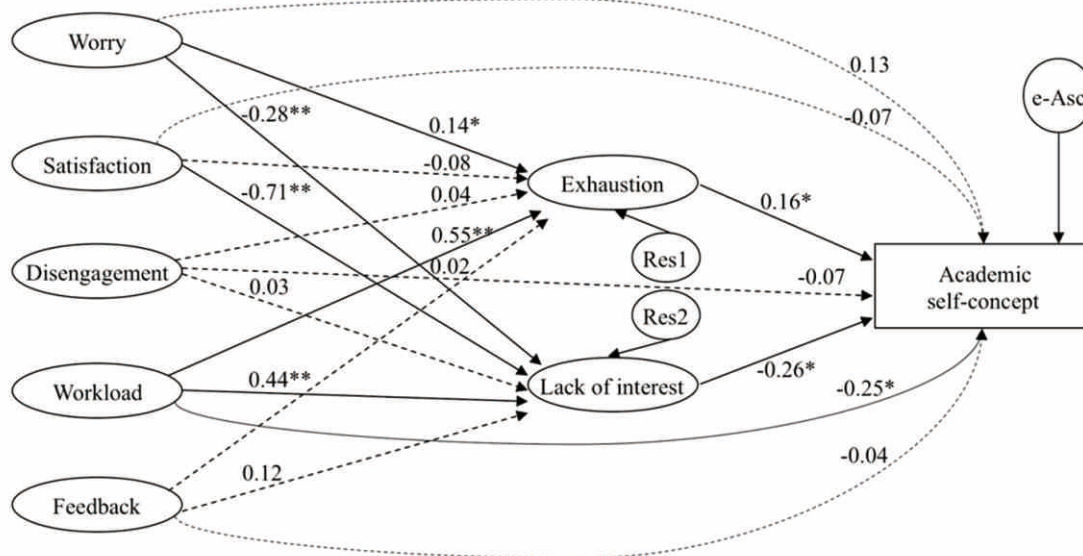Scientific
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# Creative Education

## Special Issue on Medical Education and Health Education



Only latent variables, residual errors and achievement variables are presented. Dotted lines are non-significant paths.

Res = residual; error in the prediction of endogenous factors from exogenous factors.

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# "Apprentis Chercheurs" in Drugs Disorders: A New Concept in Prevention Strategy

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## Abstract

**We report a new strategy based on scientific education for sensitizing teenagers to the addiction-related harms. This strategy is diverted from a program called "Apprentis Chercheurs". Pairs of young adolescents are welcome in research laboratories working on addiction all along the school year. They are fully integrated in the research team and directly participate to the experiments under the supervision of a senior researcher. At the end of the school year, they orally communicate their results to other students of their schools, their teachers, their parents and the research team in a peer-to-peer approach during a scientific conference organized within every participant research center.**

## Keywords

**Scientific Education, Addiction, Prevention**

## 1. Introduction

Addiction among youth, teens and pre-teens, has been a constant concern for health authorities for many years since it is now accepted that early consumption, at adolescence stage when brain tissue is still developing, is a risk factor of developing dependence in adulthood (Dewit et al., 2000; Hingson et al., 2006; Dawson et al., 2008).

The two main products consumed by young people are alcohol and cannabis. In France, the prevalence of consumption is estimated using several types of surveys: ESCAPAD (Health Survey that governs all young boys and girls between 17 and 20 years old), ESPAD (European school Survey Project on Alcohol and Other Drugs)

conducted in schools, and Health Barometer conducted on a representative sample of the general population.

According to the 2011 ESCAPAD survey (Spilka & Le Nézet, 2012), daily smoking concerned 31.5% of young people, repeated drunkenness 27.8%, and regular cannabis use 6.5%, whereas the corresponding figures in 2008 were 28.9%, 25.6% and 7.3%, respectively (Legleye et al., 2009). Data collected in the 2011 ESPAD survey (Spilka & Le Nézet, 2011), performed in more than 100 000 young people from the EU, showed the same trends when compared to the results of the 2007 survey (ESPAD, 2007).

Repeating investigations demonstrate time variations of prevalence in both decrease and increase directions. The trend between 2005 and 2008 according to the Escapad surveys was a decrease of smoking and cannabis use, associated with an increased frequency of intoxication of binge drinking. Conversely, from 2008 to 2011, smoking and binge drinking increased again while cannabis use decreased. Altogether, these data show that behaviors change quickly, and that experimentation is subject to fads and availability of products. Thus, it is difficult to predict future developments; nevertheless the results obtained so far allow emphasizing that the abandonment of a product is compensated by the attraction to another: the overall problem still remains. This suggests that preventive actions taken so far, based on various tools such as radio spots, video TV, newspapers, mini-conference within schools conducted by scientists, former drinkers, police, lawyers... are not sufficient.

In 2001, the Council of Europe has issued ten recommendations on alcohol consumption among young people, in particular children and teenagers (JOCE, 2001). Recommendation 6 stated that Member States should "increase young people's involvement in youth health-related policies and actions, making full use of the contributions which they can make, especially in the field of information, and encourage specific activities which are initiated, planned, implemented and evaluated by young people".

The MILDECA (Interministerial Mission for the Fight against Drugs and Addictive Behaviour), whose mission is to prepare the government plans to fight against drugs and drug addiction, specifically declined in the 2008-2011 plan prevention policy in schools of 1st and 2nd degrees (MILDECA, 2008). One of the main objectives is "to avoid early experiments with drugs and/or alcohol abuse and to combat attitudes that contribute to trivializing and accepting such behavior". The plan also emphasizes that reaching this aim "involves broadening the spectrum of preventive actions, traditionally confined to health education, other forms of intervention". Therefore we develop an alternate model of action.

## 2. Aims and Methods

The project is to educate young people about the dangers of addiction through scientific research based on the program "Apprentis Chercheurs" developed by the association l'Arbre des Connaissances (http://www.arbre-des-connaissances-apsr.org). Founded in 2004 by scientific researchers at the University Institute of Hematology (University Paris-Diderot), l'Arbre des Connaissances is an association whose aims are to stimulate curiosity, investigation approach and critical mind of young people. For this purpose research laboratories are asked to welcome pairs of young (one in the 4th year and one in the sixth year of high school), called the "Apprentis Chercheurs", who are tutored with senior researchers. These adolescents are trained to be critical through the experimental approach: they identify a scientific question with their tutor, plan and carry together experiences that will bring the answer. They work in the lab on Wednesday afternoon once or twice per month all along the school year. At the end of the scholar year, high school students prepare slide presentation, raising their scientific topic, questions, hypotheses and experimental results. Then, the "Apprentis Chercheurs" orally communicate their results to other students of their schools, their teachers, their parents and the research team in a peer to peer approach during a scientific conference organized within every participant research center. This formula works perfectly: since 2004, more than 1000 "Apprentis Chercheurs" were directly welcomed in 26 research centers in France, but allowing to much more pupils and family to get sensitized to scientific approach. Moreover, the association of scientists' l'Arbre des Connaissances was recognized for its work by winning the Diderot award in 2011, confirming the validity of the model.

"Apprentis Chercheurs" plan of action was initiated from the will of research scientists to open their own laboratories to generate interest in science of teenagers. Two other actions created by scientists emerged more recently in France. The program "Tous Chercheurs" proposes a model of scientific education for school students in Marseille. For three days, young pupils are welcomed in a dedicated lab in research institute, where they participate to a short research program (Hammond et al., 2010). Another action, called Science Academie was in-

itiated by researchers of Ecole Normale Supérieure in Paris of Paris Montagne association (http://www.paris-montagne.org/science-academie). It proposes to welcome high school students for 3 - 5 days in specific research laboratories or for discovery week of multi-disciplinay scientific conferences. Altogether, theses various actions allow crosstalks between science and society and permit for high school students to develop their way of thinking, useful for an active and creative citizenship.

In 2012, we decided to adapt the program "Apprentis Chercheurs" to sensitize young people to the deleterious effects of addictive drugs. According to National Research Council (National Research Council, 1996), the scientific literature contains the knowledge and the understanding of scientific concepts that are necessary for making informed decisions on personal and societal issues. In this context, our hypothesis is that performing experimentation showing the toxic potential and /or the addictive power of drugs using experimental models, either animal or not, would lead to modify their representations of the product and strengthen their awareness that the drug-related pleasure is associated with its harmfulness. Moreover, the duration of this program, all along the school year, would allow establishing a reliable link between the young and his (her) supervisor. Consequently, as the latter is a professional of the scientific research (researcher, engineer, PhD student, post-PhD student), their relationship is not be based on morality since the "Apprentis Chercheurs" share actual researches with the scientist and is not only listening the voice of the adult. The program is named MAAD, Mechanisms of Addiction to Alcohol and Drugs; in order to outspread the concept in the concerned schools and beyond we created a logo which is presented in **Figure 1**.

The MAAD program involves middle and high schools including the head masters, the teachers and the regional education authority. This is of crucial importance regarding the diffusion of the results. Indeed the "Apprentis Chercheurs" become new scientific intermediary asked to report their experience within their classes and their schools, but also within their families, and within a widened public, by being carriers of another vision of drugs.

