9.590	6.940	7.890	8.010	7.370
Median	10.000	10.000	7.000	10.000	7.000	6.000
s.d.	1.267	1.365	0.671	3.109	5.093	4.886
Variance	1.606	1.862	0.451	9.663	25.934	23.870
Skewness	-3.614	-3.507	-6.257	-1.083	0.185	0.446
SE of skewness	0.209	0.211	0.202	0.220	0.234	0.225
Range	9.000	11.000	8.000	11.000	14.000	14.000
Minimum	2.000	1.000	1.000	1.000	1.000	1.000
Maximum	11.000	12.000	9.000	12.000	15.000	15.000

*N*, number of students; s.d., standard deviation; SE, standard error; ARV, antiretroviral.

## Dual antiretroviral therapy

Out of total 154 students, 121 (78.0%) conducted dual ARV therapy and about 74 (48.1%) of the students completed the required 10 dual therapy sessions. Thirty-two students did not complete the skill at the time of data collection (Table 6).

## Intrapartum antiretroviral prophylaxis

Out of total of 154 students, 107 (69.5%) provided intrapartum ARV prophylaxis for pregnant women during labour. Eighty students had performed between one and six (0.6% – 5.8%)

**TABLE 3:** Students' performance on pre-test HIV counselling.

Students	<i>N</i>	<i>f</i>	%	%†	%‡
Valid	2	1	0.6	0.7	0.7
	4	1	0.6	0.7	1.5
	5	1	0.6	0.7	2.2
	6	3	1.9	2.2	4.5
	7	6	3.9	4.5	9.0
	8	1	0.6	0.7	9.7
	9	1	0.6	0.7	10.4
	10	119	77.3	88.8	99.3
	11	1	0.6	0.7	100.0
	Total	134	87.0	100.0	–
	Missing	99	20	13.0	–
<b>Total</b>	–	<b>154</b>	<b>100.0</b>	–	–

*N*, number of cases; *f*, frequency,  
†, valid percentage.  
‡, Cumaulative percentage.

**TABLE 4:** Students' performances on post-test HIV counselling.

Students	<i>N</i>	<i>f</i>	%	%†	%‡	
Valid	1	1	0.6	0.8	0.8	
	4	1	0.6	0.8	1.5	
	5	1	0.6	0.8	2.3	
	6	3	1.9	2.3	4.5	
	7	7	4.5	5.3	9.8	
	8	2	1.3	1.5	11.4	
	10	115	74.7	87.1	98.5	
	11	1	0.6	0.8	99.2	
	12	1	0.6	0.8	100.0	
	Total	132	85.7	100.0	–	
	Missing	99	22	14.3	–	–
	<b>Total</b>	–	<b>154</b>	<b>100.0</b>	–	–

*N*, number of cases; *f*, frequency,  
†, valid percentage.  
‡, Cumaulative percentage.

**TABLE 5:** Students' performance on rapid HIV testing.

Students	<i>N</i>	<i>f</i>	%	%†	%‡	
Valid	1	1	0.6	0.7	0.7	
	3	1	0.6	0.7	1.4	
	5	1	0.6	0.7	2.1	
	6	2	1.3	1.4	3.5	
	7	135	87.7	93.8	97.2	
	8	3	1.9	2.1	99.3	
	9	1	0.6	0.7	100.0	
	Total	144	93.5	100.0	–	
	Missing	99	9	5.8	–	–
	System	1	0.6	–	–	
Total	10	6.5	–	–		
<b>Total</b>	–	<b>154</b>	<b>100.0</b>	–	–	

*N*, number of cases; *f*, frequency,  
†, valid percentage.  
‡, Cumaulative percentage.

intrapartum ARV prophylaxis procedures for pregnant women, whilst others had conducted about 12 for each. Twenty-five (16.2%) students had managed to perform 15 procedures each, whilst about 37 (30.5%) students could not perform the skill at the time of data collection because of the programme logistics in regard to clinical hours (Table 7).