## 3. Results and Discussion

For the first session held in 2012-2013, five expert laboratories dedicated to research on addiction (**Table 1**) agreed to participate to the MAAD program and welcomed 10 pair-workers, i.e. a total of 20 "Apprentis Chercheurs". These latter spent from 9 to 12 Wednesday afternoons in the lab according to their availability. They were completely integrated in the research team, they wear a lab coat and had their own lab book and directly participated to research programs on-going in the lab. Three programs were targeted on alcohol effect and the remaining two on cocaine (**Table 1**). "Apprentis Chercheurs" participated to and performed by themselves several experiments: implementation of dependence in animals through intra-venous self-administration (Skinner cage), behavioral experiments (rotarod, plus-maze, open-field), analysis of gene expression using polymerase chain reaction, electrophysiology with long-term potentiation (LPT) and depression (LTD) measurement, im-
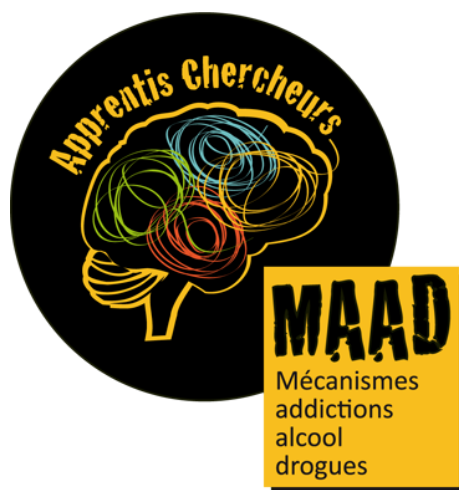


**Figure 1.** The MAAD logo.

**Table 1.** Laboratories participating to the MAAD program in 2012-2013.

| Laboratory | | | |
| --- | --- | --- | --- |
| Supervisor | Institute | Location | Title of the MAAD Program |
| M. Naassila | Inserm ERI24 | Amiens | Effect of early alcohol exposure on memory in a mice model |
| M. Baunez | CNRS UMR7289 | Marseille | Inactivation of sub-thalamic nucleus as a possible treatment of alcoholism in rats |
| M. Solinas | Inserm U1084 | Poitiers | Effect of an enriched environment on prevention of drug-dependence in rats |
| L. Lanfumey | Inserm U894 | Paris | Behavioral and brain modifications in alcohol-fed mice |
| V. Deroche | Inserm U862 | Bordeaux | Modeling drug dependence in rats and consequences on brain gene expression |

munohistochemistry... In most laboratories comparisons were done between "young" and "adult" animals. A short movie was shot in the respective labs and staged as a "NCIS[©]-like" session by a professional company (TerreTV, 2013).

At the end of the training, "Apprentis Chercheurs" were asked to present their results. For this purpose, conferences were organized in each research centers in early June 2013. Attendees were their friends, their school co-workers, their family, their teachers etc.; their number range from 70 to 100 from a center to another. Each working pair communicated their results using a slide show prepared in collaboration with the supervisor. A lecture given by a senior researcher expert in addiction completed the program. At the end of the conference, a get together party without alcoholic beverages was hold to favor discussion between all the participants. Following this conference most of the teachers organized a second presentation inside their school in order to address a general discussion on addiction with all the pupils. On the whole, around 400 pupils attended to the congress, and 200 more were present when the MAAD program was presented in the University Sorbonne in Paris during the 2013 French science week.

A second session of the MAAD program, still funded by the MILDECA, was performed in 2013-2014. Nine labs participated and 33 pupils were welcomed. They worked on alcohol, cocaine, cannabis, amphetamine and nicotine addiction in different animal models; they studied the role of genetic variant, the impact of enriched environment, the role of sub-thalamic nucleus injury, the memory defect induced by alcohol, the alteration of dopaminergic network and others topics using several sophisticated technics currently run in research labs. A movie was shot (TerreTV, 2014); conferences were held in June 2014 and about 400 adolescents attended to the congress. Moreover, each pair of Apprentice prepared a poster of their work; a specimen of each poster was send to all the schools participating to the program. They will be exhibited in the school halls in order to prompt discussion on this topic in the classroom but also within the playground.

The third session is scheduled to start in September 2014. Twelve labs will participate and 36 Apprentices will be welcomed.

Although behavior change against drug of abuse in adolescents is the ultimate end of our action, it cannot be evaluated by now. However all the Apprentices claimed that through this program they discovered that becoming addict is not only related to a psychological weakness but also to a biological sensitivity; they learned that drugs of abuse are specifically dangerous on the developing brain; finally they understand that withdrawing from an addiction is not based on the willpower only since the brain network has been injured by the drugs.

## 4. Conclusion

The MAAD program is an original way to sensitize teenagers to the addiction-related harm. Scientific education appears to be a convenient method to change the representation of drugs in adolescents.

## Acknowledgements

## Funding

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# Utilizing Service-Learning to Promote a Value Based Professional Nursing Curriculum

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## Abstract

**This article will discuss the unique way in which nursing education at one Catholic University is distinctively value-driven with a focus on the meaning of Mercy and Jesuit traditions and how these philosophies translate into professional nursing practice. An innovative approach to a value-driven education that incorporates the philosophy of the Mercy and Jesuit traditions in a professional nursing role is fostered with the teachings of Catherine McAuley and Ignatius Loyola and infused through the act of service-learning and reflection on the service-learning experience. Nursing students are educated from a perspective of historical tradition, spirituality, social justice, reflective thinking and a value-centered professional education, enriching their self-awareness toward the development of leadership behaviors. Linking the service-learning experience to nursing concepts within the Mercy and Jesuit traditions has demonstrated a deep sense of self-awareness, a high level of understanding of caring and the concept of nurses as leaders amongst the students at our university.**

## 1. Introduction

"It is not the actual physical exertion that counts toward a man's progress, nor the nature of the task, but the spirit of faith with which it is undertaken" (Faith Quotes, 2012). Students who begin the nursing curriculum directly after high school commonly have little work experience prior to starting their course of study. As faculty teaching an "introduction to professional nursing and self-awareness" class for entry level nursing students, it is

evident that many of the students are not aware of the depth of commitment that is required of them in their nursing career. Introducing service-learning at the beginning of the students' course of study allows them to interact with individuals who may be different from their own communities and backgrounds. The act of service-learning has been described as a course-based civic engagement project by students which meets community needs and is associated with reflecting on their service-learning occurrence, enriching their academic experience to ensure that they are well-equipped to fulfill the needs of their communities (Brammer & Morton, 2014). Service-learning helps students to understand vulnerable populations, diversity, community, social justice, and become more self-aware of their own attitudes and beliefs. This opens up an opportunity for students to challenge any previously held assumptions. These are lessons that become the core of their nursing curriculum as students focus on relationship-based, person-centered care. By introducing students to the concept of service-learning early in their academic career and by helping them to identify how service is tied to the mission of a Catholic university and their chosen profession, students come to understand that they are receiving a value-driven, mission-based education. In addition, the concepts of person-centered care, communication, team work and collaboration, evidenced based practices and the art of nursing are embedded throughout the course of study. The act of service-learning enriches students' understanding of these concepts by providing them with an experience that allows them to simultaneously put into practice the foundational concepts of what they learn in the classroom.

The mission statement of the School of Nursing leans heavily on the commitment to providing high quality, culturally sensitive health care services, to diverse populations in an urban context within the Mercy and Jesuit traditions. Service-learning helps students to achieve the mission by immersing them in an urban environment where they interact with vulnerable individuals, families and communities. Service-learning allows students to critically examine social issues and population diversity with an awareness of the impact that nurses can have in the community as well as within the hospital setting. An important aspect of the Mercy and Jesuit value-based, person-centered care includes spirituality and a holistic approach to each individual, inclusive of mind, body and spirit.

Incorporating spirituality into the course content emphasizes the significance of spiritual care in nursing. Throughout the introductory nursing course, didactic lectures are facilitated by the Sisters of Mercy. Nursing students are guided by faculty through the practice of reflection to increase their self-awareness and to care for themselves and each other, which is vital to their ability to provide spiritual care and to incorporate the intrinsic human dignity perspective (Connell Meehan, 2012) into their practice-central to the nursing profession. The students are taught to recognize each person's innate dignity which is paramount to the Catholic tradition and the importance of sensitivity and compassion towards the eradication of incompetent, insensitive and sometimes abusive healthcare toward the vulnerable and the sick (Connell Meehan). The purpose of this article is to present an understanding of how to incorporate service-learning within a Bachelors of Nursing Science program from the perspective of linking the experience to nursing concepts within the Mercy and Jesuit traditions.

## 2. Mercy and Jesuit Values and Founding Principles

Following in the traditions of their founder Catherine McAuley, the Sisters of Mercy are committed to serving God's people, especially the sick, poor and uneducated. Conscious of people's rights, their mission seeks to help people overcome obstacles that sometimes prevent them from living full and dignified lives (Flaherty, 2010). The Sisters are committed to both spiritual (comforting the afflicted, instructing the ignorant) and corporal (visiting the sick, welcoming the stranger) works of Mercy that embraces a multicultural and international reality. In the spirit of mercy and justice, the Sisters of Mercy carry on the work of McAuley providing for those on the margins of society (Flaherty).

The Jesuits (Society of Jesus) have been known as the "schoolmasters of Europe" for several centuries, encouraging the pursuit of knowledge in order to serve others (Jesuit Tradition, 2010). A Jesuit education seeks to challenge students to think independently, test commonly accepted knowledge and to be curious. Students are encouraged to grow personally, be responsible citizens and make sound judgments as they evolve as leaders. Students educated in the Jesuit tradition learn the importance of balance, interdependence with self-reliance and knowledge with spirituality, mind and heart.

Students educated within the Mercy and Jesuit traditions are charged with providing services with meaning and thought, based on the values of their Catholic university. Purposeful integration of course concepts such as

caring and compassion with their service-learning experience have proven to be a very valuable teaching and learning strategy. Students gain an appreciation for the art of nursing and the significance of recognizing the uniqueness of each person from a holistic perspective that encompasses mind, body and spirit. The importance of the mission and being a conscientious member of their community is integrated into the curriculum. This allows students to gain an appreciation and understanding for the founding principles of their value-driven education and informs them about the all-encompassing education that they are receiving in preparation to become citizens of the world. Albeit Catholic, the university is very student centered with a respect for the diversity of religious and cultural beliefs of the student body. Acknowledging and celebrating the uniqueness of individuals and diversity of our community is part of the values that we impart through service-learning and a mission-driven university education.

## 3. Literature Review

A collaboration of teaching and learning to enhance academic and personal growth while engaging in civic service and reflecting and examining specific outcomes of that service enhances both the quality of learning as well as the service. Service-learning facilitates learning experiences that assists students in the development of critical thinking skills with the application of what they learn in class to real-world situations. Service-learning is not a replacement for academic tuition, rather it enhances it. Students in service-learning courses report higher course satisfaction than students in non-service-learning courses. Additionally, they have been reported as having a higher academic performance (Peters, 2011).

The literature provides a plethora of evidence to support service-learning as being a powerful pedagogical approach at the college level (Amerson, 2010; Foli, Braswell, Kirkpatrick, & Lim, 2014; Fowler, 2013; Trail Ross, 2012), and an important component of nursing education (Groh, Stallwood, & Daniels, 2011). Evidence indicates that service-learning fosters students' interest in strengthening their commitment to working for social changes and pursuing socially responsible work (Seider, Gillmore, & Rabinowicz, 2012). One of the key components of The Future of Nursing document urges the nursing profession to get involved in the transformation of healthcare (Institute of Medicine, 2010). With the Affordable Care Act, the emphasis is on preventative medicine and nurses can play an essential role as coaches of healthy living. An introduction to servant leadership with service to the community helps nursing students appreciate the meaning of becoming a professional nurse and their responsibility to the public to negotiate the transformation that is occurring in the healthcare arena. The complexity of issues facing our communities, and the diversity of the individuals and families that they will be caring for are familiar encounters of their community service experience.

Students work in all capacities sharing interdisciplinary encounters with members of the community organizations that provide unyielding assistance to vulnerable populations. Faculty has noted the positive outcomes of the service-learning experience. Reluctant students soon become willing participants who empathize with the population they serve. Students have reported the interprofessional service-learning experience as making them feel more confident and competent, achieving a better cultural understanding and an increased ability to problem-solve (Matthews, Parker, & Drake, 2012).

The Metaparadigm of Nursing (Chitty & Black, 2010) and the Social Change Model (Wagner, 2006) provide the framework for the service-learning experience. The relationship between the four concepts of the Metaparadigm of Nursing: patient (person), environment, health and nursing, defines professional nursing practice. The association between these concepts can be identified in almost all conceptual models and philosophies of nursing. Concepts associated with the metaparadigm are diversity, cultural awareness (persons), community (environment), vulnerable populations, person-centered care, caring, empathy, communication, teamwork and collaboration, social justice, evidence based practice and the holistic approach (mind, body, spirit) to caring for people (nursing). Baccalaureate nursing students, even at the introductory level, are challenged to identify how these concepts are defined and work together with respect to the service-learning experience.

The Social Change Model (SCM) is founded on relationships and collaboration. It recognizes a nonhierarchical approach to leadership and encompasses the three main concepts of individual, group and community leadership values (Astin, 1996). The SCM applies to service-learning, by framing service as an *individual* leadership experience, where students gain self-awareness through reflective practice. Students become aware of their potential impact on social issues in the communities that they serve and then reflect on possible strategies they—as individuals—can do to become change agents to solve an issue.

Throughout the semester "self-awareness" is emphasized; awareness is examining one's own biases and prejudice (Amerson, 2010); for instance, students are taught to become aware of their biases and how their precon ceived judgments could affect the care they provide to their patients. An emphasis is placed on concepts such as caring, empathy and cultural awareness, communication and the holistic approach of nursing. Compassion through service—a commitment to serve and understand people's needs—is the ultimate goal of the service-learning encounter.

## 4. Teaching and Learning via Service-Learning

Many suburban students have had little exposure to the high poverty level and prevalence of vulnerable populations within an urban context. Following in the Mercy and Jesuit traditions, faculty strives to develop students who are both compassionate and competent, embracing concepts such as social justice and spirituality. The approach to service-learning encompasses Florence Nightingale's ethos to nursing education that balances the most current scientific development of the time with the spiritual development of the student. Spirit is acknowledged as being that vital or animating force in one's life—the integrating factor and the glue that holds it all together. Nursing was viewed as a "calling" where one was obligated to use one's talents and skills for others since they are gifts from God. Catherine McAuley's model of nursing called "Careful Nursing" focused on attention to the whole person-caring for the physical and emotional needs was always accompanied by sharing religious practices. The demeanor of the nurse was described as one of "contagious calmness". The nurse was to bring a sense of peace and calm to patients in the midst of their physical, emotional and spiritual distress (Meehan, 2012). The essence of spiritual care-giving is the capacity to enter into the world of others and respond with feeling. The message is clear: serve with a caring and compassionate approach.

The pedagogical method employed in the service-learning class begins with thought-provoking exercises. The students are invited to participate in an exercise of "deep listening" where they sit quiet, ask for the light, then reflect on how they feel about a situation or person for that day. Students are asked to listen deeply to what their inner light is telling them and to choose what they will take from the experience as well as what they could change. The exercise transcends diverse spiritual philosophies of most nurses with the belief that spiritual experiences can be captured during times of silence (Connell Meehan, 2012). Exercises such as this, helps students recognize their own thoughts, beliefs, and previously held assumptions. Following the though-provoking exercise, students go on to partake in the act of service.

Students in this introductory nursing course are required to complete six hours of service within a small group. A list of service-learning sites is carefully selected by the faculty, so that students can gain experience with a variety of social issues. Students are allowed to choose their own site with faculty guidance. The selection of sites is intentional, so that predictable experiences can be orchestrated by the professors to meet the objectives of the course. The chosen sites allow students to interact with individuals who may be vulnerable, marginalized or disenfranchised. The course faculty strives to make sure students are exposed to people in need across racial and social strata, as a result of various societal issues and personal choices.

The act of serving exposes students to social situations that require them to examine strategies toward improving the current state of social inequity. The issue of social justice is presented early in their course of study. Students, not previously exposed to healthcare inequity, often experience it first hand at their service-learning site. Exposure to service sites such as soup kitchens, boys and girls clubs, nursing homes, food banks and teen pregnancy centers are some of the sites served. Students' experiences at these sites supports Catholic social teaching within the Jesuit traditions that seeks to instill in them a sense of solidarity with one another (White, 2012) where learning encompasses contact with the real world rather than learning solely through concepts introduced within the classroom setting.

Students are required to work in groups. Early in the course, students are educated about "group dynamics" and the "stages of team development" that prepares them for the interdisciplinary approach to caring for patients. They are encouraged to take ownership of the service-learning arrangements within their group to enable them to develop some organizational and time management skills. Group dynamics can be challenging and the students are charged with developing problem-solving skills for issues that may arise. Faculty purposely step back to allow students to solve their own group dynamics, intervening only when necessary.

Before and after conducting their service, students are required to individually reflect on both their expectations and the realities of their experience. Reflection (Spiritual Exercise) was practiced by Saint Ignatius, with

the concept that the reasoning for one self brings about a better understanding or a transformation of the self (Sluhovsky, 2013). Emulating the concept of spiritual exercise, students are required to reflect on their service to deepen the service-learning experience beyond being a mere task. There are many meaningful and challenging reflection activities, for instance: 1) inquiring what the student might expect to be the benefit of the service-learning experience; 2) querying what strategies would benefit the population served; 3) describing a challenging event; 4) indicating why this learning experience is significant (Jesuit Tradition, 2010). An effective approach for enhancing reflection is based on four "C" core elements—the "Four C's" criteria (continuous, connected, challenging and contextualized). The aim is to "challenge" the student to think in new ways on a more philosophical level by inquiring about their perceptions and impressions of their experiences as they are asked to identify relevant concepts (contextual) relating to their service-learning. Ongoing (continuous) reflection throughout the duration of the course provides students the opportunity to link abstract new nursing concepts via hands on experience with real life issues (connected) (Peters, 2011). The guided reflections have been beneficial in transforming the novice thinking of entry-level nursing students, to becoming introspective and more self-aware of their own values, beliefs and biases.

After the students conduct their service, they are charged with presenting their service-learning experience in class. Freedom of expression is encouraged—tapping into their group members' artistic and creative talents can make this endeavor interesting and exciting rather than just another assignment. Suggestions are provided for the final group presentation and include presenting through poetry, either writing a poem or citing a current poem and describing the association of service-learning and nursing concepts to the poem; creating a picture (students are encouraged to think about using shadows) to illustrate the association; designing a box with key values or dimensions labeled on the outside and inside have slips of paper that reflect the service-learning experience (caring, compassion, advocacy for instance)—team members can draw out a slip of paper and briefly talk about that concept; act out a scenario of significance that occurred during their service; make an art piece, for example a dream catcher that represents key learning; weave a piece of fabric to illustrate connections; music; creative writing; stained glass, or a poster board presentation are all encouraged. The presentations are moderated by faculty to further emphasize the course concepts outlined in the course objectives and assist the students to understand that service to others is the bases for their chosen profession. The applicable course objectives include describing concepts of 1) person-centered care; 2) communication; 3) teamwork and collaboration; 4) diversity; 5) the art of nursing.

Some students become overwhelmed with emotion when presenting their experience; mainly because they may have been exposed to a social issue that they have never confronted, or because they are so appreciative for the opportunity to dispel their own long-held preconceived notions. The process by which students can openly share their previous biases and identify that perhaps their judgments were not warranted, is transformational, both for the individual and the class at large. By applying their thoughts about "the person" and what the individual was experiencing at that time and place in their lives that they required assistance, it becomes evident that students are compelled to a deeper understanding of the importance of individualizing each human being and what it means to really care.