## Neonatal antiretroviral prophylaxis

Of the students 116 (75.3%) students conducted neonatal ARV prophylaxis. Of these, 23 (14.5%) students performed 15 neonatal care prophylaxis procedures. Fourteen (12.1%) students performed provided between 11 and 14 procedures. The majority, that is 77 (66.4%), of the students had performed between one and five procedures, which is fewer than the required level of performance for this competency.

## Ethical considerations

The University of the Western Cape research ethics committee granted permission. The portfolios of evidence formed part of the student's formative assessment, but for this study no names were used and anonymity was applied so no student is identifiable. There were no potential physical harm nor potential psychological dangers anticipated. Students were informed that the assessment forms part of the research project, but their names will remain anonymous. The ethical principle as spelt out in medical research involving human subjects was applied.

## Trustworthiness

### Validity and reliability

To avoid threats to reliability and validity in descriptive design, Burns and Grove (2009:237) suggest various ways the researcher can maintain rigor. The following were applied in the study:

- Sample selection and size: the sample included all students studying midwifery in that period and the target population was achieved.
- Use of valid and reliable instrument: the instrument was previously used in 2009 as a pilot to a different group of student cohorts who were studying the same module in a non-realigned curriculum.
- Data collection procedures that achieve some environmental control: a control on the confounding effects of extraneous variables on study variables was achieved by allowing data to be collected only during the students' clinical placements timetable, and only under the supervision of clinical supervisor. This therefore posed no threat to the natural setting where data were collected.

## Discussion

### Outline of the results

The aim of the study was to assess the students' performance on the PMTCT competencies taught and integrated into the curriculum. The purpose for this paper was to describe the innovative teaching and learning approaches used in the

**TABLE 6:** Students' performance on dual antiretroviral therapy.

Students	<i>N</i>	<i>f</i>	%	%†	%‡
Valid	1	9	5.8	7.4	7.4
	2	2	1.3	1.7	9.1
	3	6	3.9	5.0	14.0
	4	5	3.2	4.1	18.2
	5	9	5.8	7.4	25.6
	6	4	2.6	3.3	28.9
	7	7	4.5	5.8	34.7
	8	2	1.3	1.7	36.4
	9	2	1.3	1.7	38.0
	10	74	48.1	61.2	99.2
	12	1	0.6	0.8	100.0
	Total	121	78.6	100.0	–
Missing	99	32	20.8	–	–
	System	1	0.6	–	–
	Total	33	21.4	–	–
<b>Total</b>	–	<b>154</b>	<b>100.0</b>	–	–

*N*, number of cases; *f*, frequency,

†, valid percentage.

‡, Cumaulative percentage.

**TABLE 7:** Students' performance on intrapartum antiretroviral prophylaxis.

Students	<i>N</i>	<i>f</i>	%	%†	%‡
Valid	1	7	4.5	6.5	6.5
	2	11	7.1	10.3	16.8
	3	11	7.1	10.3	27.1
	4	9	5.8	8.4	35.5
	5	9	5.8	8.4	43.9
	6	6	3.9	5.6	49.5
	7	2	1.3	1.9	51.4
	8	1	0.6	0.9	52.3
	9	5	3.2	4.7	57.0
	10	9	5.8	8.4	65.4
	11	3	1.9	2.8	68.2
	12	5	3.2	4.7	72.9
	13	3	1.9	2.8	75.7
	14	1	0.6	0.9	76.6
	15	25	16.2	23.4	100.0
Total	107	69.5	100.0	–	
Missing	99	47	30.5	–	–
<b>Total</b>	–	<b>154</b>	<b>100.0</b>	–	–

*N*, number of cases; *f*, frequency,

†, valid percentage.

‡, Cumaulative percentage.

**TABLE 8:** Students' performances on neonatal antiretroviral prophylaxis.

Students	<i>N</i>	<i>f</i>	%	%†	%‡
Valid	1	7	4.5	6.0	6.0
	2	14	9.1	12.1	18.1
	3	12	7.8	10.3	28.4
	4	12	7.8	10.3	38.8
	5	11	7.1	9.5	48.3
	6	5	3.2	4.3	52.6
	7	7	4.5	6.0	58.6
	8	5	3.2	4.3	62.9
	9	2	1.3	1.7	64.7
	10	9	5.8	7.8	72.4
	11	3	1.9	2.6	75.0
	12	3	1.9	2.6	77.6
	13	2	1.3	1.7	79.3
	14	1	0.6	0.9	80.2
	15	23	14.9	19.8	100.0
Total	116	75.3	100.0	–	
Missing	99	38	24.7	–	–
<b>Total</b>	–	<b>154</b>	<b>100.0</b>	–	–

*N*, number of cases; *f*, frequency,

†, valid percentage.

‡, Cumaulative percentage.

integration and assessment of acquiring the competencies. The WHO suggests two approaches for PMTCT integration. One approach is when components of PMTCT are provided by one health worker, a student in this case, within a maternal child health and family planning service. Another approach is when each of the PMTCT services is provided under one roof by several individuals. Both approaches are practiced in health facilities in Cape Town; yet, there is no documentation to determine which of these is most effective. Nevertheless, programme evaluations in some African countries identified integration deficiencies in various components of PMTCT programmes (Perez *et al.* 2004; Temmerman *et al.* 2003). For this study, each student was expected to be competent in the provision of each of the PMTCT competencies integrated to each reproductive cycle, as per the midwifery curriculum.

The study followed the framework provided by the COPA model to identify the essential PMTCT competencies to be integrated into the midwifery curriculum. The competencies suggested in by the National Department of Health (2011) protocols are evidence based and supported by the WHO (2007). Each student was assigned to conduct a certain number of each of these competencies, in order to be rendered competent overall (Welty *et al.* 2005).

Case-based learning and skills-based methodology as innovative approaches to teach competencies to bigger classes (White & Ewan 1991) were successfully applied to teach the three prongs of a competency, that is, cognitive, technical skills, and affect, where students practise both in simulated and real clinical environments. The use of simulated patients assisted in the practise of interpersonal skills on 'real' patients for the attribute of affect. Previous studies support the use of a portfolio of evidence to document the learning that has occurred, with students being at the centre of collecting evidence and having achieved the outcomes (Wright & Barton 2001; Yip *et al.* 2001).

The competencies related to child health, that is, baby feeding options and PCR, are not reported in this paper because of challenges faced at real settings in the integration of child health. The students were able to practise administering neonatal ARV therapy that is offered at child health clinics, but could not practise PCR testing. For infant feeding options, this section has been omitted because, at the time of writing this article, the new compulsory breastfeeding policy was in the process of being drafted, to be effective as of 01 March 2012. The integration of PMTCT into sexual health, family planning and syndromic management of sexual transmitted infections is not reported in this paper.

Student midwives met the requirements on set criteria to measure their competencies on PMTCT. Fullerton and Thompson (2005); Pathak, Kwast and Mallah (2000) assert that midwives are to possess essential competencies to be responsive to the country's needs. About 154 trainee midwives conducted 10 HIV counselling tests, which is translated to 1540 provider-initiated HIV pre-test counselling cases undertaken at 19 health clinics for a period of six

months. Some counselling might have been repeated more than once to one woman as students had to conduct HCT across the phases of woman's reproductive cycle.

Out of the 1540 counselling sessions, 945 women were also tested for HIV using the rapid finger prick. About 748 women were also provided with dual ARV therapy, but this may not necessarily be with the same women who were tested because some women were initiated on therapy based on their CD4 cell count and WHO clinical staging. A major part of the success of PMTCT relies on antiretrovirals to reduce the viral load and HIV transmission (WHO 2010). Students, under supervision, were to initiate regime one at 14 weeks gestation and during labour, as per the Western Cape Province protocol. The challenge was implementation of lifelong ART and that will remain a challenge at midwife obstetric units to initiate and refer clients for such, especially as this is still a doctor-oriented activity. At the time of this study, students were not allowed to participate when pregnant clients on highly active ART presented at a health facility. Nevertheless, students provided many women in labour with prophylaxes, combined with the whole package of how to take care of HIV-positive clients in labour in regard to: artificial rupture of membranes, cutting of an episiotomy, vaginal cleansing, infant drying practices and airway suctioning. However, linking with intrapartum ARV for mothers, fewer neonatal ARV prophylaxis procedures were provided, with some students conducting only one, compared to the required 15. This is of concern and it resonates with the debate that midwives focus less on babies and more on mothers during labour.