Throughout the semester "self-awareness" is emphasized. Students are taught about biases and how their preconceived judgments could affect how they care for their patients. An emphasis is placed on concepts such as caring, empathy, cultural awareness, communication and the holistic approach to nursing. Nursing faculty utilized practice-based experiences to generate lively dialogue and stimulate discussions related to class content.

The mission of the university is to be Catholic, Mercy, and Jesuit; urban and student-centered. Service-learning is introduced as a means of enhancing academic content as well as benefiting the community with an altruistic approach that reflects the Catholic tradition for the common good of the world community. The Sisters of Mercy align the meaning of service for the students in the introductory nursing class by reinforcing and embracing the mission of the university that seeks to integrate the spiritual development of their students.

## 5. The Service-Learning Experience

The aim of the service-learning experience is embedded in real-world scenarios that students are encouraged to critically evaluate. Critical self-reflection allows nurses to develop and cultivate a caring mindset—the start of a great foundation for nursing care (Vanlaere & Gastmans, 2007). Included in the Jesuit traditions are the notions of reflection and curiosity which are more commonly referred to in the nursing field as critical thinking. Critical

thinkers decide what to believe or do, which requires the use of reflection, inquisitiveness, open-mindedness, flexibility, clarity, judgment and honesty in facing personal biases, to make rationale, well-informed decisions. Critical thinkers are willing to reconsider, provide order to complex matters and are diligent in seeking pertinent answers (An & Yoo, 2008). Care-giving has become very complex and new nurses must learn how to think critically within mentally appropriate structures that provide them with processes to work within (Bryon, de Casterlé, Gastmans, Steeman, & Milisen, 2008). By lecturing on a subject and exposing nursing students to service-learning, the idea of critical thinking that bridges the gap between theory and practice for the new nurse, is emphasized. The act of service and reflection has proven to be an effective strategy in taking students' learning from levels of identification and application to the higher levels of analysis and evaluation (Ash et al., 2005) as identified in Bloom's Taxonomy (Brewer & Brewer, 2010).

Social interaction opportunities manifest with students serving meals to culturally diverse and often economically depressed people. The complexity of some vulnerable populations requires flexibility and balance. Students have reported on confliction of values and reliance on the ethical principles of justice and utilitarianism, where utilities are maximized for the good of all. An example was when a homeless man wanted more than one sandwich with his soup. The student wanted to give him extra; however the ethical principle of justice was conflicted by the necessary structure of the soup kitchen where only one sandwich per guest was allowed so that there would be enough food to go around. Situations like this provide opportunity for students to evaluate ethical dilemmas. Students frequently report changes in their attitude toward the disadvantaged they served. One student realized his bias toward single pregnant teenagers and young women, indicating the service-learning experience in a home for unwed mothers changed his opinions when he encountered a pregnant rape victim.

At the end of the course, students provide feedback in a faculty prepared questionnaire. Students' feedback related directly to the course objectives for instance, self-awareness: "I got comfortable with mentally disabled people… being aware of other's needs and being self-aware and how that can help me in patient care"; "service-learning made me more aware about myself, such as my own biases, stereotypes and things I would like to change"; "I learned that everyone deserves help, no matter what color or race they are"; and compassion: "I feel that I gained a lot of compassion, empathy and patience during my time at Angles Place".

## 6. Nurses as Leaders

Nurses are being called upon to become transformational leaders (Institute of Medicine, 2010). Baccalaureate level nurses who demonstrate leadership behaviors are sought after by institutions pursuing Magnet recognition– a designation of excellence denoting a progressive organization that values nurses' decision-making and health care driver capabilities (Foli et al., 2014). The nursing literature describes community participation associated with reflection, as an integral pedagogical approach for the development of leadership behaviors (Foli et al.). The transformational leader is described as being charismatic, self-confident and a visionary who recognizes the strengths and talents of their followers and motivates and encourages them to work to their full potential (Northouse, 2013). Students who have participated in service-learning have described concepts of encouragement and motivation: "I learned to inspire and let the kids know we are all connected in some way to help each other". They also benefitted from teamwork that is essential in nursing practice: "we learned teamwork; working together."

Reflecting on their experiences in their service-learning sites, students write about the happenings of the event, but also a vast array of human characteristics and interactions they have observed within some organizations. Homogeneity is the enemy of truth (Porter O'Grady & Mallock, 2011) and the aim is to expose the students to diverse cultural experiences and situations, sometimes quite shocking to them; nevertheless, students' feedback indicated service-learning as a highly impressionable experience that achieved the objective of increasing self-awareness toward leadership behaviors: "I proved to myself that I am a natural leader and can handle dealing with different types of people" and "I believe the experience aided me in my true calling to serve others". Teaching students to approach each individual from a holistic perspective and having sensitivity to their needs, will in turn benefit families and communities they will serve as professional nurses.

## 7. Conclusion

Service-learning is a teaching pedagogy that can greatly enhance the learning experience for the student who benefits from an experiential immersion. This paper introduced one way in which service-learning can be operationalized by developing students' ability to relate classroom content to real-life scenarios. Both the Mercy and

Jesuit ideals provide a framework for reflection—it is within that reflection that students become more self-aware, which will provide them with a solid foundation to become future leaders of change within the health care arena. Service-learning has proven to be very beneficial to introductory nursing students from many perspectives, most importantly, they become more sensitive to the needs of others and go on to serve the most vulnerable of our society with empathy and compassion.

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◆◆ Scientific
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# Medical Students' Perceptions of Their Learning Environment, Well-Being and Academic Self-Concept

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## Abstract

This study investigated medical students' perceptions of their learning environment and how these related to well-being in terms of experienced exhaustion and losing interest in personal studies. The goal was to also examine whether students' perceptions and experiences of well-being related to their academic self-concept. Experiences were compared between lecture-based learning (LBL) and problem-based learning (PBL) environments. The MED NORD questionnaire was used to measure students' experiences of their learning environment, experienced well-being (i.e. exhaustion and lack of interest) and academic self-concept. A total of 610 students participated. Structural equation modelling was used to investigate relationships between the variables under study. A cross-sectional design was used to compare experiences between different medical schools. Worry about future workload was found to positively relate to exhaustion, whereas worry and study satisfaction both negatively related to lack of interest. Experienced high workload related to both exhaustion and lack of interest. In turn, lack of interest was negatively related to academic self-concept, whereas exhaustion was positively related to it. PBL students reported higher levels of worry concerning future workloads, but they also experienced receiving more feedback. In addition, novice PBL students experienced higher levels of exhaustion and better academic self-concept than LBL students. No such differences were found between students in the clinical phase. Lack of interest concerning personal studies appeared to be more unfavourable than experiences of exhaustion, because the former was related to low academic self-concept. The PBL environment appeared challenging, but only during the first years of study.

## Keywords

**Problem Based Learning, Undergraduate Medical Education, Structural Equation Modelling,**

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**Student Perception, Well-Being**

## 1. Introduction

The purpose of medical education is to offer students an empowering and engaging environment to practice their skills of advocating health and caring for the sick (WFME, 2003). Medical students enter medical school aiming to learn the skills required for being a doctor, and they are equipped with competencies they have acquired during their secondary education. In medical school, the aim to learn a doctor's skill set and previously acquired competencies are confronted with new academic demands.

The perceived learning environment, when defined not only as the physical setting of the medical school, but also as its social norms, atmosphere, and characteristics, has implications for students' well-being and study success (Genn, 2001). For example, dissatisfaction with the learning environment, high workload and insufficient feedback are associated with problems with well-being (Dahlin et al., 2010; Dyrbye et al., 2009; Salanova et al., 2010). On the other hand, satisfaction with the learning environment and support from peers and senior doctors helps medical students in achieving a higher academic performance and protects them from stress (Abdulghani et al., 2014; Tyssen et al., 2005) and exhaustion (Dahlin et al., 2010). However as Dyrbye et al. (2009) conclude, additional research is needed to determine how to create a learning environment that cultivates students' professional development while minimizing problems with their well-being. In this study we studied perceptions of the learning environment with five constructs: 1) Worry about future workload, i.e. how the student sees his future occupation; 2) Satisfaction with the learning environment, i.e. whether the student feels being in the right place; 3) Disengagement, i.e. an experience of a poor learning climate; 4) Workload, i.e. the experienced pace of one's studies; and 5) Feedback, i.e. encouragement and feedback from teachers.

### 1.1. Students' Well-Being during Medical Education: Exhaustion and Lack of Interest

Medical students seem to have a higher level of engagement in their studies than students of other fields (Salmela-Aro & Kunttu, 2010), which may be due to the strict selection procedures in medical schools and the highly complex nature of the field. On the other hand, as a learning environment, medical education seems to be a demanding and overwhelming experience for many students. Compared to the general population, medical students experience higher levels of psychological distress (Benbassat, 2014; Dyrbye et al., 2006). While some amount of stress is desirable as a sign of study commitment (Kember & Leung, 2006), high distress levels during personal studies are related to poor academic performance (Stewart et al., 1999) and declining empathy (Thomas et al., 2007). However, as long as the student is deeply interested in medicine, this appeal may keep him or her motivated despite the experienced distress. Particularly detrimental is losing interest in studying, which is often associated with lower grades and slower study progress (Mäkinen et al., 2004), and to considerations of interrupting scientific studies among Ph.D. students (Stubb et al., 2012). Diminished interest reflects an increasingly cynical attitude towards studying and losing the general meaning of the subject matter. Such an attitude combined with feelings of exhaustion may result in burnout, which develops over a long period of time. Burnout is prevalent among physicians in working life (Shanafelt et al., 2003), and its' consequences are severe (Taris, 2006). Although burnout has not been frequently reported among medical school students (Dyrbye et al., 2006), the risk factors (i.e. diminished interest and feelings of exhaustion) may arise during medical education and its' development may already begin during this phase (Dahlin et al., 2010; Krakowski, 1982; Wolf et al., 1989). The risk factors of burnout manifest themselves during education as having a cynical, detached, and uninterested attitude toward one's studies and feeling exhausted because of the study demands.

### 1.2. Academic Self-Concept

Academic self-concept is characterized as how a student perceives his/her personal academic ability. Academic self-concept is formed through experiences with the learning environment and is heavily dependent on the social comparison of self to others as a frame of reference (Bong & Skaalvik, 2003; Marsh, 1987). Academic self-concept, in addition to performance, may suffer due to exhaustion and lack of interest. Academic self-concept is re-

lated to both actual achievement (Hansford & Hattie, 1982; Ma & Kishor, 1997) and well-being (Skaalvik & Rankin, 1995; Skaalvik, 1997). Medical schools are high-ability environments with a highly selected student population. Obtaining a weak sense of academic accomplishment in comparison to other medical students can be a particularly stressful experience in the context of medical education.

## 1.3. Problem-Based and Lecture-Based Learning

In medical schools, two instructional formats are commonly used, namely traditional, lecture-based instruction (LBL) or problem-based learning (PBL). PBL is characterized by small groups working on open-ended problems, which simulate real-life clinical cases. PBL effects on students' knowledge and skills seem positive when compared to conventional, lecture-based instruction (Schmidt et al., 2009). On the other hand, PBL requires self-directed learning skills, which some students may not yet possess when entering medical school.

But does PBL have effects on students' well-being? No differences have been found on measures of depression between PBL and non-PBL students (Camp et al., 1994). During the first two years of medical school, however, PBL has been associated with uncertainty about faculty expectations and appropriate study behaviours, unclear curricular demands, and concerns with assessment (Lewis et al., 2009; Moffat et al., 2004). On the other hand, PBL students have been found to be more satisfied with their learning environment and study conditions, and they reported receiving more feedback from teachers when compared to a traditional curriculum (Kiessling et al., 2004). Nevertheless, perceptions of the learning environment seem to change over time (Loyens et al., 2009), but research on how they change in a PBL environment among medical students is scarce. The present study tried to fill this gap by comparing students' well-being in both LBL and PBL environments, taking into account different phases of the medical education program (i.e., preclinical and clinical).

## 1.4. The Present Study

The first goal of our study was to investigate medical students' perceptions of their learning environment (i.e., worry about future workload, satisfaction, disengagement, workload, and feedback), how these relate to students' well-being (i.e., exhaustion and lack of interest) among medical students, and how these, in turn, relate to students' academic self-concept. Hence, our first research question was: How are students' perceptions of the learning environment, students' well-being, and their academic self-concept related? A structural equation model with exhaustion and lack of interest as mediators between the perceptions of the learning environment and academic self-concept was constructed. Academic self-concept, as being a comparison of personal capabilities in relation to other students reflects the perception of self in the educational environment. It is a result of the fit between the learner and the learning environment, and was chosen as the dependent variable in the model. Furthermore, it is tested whether exhaustion and lack of interest operate as mediating variables between perceptions of the learning environment and academic self-concept. Before testing the hypothesized model, we first conducted a confirmatory factor analysis (CFA) to assure the suitability of the used MED NORD (Lonka et al., 2008) questionnaire.

Based on previous research (Dahlin et al., 2010), we hypothesized that the perception of worry would positively relate to exhaustion while satisfaction with the learning environment would negatively relate to it. In addition, we hypothesized that lack of interest would negatively relate to academic self-concept, since previous research has established this relationship (Skaalvik, 1997).

The second goal of our study was to compare students' perceptions of their learning environment, exhaustion, lack of interest, and academic self-concept in PBL and LBL curricula and during different phases of medical education (pre-clinical and post-clinical phases). As mentioned earlier, effects of PBL on students' well-being are not unequivocal, since both uncertainty and satisfaction with the learning environment have been reported in earlier research. However, the phase of the program a student is enrolled in, also comes into play in this respect (e.g. Loyens et al., 2009). Therefore, our second research question was: Do students' perceptions of the learning environment, well-being (i.e., exhaustion and lack of interest), and academic self-concept differ in PBL and LBL curricula and in the pre-clinical versus clinical phase of the program? Based on previous research (Kiessling et al., 2004; Lewis et al., 2009; Moffat et al., 2004), we hypothesized that novice students report more workload and exhaustion in the PBL environment. On the other hand, we also anticipated that students in the PBL environment report to receive more feedback, as a perception of their learning environment.

## 2. Methods

### 2.1. Participants and Procedure

Participants were 610 medical students (69% male, 31% female) from three medical faculties in Finland. The mean age was 23.2 years (SD = 3.1). Because the study language is Finnish, the participants were ethnically a homogenous group. The first (n = 194) and second medical school (n = 240) have a lecture-based (LBL) curriculum. Of the students in the LBL medical schools, 251 were in the pre-clinical phase of their studies (1st and 2nd year of the programme) and 183 in their clinical phase (3rd to 6th year of the programme). The third medical faculty (n = 176, pre-clinical n = 90, clinical n = 86) had a PBL curriculum.

Data for this study were gathered using the MED NORD (Lonka et al., 2008) questionnaire, which was mailed to those students as stated as studying for first or fourth year at the medical faculty. They were informed that the materials concerned a study on student views of learning and studying. The questionnaire included 133 items and a background section, and took approximately 30 minutes to complete. Participation was voluntary and responses were analysed anonymously. Of the 735 students who received the questionnaire, 610 returned it (i.e. a response rate of 83%). The students were informed that those who returned the questionnaire would receive a movie ticket voucher as a reward.

### 2.2. The Learning Environments in Which the Study Took Place

Entry to medical education in Finland is through an entrance examination. From those who take part in the examination about 10% to 15% get in and therefore the students constitute a highly selected group. Medical education in Finland is 6 years in duration. The first two years focus on preclinical phase and topics about normal development and thereafter the focus is on clinical medicine and patient cases. Data for this study were gathered in three of the five medical schools in Finland. The curriculum in the first lecture based medical school is built around periods, which have a particular theme and in the end of each period students take part in an exam or other evaluation method. Teaching methods comprise of lectures, laboratory work, demonstrations and eLearning. The second lecture based medical school has a traditional school like curriculum with lectures and laboratory work, and an emphasis in working in hospitals and health centres. In addition to exams, evaluation is done through portfolios. The third problem-based medical school applies the approach of seven steps (i.e., Seven Jump, Schmidt, 1983): 1) Clarify terms and concepts; 2) Define the problem; 3) Analyse the problem; 4) Draw a systematic inventory of explanations; 5) Formulate learning objectives; 6) Collect additional information; 7) Synthesize and test the acquired information. Evaluation is done mostly through logbooks, self-evaluations, and exams.

### 2.3. Materials

The MED NORD (Lonka et al., 2008) questionnaire was designed to measure several aspects related to student well-being and perceptions of the learning environment. Our study focused on a particular section of the MED NORD, namely a brief version of the Higher Education Stress Inventory (HESI), designed to capture a variety of stressful aspects and other conditions of the learning environment and that can be applied to different higher educational settings (Dahlin, 2007).

The MED NORD includes five HESI scales, which consist of a total of 18 items (Dahlin et al., 2005): *disengagement* (e.g. "Education produces anonymity and isolation among students"), *receiving feedback* (e.g. "Teachers give feedback on students' knowledge and competence"), *workload* (e.g. "Course literature is too difficult and extensive"), *worry* (e.g. "I am worried about being able to master the pool of knowledge required in my future profession") and *satisfaction* (e.g. "Teachers treat me with respect"). Two HESI scales, *low commitment* and *financial concerns,* were not included in the MED NORD. All items were rated on a 4-point Likert scale ranging from 1 (not true at all) to 4 (very true).

Participants' experiences of exhaustion and lack of interest were also included additionally to the HESI scales. *Exhaustion* (e.g. "I feel I am studying too hard") was measured by four items that were taken from occupational health research and modified to fit higher education studies (Maslach & Jackson, 1981). *Lack of interest* (e.g. "The contents of my studies do not interest me") was measured by two items (Mäkinen et al., 2004). The *exhaustion* and *lack of interest* items were measured on a 5-point Likert scale ranging from 1 (not true at all to 5 (very true).

Finally, *academic self-concept* was measured by asking participants to position themselves compared to their peer students. Respondents were asked to indicate whether their typical grade was worse than the average grade of their class, approximately the same as the average of their class, or better than average. These were coded as 1, 2 and 3, respectively. In a previous study with a similar non-medical student sample, the correlation between this item and actual GPA was 0.63 (Nieminen, 2011).

## 2.4. Analyses

Before running the analyses, data were screened for missing values and each item was checked for normality. Missing value analysis revealed that one item belonging to the subscale *disengagement*, (i.e. "I am being less well treated because of my ethnic background") had 208 missing values (31.7%). The distribution was also highly skewed towards disagreeing with the statement (M = 1.15, SD = 0.44). Students in Finnish medical schools have a rather similar ethnic background and participants probably did not experience the question as relevant to them. This item was therefore deleted from further analyses. Those participants who had not answered the item about academic self-concept (n = 28), were dropped out. One other item (i.e. "My personal values are in conflict with the professional role mediated by the education") had eight missing values (1.1%), while all other items had four (0.7%) missing values or less. Missing values n = 25 (0.2% of all values) were replaced using the EM method in SPSS.

After data screening, a confirmatory factor analysis was used to validate the hypothesised survey structure of the MED NORD. The reliability of the latent constructs was assessed using coefficient H (Hancock & Mueller, 2001) and descriptive statistics were calculated. After these preliminary analyses, a model was estimated using structural equation modelling (SEM) to investigate the relationships between student perceptions of the learning environment, well-being (i.e. lack of interest and exhaustion) and academic self-concept. Experience differences between PBL and non-PBL students were finally analysed with a multivariate analysis of variance (MANOVA).