### Practical implications

It is suggested that further research is needed to evaluate the impact of PMTCT integration into the quality of maternal health service. This study focused on PMTCT uptake when integrated within midwifery. Core competencies such as caring and human rights attributes to address the affect and value addition were embedded into each skill and taught, but this is difficult to assess in real settings because they are constructs (Quinn 2001).

The students' reflection as part of their portfolio of evidence assessment in following up a HIV-positive pregnant client is reported qualitatively in a second, forthcoming paper, as a result of space shortage in this present paper.

### Limitations of the study

The regular updates of the PMTCT national and provincial guidelines posed a challenge, because we had to keep on changing our focus to keep up to date with new information as per the new national guidelines and provincial protocols.

The SLM success is dependent on a number of factors, such as the availability of skills laboratory equipment. The procedure-based skills approach requirements versus competency-based skills acquisition was challenging, as students still have to undertake a large quantity of procedures to meet the

South African Nursing Council requirements on the number of skills they have to conduct, which were not necessarily competency-based.

Learning could only be assessed when the student was ready and felt competent and this posed a challenge because of programme requirements. Most midwife mentors in the clinical settings were not trained in PMTCT competencies and this created problems in mentoring and transferring the effective clinical experiences to students during their clinical practice. PMTCT services are not completely integrated into maternal and child health services and not all maternity services were offering PMTCT services at the time of the study.

During midwifery contact, students see women only during antenatal care and rarely in pre-pregnancy and in the six-week postnatal period. The latter is essential to conduct a follow up for both mother and baby. Each component of the competency, namely, cognitive, technical skill and affect, was taught and assessed, but this paper reports on the technical skills only.

## Recommendations

PMTCT competencies should be integrated into all midwifery and nursing curricula. There is a need for further research to explore on how to teach and assess attributes such as caring, which is very crucial when rendering services to at risk populations, such as those with terminal conditions such as AIDS. Even though the government has developed a national PMTCT policy and provincial protocols to reduce the HIV transmission from the mother to the baby, this policy needs competent nurses and midwives to effectively implement it. Integrating PMTCT competencies into existing midwifery competencies using innovative teaching and learning approaches promotes competent students for rendering of the PMTCT programme.

## Conclusion

HIV should be integrated into the midwifery competencies and not be isolated from other nursing and midwifery care. The South African Nursing Council should consider revising the number of procedures that students are required to complete and focus instead on competency-based skill acquisitions. For a large number of students, innovative approaches such as the SLM can be effective in teaching and learning competencies.

## Acknowledgements

The authors acknowledge the following midwifery lecturers: Mr D. Newman, Ms D. Mugendi and Ms S. Walker. This study was funded through a PEPFAR grant.

## Competing interests

The authors declare that they have no financial or personal relationships which may have inappropriately influenced them in writing this paper.

## Authors' contributions

M.B. (University of the Western Cape) was the PMTCT project coordinator and N.M. (University of the Western Cape) was the project leader and principal investigator.