For the CFA and SEM, four different fit indices were used: the conventional $\chi^2$, the Comparative Fit Index (CFI) (Bentler, 1990), the Tucker-Lewis Index (TLI) (Tucker & Lewis, 1973) and the Root Mean Square Error of Approximation (RMSEA) (Browne & Cudeck, 1993), as suggested by Schreiber et al. (Schreiber et al., 2006). For the $\chi^2$, a non-significant result indicates a good model fit. However, $\chi^2$ is affected by sample size and is very restrictive. A ratio of $\chi^2$ and the accompanying degrees of freedom is therefore used. A ratio of 3 or less indicates a suitable fit. The CFI and TLI range from 0 to 1, with higher values indicating a better fit. Values greater than 0.90 are associated with an acceptable fit and values are greater than 0.95 with a well-fitting model. RMSEA values of 0.05 or less indicate a good fit, whereas values smaller than 0.08 are still indicative of an acceptable fit. Values greater than 0.10 should lead to model rejection (Browne & Cudeck, 1993). The RMSEA was reported with 90% confidence intervals.

Finally, $\Delta\chi^2$ tests were used to evaluate the three-level structure (i.e., the mediating role of lack of interest and exhaustion). Alternative hierarchical models were constructed without direct paths between the HESI scales and academic self-concept. The $\Delta\chi^2$ statistic reflects the difference between the $\chi^2$ values of the two hierarchical models, its degrees of freedom equals the difference in the two models' degrees of freedom. A non-significant value of $\Delta\chi^2$ suggests that the overall fits of the two models are similar. With respect to the mediating, regulation variables, this implies that a completely mediated relation between students' conceptions and processing strategies by regulation activities is supported. A significant value of $\Delta\chi^2$ supports retention of the direct paths and therefore implies a partially mediated relationship between the perceptions of the learning environment and academic self-concept level by exhaustion and lack of interest (Kline, 2005).

After the SEM analysis, differences between the LBL and PBL programs were investigated using a MANOVA analysis. Data were analysed using a two-way MANOVA, with two medical schools (LBL and PBL) and study phases (pre-clinical and clinical) as independent between-subject factors, and disengagement, feedback, workload, worry, satisfaction, exhaustion, lack of interest and academic self-concept as dependent variables. Following Cohen (1988), partial $\eta^2$ = 0.01 was interpreted as small, partial $\eta^2$ = 0.06 as medium, and partial $\eta^2$ = 0.14 as large effect size. The CFA and SEM analyses were conducted using AMOS 18.0 and all other analyses were performed using SPSS 18.0.

## 3. Results

Table 1 reports the descriptive statistics of the five HESI scales measuring perceptions of the learning environ-

**Table 1.** Descriptive statistics, Coefficient H and Pearson correlations for the study variables (n = 610).

| Variable | Descriptive Statistics | | | | |
|---|---|---|---|---|---|
| | Scale | Mean | SD | Items, n | Coefficient H |
| 1 Worry | 1 - 4 | 2.79 | 0.75 | 3 | 0.78 |
| 2 Satisfaction | 1 - 4 | 3.37 | 0.38 | 5 | 0.66 |
| 3 Disengagement | 1 - 4 | 1.69 | 0.48 | 5 | 0.64 |
| 4 Workload | 1 - 4 | 2.12 | 0.68 | 2 | 0.65 |
| 5 Feedback | 1 - 4 | 1.99 | 0.63 | 2 | 0.89 |
| 6 Exhaustion | 1 - 5 | 2.61 | 0.87 | 4 | 0.87 |
| 7 Lack of Interest | 1 - 5 | 1.80 | 0.84 | 2 | 0.71 |
| 8 Academic Self-Concept | 1 - 3 | 2.12 | 0.67 | 1 | |

| Variable | Correlations | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| 1 Worry | | −0.23[*] | 0.19[*] | 0.33[*] | −0.12[*] | 0.35[*] | 0.11[*] | 0.02 |
| 2 Satisfaction | | | −0.34[*] | −0.18[*] | 0.25[*] | −0.17[*] | −0.38[*] | 0.09 |
| 3 Disengagement | | | | 0.23[*] | −0.12[*] | 0.20[*] | 0.28[*] | −0.12 |
| 4 Workload | | | | | −0.12[*] | 0.46[*] | 0.32[*] | −0.18[*] |
| 5 Feedback | | | | | | −0.12[*] | −0.10[*] | −0.01 |
| 6 Exhaustion | | | | | | | 0.27[*] | −0.03 |
| 7 Lack of Interest | | | | | | | | −0.24[*] |
| 8 Academic Self-Concept | | | | | | | | |

[*]Correlation is significant at the 0.01 level.

ment (i.e. worry, satisfaction, disengagement, workload and feedback) together with lack of interest and academic self-concept. The scores were highest concerning satisfaction with the learning environment, and also rather high concerning worry and workload. This implies that students were mostly satisfied with their learning environment, but they were also somewhat worried about their future competence and experienced high workload. Furthermore, their reported exhaustion scores were higher than their lack of interest scores, but both scales indicated quite healthy measures in general. High levels of lack of interest were quite rare.

Correlations between the seven variables are also displayed in **Table 1**. Satisfaction was related to lower levels of worry concerning future competence, disengagement, experienced workload, exhaustion and lack of interest. Furthermore, the more students reported disengagement, the more they experienced worry, workload, exhaustion and lack of interest. Workload was also related to higher levels of worry, exhaustion and lack of interest, and to lower levels of received feedback. Exhaustion and lack of interest also correlated positively with each other. Academic self-concept had negative correlations with both lack of interest and workload.

The reliability of the seven latent constructs was assessed using coefficient H (Hancock & Mueller, 2001), which measures the degree of replicability of a construct based on its measured indicators. The cut off value of 0.70 has been used for a good reliability. As can be seen in **Table 1**, construct reliability values ranged from 0.64 to 0.89, reflecting acceptable construct reliability.

Confirmatory factor analysis demonstrated that HESI factor structure appeared adequate. The chi-square statistic was statistically significant ($\chi^2$ [109, n = 610] = 275.1, $p < 0.001$), but the ratio was smaller than 3.0 (i.e. 2.5). Furthermore, results showed a CFI of 0.90, TLI of 0.87 and a RMSEA of 0.050 (90% CI: 0.043 - 0.057). Therefore, the HESI factorial structure was considered adequate.

Preceding the MANOVA-analysis, the data were screened for independence of observations, normality and homogeneity of the covariances. The observations were independent because each student filled out the questionnaire independently of the others. All dependent measures met the normality criterion. Box's test of equality of covariance matrices was significant (Box's M = 148.8, $p$ = 0.011), but as noted by Tabachnick & Fidell (2007) the test is highly sensitive and covariances can be treated as equal unless $p$ level is below $p < 0.001$. We therefore concluded that the assumption of equal covariances was met.

## 3.1. Relationships between Perceptions of the Learning Environment, Lack of Interest, Exhaustion, and Academic Self-Concept

After confirming the factor structure of the HESI scales measuring students' perceptions of their learning environment, a structural equation model was used to test the relationships between these perceptions with lack of interest, exhaustion, and academic self-concept. As presented in **Figure 1**, the model tested whether exhaustion and lack of interest mediated the relationship between perceptions of the learning environment and academic self-concept. Academic self-concept reflected the perception of self in the educational environment. As a result of the fit between the learner and the learning environment, it was chosen as the dependent variable in the model. Only students who had answered the item about academic self-concept (n = 582) were included in the analysis. The model yielded a reasonable fit. The chi-square test was statistically significant ($\chi^2$ [226, n = 582] = 516.9, $p < 0.001$), but the ratio was smaller than 3.0 (i.e. 2.3). Results furthermore showed a CFI of 0.91, a TLI of 0.89 and a RMSEA of 0.047 (90% CI: 0.042 - 0.052).

The results of the structural model are summarised in **Figure 1**. Worry and even more strongly, workload were positively significantly related to exhaustion. Worry and satisfaction were negatively related to lack of interest, whereas workload was positively related to it. Regarding any learning environment perceptions, only workload was related to academic self-concept. Exhaustion was positively, and lack of interest negatively related to academic self-concept.

Finally, a model without direct paths from students' perceptions to academic self-concept was compared with the hypothesized model as suggested by **Figure 1**. This was done to examine whether relations between students' perceptions of the learning environment and the academic self-concept are completely mediated by exhaustion and lack of interest. This alternative model was identical to the model in **Figure 1**, but it did not assume direct paths from the perceptions directly to academic self-concept. This alternative model resulted in a model with 231 degrees of freedom. The value of $\Delta\chi^2$ (df = 5) = 15.94, was significant at the .01 level, assuming partial mediation. In other words, adding direct relations between conceptions and processing variables lead to a better explanation of the data compared to complete mediation. Therefore, relations between perceptions of the learn-
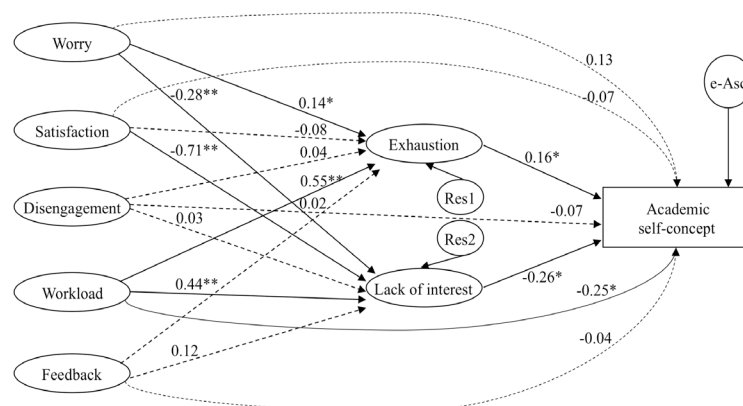


Only latent variables, residual errors and achievement variables are presented. Dotted lines are non-significant paths.

Res = residual; error in the prediction of endogenous factors from exogenous factors.

**Figure 1.** Parameter estimates (standardized regression coefficients) for the structural equation model of the linear relationships between students' perceptions of the learning environment, exhaustion, lack of interest and academic self-concept (n = 582).

ing environment and the academic self-concept are only partially mediated by students' exhaustion and lack of interest.

## 3.2. Comparing LBL and PBL Curricula

Results of the MANOVA showed significant differences on the dependent measures between the lecture-based and problem-based curricula [Wilks's $\Lambda$ = 0.93, F(8, 571) = 5.19, $p < 0.001$, $p\,\eta_p^2$ = 0.068] as well as between different programme years [Wilks's $\Lambda$ = 0.92, F(8, 571) = 6.65, $p < 0.001$, $p\,\eta_p^2$ = 0.085]. The interaction effect of the two independent variables was also significant [Wilks's $\Lambda$ = 0.97, $F$(8, 571) = 2.43, $p$ = 0.014, $\eta_p^2$ = 0.033].

Univariate results showed significant differences between the different curricula. PBL students experienced more worry [F(1) = 5.39, $p$ = 0.021, $\eta^2$ = 0.009; MD PBL − LBL = 0.17], receiving more feedback [F(1) = 6.96, $p$ = 0.009, $\eta_p^2$ = 0.012; MD PBL − LBL = 0.15], more exhaustion [F(1) = 8.45 , $p$ = 0.004, $\eta^2$ = 0.014; MD PBL − LBL = 0.24] and higher levels of academic self-concept [F(1) = 6.08, $p$ = 0.014, $\eta_p^2$ = 0.010; MD PBL − LBL = 0.15].

Differences concerning satisfaction and workload also existed between the pre-clinical phase and clinical phase of students' study. Students in the pre-clinical phase reported more satisfaction [F(1) = 11.95, $p$ = 0.001, $\eta^2$ = 0.020; MD PreCl − PostCl = 0.12] and more workload [F(1) = 13.74, $p < 0.001$, $\eta^2$ = 0.023; MD PreCl − PostCl = 0.18].

The interaction effect appeared significant for exhaustion [F(1) = 7.24, $p$ = 0.007, $\eta_p^2$ = 0.012] and academic self-concept [F(1) = 7.05, $p$ = 0.008, $\eta_p^2$ = 0.012]. As can be seen in **Table 2**, PBL students experienced more exhaustion during their pre-clinical phase compared to LBL students, but not during their clinical years. **Table 2** also shows a similar pattern for academic self-concept. It was significantly higher in the pre-clinical phase for the PBL group, but this difference disappeared in the clinical phase.

## 4. Discussion

Our present study investigated students' experiences of their learning environment in relation to reported exhaustion, lack of interest and academic self-concept. We particularly examined 1) how experiences of the learning environment were related to exhaustion, lack of interest and academic self-concept and 2) how these experiences differed between PBL and LBL medical schools and different study phases (preclinical/novice, clinical/advanced). It was assumed that worry about future competence would positively relate to exhaustion and satisfaction with the learning environment would negatively relate to it. We also anticipated that lack of interest would negatively relate to academic self-concept. Concerning differences between medical schools our hypothesis was that students in the PBL environment would experience more workload and exhaustion at the beginning of their studies. We also anticipated that students in the PBL environment would experience receiving more feedback.

**Table 2.** Means and standard deviations of the eight dependent variables in two medical schools and two phases of studies.

| | | Lecture-Based (LBL) | | | | Problem-Based (PBL) | | | |
| | | Pre-Clinical | | Clinical | | Pre-Clinical | | Clinical | |
| Variable | Range | M | SD | M | SD | M | SD | M | SD |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Worry | 1 - 4 | 2.70 | 0.72 | 2.81 | 0.81 | 2.92 | 0.75 | 2.92 | 0.70 |
| Satisfaction | 1 - 4 | 3.42 | 0.38 | 3.32 | 0.40 | 3.40 | 0.31 | 3.27 | 0.38 |
| Disengagement | 1 - 4 | 1.69 | 0.49 | 1.74 | 0.50 | 1.60 | 0.39 | 1.66 | 0.42 |
| Workload | 1 - 4 | 2.15 | 0.63 | 2.04 | 0.70 | 2.30 | 0.75 | 1.95 | 0.64 |
| Feedback | 1 - 4 | 1.93 | 0.64 | 1.96 | 0.62 | 2.01 | 0.65 | 2.18 | 0.59 |
| Exhaustion | 1 - 5 | 2.48 | 0.85 | 2.60 | 0.90 | 2.92 | 0.78 | 2.62 | 0.87 |
| Lack of Interest | 1 - 5 | 1.88 | 0.88 | 1.74 | 0.80 | 1.74 | 0.72 | 1.68 | 0.81 |
| Academic Self-Concept | 1 - 3 | 2.04 | 0.70 | 2.11 | 0.61 | 2.35 | 0.63 | 2.10 | 0.69 |

Construct reliability values of the HESI scales gave evidence of good reliability in terms of internal consistency. Based on the reliability measures and confirmatory factor analysis of the present data, students were able to distinguish between the five different perceptions of the learning environment and the HESI scales were adequate measures of learning environment perceptions in the used sample. Students' experiences of their learning environment have been studied using various instruments (Fraser, 1998). In medical education, one widely used measurement tool is DREEM (Dundee Ready Education Environment Measure) (Miles et al., 2012; Roff et al., 1997). Although originally it was considered a generic and culturally independent instrument (Roff, 2005), problems with internal consistency have been found even when comparing culturally similar groups (Hammond et al., 2012). It is therefore important to assure the suitability of the used measurement in our study sample and the present results seem to suggest this was the case.

Relations between perceptions of the learning environment, early signs of burnout (i.e. exhaustion and lack of interest) and academic self-concept were examined with a structural equation model. Workload and worry about future endurance were related to exhaustion, which was in line with our hypothesis. This result is in line with earlier findings concerning the unfavourable effects of a high perceived workload (Guthrie et al., 1995; Wolf et al., 1988) and worries about future competence (Dahlin et al., 2010) on students' well-being. The strong negative relation between satisfaction and lack of interest corresponded with our second hypothesis. If a medical student loses interest or experiences feelings of cynicism already during his or her studies, chances are this will continue during working life (Dahlin et al., 2010; Salmela-Aro et al., 2009).

The negative relation between worry about future competence and lack of interest was rather surprising. It could be argued that worry about personal competence and workload in the future profession reflects commitment to this profession, which would relate to a higher interest (i.e. lower levels of lack of interest). It could be a sign of devotion and high ethical standards: concentrating on personal competence and skills is probably a good motivator for continuous development in the long run. The positive relation between exhaustion and academic self-concept is probably in line with this, reflecting high standards and working moral. While some amount of challenge and workload is needed for effectively focusing attention, excessive demands however are not desirable (Kember & Leung, 2006). Prolonged worry and exhaustion may result in problems with occupational health.

Disengagement and feedback did not relate to either exhaustion or lack of interest. The HESI scale for disengagement focuses on anonymity and competition among students and on whether the professional role in education is in conflict with students' personal values. Feedback refers to whether students receive encouragement or feedback from their teachers. Although disengagement and feedback are important aspects of study conditions, in our study they appeared separate from experiences of exhaustion and losing interest in personal studies. The $\Delta\chi^2$ tests supported partial mediation between the perceptions of the learning environment and academic self-concept by exhaustion and lack of interest. Therefore, relations between perceptions of the learning environment and the academic self-concept are only partially mediated by students' exhaustion and lack of interest.

Students in the pre-clinical phase of their studies experienced more workload and satisfaction than students in later phases of their studies. At the beginning of their studies students need to make an effort and learn new strategies to help grasp extensive amounts of information resulting in increased workload. During the pre-clinical phase students have predefined lessons and practical sessions, and the programme may seem structured and easier to comprehend. Dealing with the uncertainty and emotional complexity of working with real medical casesduring the clinical phase requires adjustment from the student, which may lead to more dissatisfaction. Moreover, experiences of being treated unfairly have been found to be most common during the clinical phase of studies (Elnicki et al., 2002).

The PBL curriculum appeared an engaging but challenging environment for novice students. As we expected, PBL students reported more exhaustion than their peers in the non-PBL group at the beginning of their studies. During this time, PBL students may be forced to work at the upper limits of their skills. In addition, PBL students reported higher levels of concern for their studies than students in the lecture-based group. This concurs with findings by Moffat et al. (2004) about uncertainty in study behaviour, progress, aptitude and assessment and by Lewis et al. (2009) about PBL students feeling uncertain about what is expected of them by the faculty and experiencing the curriculum as unclear. PBL students, however, also reported higher levels of academic self-concept in the pre-clinical phase of their studies. In line with our hypothesis they also experienced receiving more feedback. Contrary to our hypothesis, there was no difference in the level of experienced workload.

Studies comparing students' experiences in LBL and PBL environments have been scarce, their results mixed and more studies are needed to detect the curricular factors that play a role in student well-being (Dyrbye et al., 2006). Our study adds to this and suggests that PBL students may feel somewhat overwhelmed at the beginning of their studies. Novel settings produce negative emotions for learners, because they are not yet able to achieve the required degree of self-regulation (Lindblom-Ylänne & Lonka, 2000; Pekrun, 2006; White et al., 2014). For example, some amount of stress is needed for effectively focusing attention, but excessive stress leads to a loss of concentration (Kember & Leung, 2006). A cross-sectional design was used in our present study, which places restrictions on result interpretation. Future research using a longitudinal design could shed light on developmental paths. It should also be noticed that in addition to differences related to lecture-based and problem-based curricula, other factors also play a role in how students experience their learning environment. Faculty size, physical features of the building, atmosphere, group cohesion among students and student selection criteria are factors that may affect students' observations and well-being (Genn, 2001). Dealing with this complexity has to be accepted, because random control trials are not an option when comparing the long-term effects of the learning environment.