## References

- Blumenthal, S., 2012, *Making AIDS history: Achieving an HIV-free generation*, viewed 30 July 2012, from [http://www.huffingtonpost.com/susan-blumenthal/international-aids-conference\\_b\\_1694865.htm](http://www.huffingtonpost.com/susan-blumenthal/international-aids-conference_b_1694865.htm)
- Burns, N. & Grove, S., 2009, *The practice of nursing research. Appraisal, synthesis and generation of evidence*, Elsevier, St Louis.
- Chikering, A. & Gamson, Z., 1987, 'Seven principles for good practice in undergraduate education', *American Association of higher education Bulletin* 39(7), 5–10.
- Doherty, T., Chopra, M., Nsiband, D. & Mngoma, D., 2009, 'Improving the coverage of the PMTCT programme through a participatory quality improvement intervention in South Africa', *BMC Public Health* 9, 406. <http://dx.doi.org/10.1186/1471-2458-9-406>
- Fullerton, J. & Thompson, J., 2005, 'Examining the evidence of the International Confederation of Midwives' essential competencies for midwifery practice', *Midwifery* 21(1), 2–13. <http://dx.doi.org/10.1016/j.midw.2004.10.004>
- Ginsbury, A.S., Hoblitzelle, C.W., Sripathana, T.L. & Wilfert, C.M., 2007, 'Provision of care following prevention of mother-to-child HIV transmission service in a resource limited setting', *AIDS* 21(18), 2529–2532. <http://dx.doi.org/10.1097/QAD.0b013e3282f155f4>, PMID:18025890
- Gordon, R., 1994, 'Keeping student at the centre: Portfolio assessment at the college level', *Journal of experimental education* 17(1), 23–27.
- International Confederation of Midwives, 2011, *The state of the world's midwifery report*, viewed 30 June 2011, from [http://www.unfpa.org/sowmy/resources/docs/main\\_report/en\\_SOWMR\\_Full.pdf](http://www.unfpa.org/sowmy/resources/docs/main_report/en_SOWMR_Full.pdf)
- International Labour Organization, 2009, 'HIV/AIDS and the world of work', in ILO (ed.), *Proceedings of the 98th International Labour Conference*, report IV(1), Geneva, Switzerland, 03–19 June.
- Israel, E. & Kroeger, M.C., 2003, *Integrating prevention of mother-to-child transmission of HIV into existing maternal, child and reproductive health programs*, viewed 14 July 2010, from [http://www2.pathfinder.org/site/DocServer/Technical\\_Guidance\\_Series\\_3\\_PMTCTweb\\_01.pdf?docID=242](http://www2.pathfinder.org/site/DocServer/Technical_Guidance_Series_3_PMTCTweb_01.pdf?docID=242)
- Lenburg, C.B., 1999, 'The framework, concepts and methods of the competency outcomes and performance (COPA) model', *Online Journal of Issues in Nursing* (4)3, viewed 10 July 2010, from <http://www.nursingworld.org/MainMenuCategories/ANAMarketplace/ANAPeriodicals/OJIN/TableofContents/Volume41999/No2Sep1999/COPAModel.aspx>
- Lenburg, C. & Mitchell, C.A., 1991, 'Assessment of outcomes: The design and use of real and stimulation nursing performance examinations', *Nursing & Health Care* 12, 68–74. PMID:1996172
- Maclsaac, D. & Jackson, L., 1994, 'Assessment processes and outcomes: Portfolio construction', in L. Jackson & R.S. Caffarella (eds.), *Experiential learning: A new approach. New directions for adult and continuing education*, pp. 63–72, Jossey-Bass, San Francisco. <http://dx.doi.org/10.1002/ace.36719946205>
- McIntyre, J. & Gray, G., 2000, 'Preventing mother-to-child transmission of HIV', *Medicine* (1)1, 30–31.
- Melrose, S., 2004, 'What works? A personal account of clinical teaching strategies in nursing', *Education for Health* 17(2), 236–239. <http://dx.doi.org/10.1080/13576280410001711067>
- Mitchell, G.C., 2009, 'Adult learning and high stakes testing strategies for success', *Adult Learning* 15(3/4), 16–18.
- National Department of Health, 2007, *Saving mothers report*, National Department of Health, Pretoria.
- National Department of Health, 2010a, *Country progress report on the declaration of commitment on HIV/AIDS*, viewed 11 July 2012, from [http://data.unaids.org/pub/report/2010/southafrica\\_2010\\_country\\_progress\\_report\\_en.pdf](http://data.unaids.org/pub/report/2010/southafrica_2010_country_progress_report_en.pdf)
- National Department of Health, 2010b, *Negotiated service delivery agreement document*, National Department of Health, Pretoria.
- National Department of Health, 2011, *Prevention of mother to child HIV transmission (PMTCT) policy guidelines*, National Department of Health, Pretoria.
- Pathak, L., Kwast, B. & Mallah, D., 2000, 'Process indicators for safe motherhood programmes: the application and implications as derived from hospital data in Nepal', *Tropical Medicine & International Health* 5(12), 882–890. <http://dx.doi.org/10.1046/j.1365-3156.2000.00662.x>
- Perez, F., Mukotekwa, T., Miller, A., Orne-Gliemann, J., Glenshaw, M. & Chitsik, I. et al., 2004, 'Implementing a rural programme of prevention of mother-to-child transmission of HIV in Zimbabwe: First 18 months of experience', *Tropical Medicine and International Health* 9, 774–783. <http://dx.doi.org/10.1111/j.1365-3156.2004.01264.x>
- Quinn, F.M., 2001, *Principles and practice of nurse education*, Neson Thornes Ltd., London.
- Schmidt, B.S., 1999, 'Constructing curriculum: Creating a teaching-learning space', *Nursing Sciences Quarterly* 12(4), 297–298. <http://dx.doi.org/10.1177/08943189922107214>
- Temmerman, M., Quaghebeur, A., Mwanyumba, F. & Mandaliya, K., 2003, 'Mother-to-child HIV transmission in resource poor settings: How to improve coverage?', *AIDS* 17(8), 1239–1242. <http://dx.doi.org/10.1097/00002030-200305230-00016>
- Treatment Action Campaign, 2009, *Address by the President of the Republic of South Africa, Mr. Jacob Zuma, to the National Council of Provinces (NCOP)*, viewed n.d., from <http://www.tac.org.za/community/node/2767>
- United Nations Programme on HIV/AIDS and World Health Organization, 2009, *Integrating prevention of mother-to-child transmission of HIV into existing African health care system*, viewed 16 July 2010, from [http://data.unaids.org/pub/Report/2009/JC1700\\_Epi\\_Update\\_2009\\_en.pdf](http://data.unaids.org/pub/Report/2009/JC1700_Epi_Update_2009_en.pdf)
- Wagner, S. & Ash, K., 1998, 'Creating the teachable moment', *Journal of Nursing Education* 37, 278–280. PMID:9749819
- Welty, T.K., Bulterys, M., Welty, E.R., Tih, P.M., Ndikintum, G; Nkuoh, J. et al., 2005, 'Integrating prevention of mother-to-child transmission of HIV into routine antenatal care: the key to program expansion in Cameroon', *Journal of Acquired Immune Deficiency Syndromes* 40(4), 486–493. <http://dx.doi.org/10.1097/01.qai.0000163196.36199.89>
- White, R. & Ewan, C., 1991, *Clinical teaching in nursing*, Nelson Thomas Ltd., London, . PMID:2002672
- World Health Organization, 2010, *PMTCT strategic vision 2010–2015: Preventing mother to child transmission of HIV to research the UNGASS and Millennium Development Goals*, WHO Press, Geneva, viewed 22 July 2010, from [http://www.who.int/hiv/pub/mtct/strategic\\_vision.pdf](http://www.who.int/hiv/pub/mtct/strategic_vision.pdf)
- World Health Organization, United Nations Children Fund, United Nations Programme on HIV/AIDS & United Nations Population Fund, 2007, *HIV and infant feeding: Framework for priority action*, WHO Press, Geneva, viewed 10 May 2010, from [http://www.who.int/hiv/pub/mtct/infant\\_feeding/en/index.html](http://www.who.int/hiv/pub/mtct/infant_feeding/en/index.html)
- Wright, W.A. & Barton, B., 2001, 'Students mentoring portfolio development', in J.E. Miller, J.E. Groccia & M.S. Miller, (eds.), *Student assisted teaching: A guide to faculty student teamwork*, p. 60–76, Anker, Bolton.
- Yip, H.K., Smales, R.J., Newsome, P.R.H., Chu, F.C.S. & Chow, T.W., 2001, 'Competency-based education in a clinical course in conservative dentistry', *British Dental Journal* 191(9), 517–522. <http://dx.doi.org/10.1038/sj.bdj.4801221a>