## 5. Conclusion

In conclusion, this paper investigated how students' perceptions of the learning environment are connected with their well-being and academic self-concept. Additionally, it was examined whether traditional, lecture-based and more student-centered problem-based learning environments differ in this respect.

Given the present findings, students' well-being might be increased by tackling their experiences of high workload and worry about their current and future stress. At the beginning of their studies, this might be facilitated by helping students obtain necessary study skills for dealing with complex and extensive amounts of information. To prevent problems later on during their career, it is advisable to be aware of the early signs of burnout that begin developing during medical school. It would also be important to find ways to deal with their career choice satisfaction and how education prepares them for it. It seems that although PBL and other novel teaching methods are likely to be beneficial in the long term, at first they may be burdening. High challenge and experience of exhaustion may be an essential part of the process of gradually learning to take responsibility for the learning process.

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Scientific Research

# How Do Graduates of Longitudinal Integrated Clerkships Fare on the Medical Council of Canada Qualifying Exam Part ll?

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## Abstract

The longitudinal integrated clerkship (LIC) model has recently become a popular educational model for training clinical clerks. LICs permit students to train in multiple disciplines concurrently and typically in rural practice sites. Because little is known about how graduates of LIC programs fare in residency, the purpose of this study was to compare the clinical performance of residents who graduated from rural longitudinal integrated and urban rotation-based clerkships on the Medical Council of Canada Qualifying Exam Part ll (MCCQE Part ll) taken 16 months into residency. Participants included medical school graduates from the classes of 2009, 2010 and 2011 at the University of Calgary. Each of the 34 LIC students were prospectively matched (first on Medical Skills ll course performance, then grade point average) with 4 students from the traditional rotation-based (RB) stream to serve as controls (n = 136). A dataset containing 170 graduates was forwarded to the Medical Council of Canada (MCC) who subsequently supplied MCCQE Part ll pass/fail status and total score for each resident, and returned the dataset for our analysis. Data were analyzed using chi-square and analysis of variance. The final dataset for analysis consisted of 30 (88%) LIC graduates and 115 (85%) RB graduates. Analysis revealed a similar MCCQE Part ll pass rate for LIC (28/30; 93.3%) and RB (107/115; 93.0%) graduates, $p > 0.05$. The MCCQE Part ll mean total score for the LIC graduates ($M$ = 527.4; $SD$ = 64.3) did not differ from the mean total score ($M$ = 529.9; $SD$ = 61.4) reported by the RB graduates, $F$ = 0.04, $p$ = 0.85. Completing the majority of clerkship in a rural community over an extended period allowed LIC graduates to perform as well as their peers on a measure of clinical skills taken 16 months into residency.

## Keywords

**Qualifying Examination Part ll**

## 1. Introduction

The longitudinal integrated clerkship (LIC) model permits students to train in multiple disciplines concurrently while a rotation-based (RB) model requires students to rotate through mandatory disciplines in blocks of varying lengths. LIC students train in rural practice sites while RB students typically train in urban tertiary teaching hospitals. Recently LICs have become a popular educational model for training clinical clerks. Providing student continuity with both patients and preceptors and offering students the opportunity to perform "doctor-like" roles are some of the noted advantages of the LIC model (Hauer et al., 2012).

The University of Calgary recently implemented (Class of 2009) a LIC program available to students in the third and final year of the undergraduate program. Details of the Calgary program are outlined elsewhere (Woloschuk, Myhre, Jackson, McLaughlin, & Wright, 2014) but briefly, students spend 32 weeks in a rural community under the supervision of a family physician who serves as the primary preceptor. Students simultaneously complete core clinical training in anesthesia, emergency medicine, family medicine, obstetrics and gynecology and psychiatry as well as some exposure to internal medicine, pediatrics and surgery. At the completion of 32 weeks students return to Calgary where they complete a short 4 week burst of rotation-based training in each of internal medicine, pediatrics and surgery. All students write the same examinations regardless of clerkship stream.

It was recently reported that LIC students in the Calgary program performed as well as RB students on various performance measures in clerkship (Myhre, Woloschuk, Jackson, & McLaughlin, 2014) and residency according to program director ratings collected at the end of the first post-graduate year (Woloschuk et al., 2014). These findings are consistent with the results of a recent review of LIC programs indicating that students who train under the LIC model perform at least as well and sometimes better on knowledge and clinical skills when compared to their RB peers (Walters et al., 2012). Because LICs are a recent innovation, little is known about how LIC students in general perform beyond their undergraduate training. The purpose of this study was to add to our understanding about the post-graduate performance of LIC students by examining how LIC graduates fare on the MCCQE Part ll (first attempt) taken approximately 16 months into postgraduate training. The MCCQE Part ll employs an Objective Structured Clinical Examination (OSCE) format that measures a candidate's clinical skills (Reznick et al., 1993).

## 2. Methods

This study was part of a comprehensive 3-year evaluation plan that studied various outcomes of the LIC program at the undergraduate and post-graduate levels. Participants included medical school graduates from the classes of 2009, 2010 and 2011 at the University of Calgary. To study clinical skills performance each of the 34 LIC students was prospectively matched at the start of clerkship (first on Medical Skills ll course performance, then grade point average) with 4 students from the traditional rotation-based (RB) stream to serve as a control (n = 136). Matching performance on the Medical Skills ll course was selected because of similarities with the MCCQE Part ll in content and exam format. A dataset containing 170 graduates was forwarded to the Medical Council of Canada (MCC) who subsequently supplied MCCQE Part ll pass/fail status and total score for each resident, and returned the dataset for our analysis. MCC policy restricts release of the MCCQE Part ll subscale scores. All participants provided written consent for us to obtain their MCCQE Part ll scores from the MCC. Because 4 graduates of the LIC stream had not yet taken the exam the respective RB controls for those 4 LIC graduates were removed from the dataset. Additionally, 5 RB graduates who were serving as control participants had not taken the exam and therefore had no MCCQE Part ll score. As a result 5 LIC graduates had 3 rather than 4 control participants. MCCQE Part ll performance served as dependent variables while clerkship stream (LIC vs. RB) served as the independent variable. The distribution of exam scores was examined for normality. The pass/fail data were analyzed using chi-square while exam scores were subjected to an analysis of variance. All data analyses were carried out using STATISTICA Version 12. The study received ethical approval from the Conjoint Health Research Ethics Board of the Faculties of Medicine, Nursing, and Kinesiology at the University

of Calgary.

## 3. Results

The final dataset for analysis consisted of 30 (88%) LIC graduates and 115 (85%) RB graduates. Various indicators of normality including a histogram, skewness, kurtosis, and the Kolmogorov-Smirnov test confirmed that the overall dataset of 145 exam scores was normally distributed. Of the 30 LIC graduates, 24 (80.0%) were training in family medicine while 89 (77.4%) of the 115 RB graduates were training in disciplines other than family medicine. Analysis revealed a similar MCCQE Part ll pass rate for LIC (28/30; 93.3%) and RB (107/115; 93.0%) graduates, $p > 0.05$. The MCCQE Part ll mean total score for the LIC graduates ($M = 527.4$; $SD = 64.3$) did not differ from the mean total score ($M = 529.9$; $SD = 61.4$) reported by the RB graduates, $F = 0.04$, $p = 0.85$.

## 4. Discussion

This study compared the performance of LIC and RB graduates on the MCCQE Part ll that measures clinical skills and found no difference between the two groups on both pass rate and total score. Graduates who trained primarily under generalists and completed most of their core clerkship training in rural sites performed as well on the licensing exam as their rotation-based peers who trained primarily in tertiary teaching hospitals. These results are consistent with the findings previously reported for this matched cohort on measures of clinical skills at the undergraduate level (Myhre et al., 2014). It appears that expanding clerkship training into community practices for longer periods and across multiple disciplines is not only viable but can be done without detriment to the student's performance later in training. The LIC model may open a myriad of new training opportunities for clinical clerks and addresses the need for more generalist based instruction for medical students (Fraser, 1991).

The literature is replete, and this paper supports previous work demonstrating the academic equivalency of the LIC and RB models. However, if the LIC model provides students with various educational advantages that are purported to facilitate learning, why is the performance of our LIC cohort not superior? The reasons for this have yet to be elucidated and at this point we can only speculate. For example, possibly the measures we have used across the continuum are not sensitive to the nuances of the LIC experience or that some elements of LIC, which we are unaware of, counteract the noted advantages. Further study is required to illuminate this issue.

This study has limitations that should be noted. Our study had a small sample size and participants were from a single medical school which is three years in duration so the findings may not generalize to students who graduated from other schools. Because the MCCQE Part ll is taken approximately 16 months into post-graduate training it is not known what impact residency training itself has had on these results considering that most of the LIC graduates were training in family medicine while most of the RB graduates were training in a wide range of other specialties. To maintain continuity the same matched cohort to compare clinical skills performance at both the undergraduate and post-graduate levels was used. Considerable time elapsed between the start of clerkship when the groups were matched and taking of the MCCQE Part ll.

## 5. Conclusion

Completing the majority of clerkship in a rural community over an extended period allowed LIC graduates to perform as well as their peers on a measure of clinical skills taken 16 months into residency.

## Acknowledgements

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Scientific
Research

# Education and Health: Epidemiological Indicators Can Improve the Continuing Education Process

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## Abstract

**In the field of Health Education, understanding human development is essential, taking into account a set of actions that can promote the protection and care to a better child development, so we researched about the evolution in epidemiological indicators related to child development, through literature review and systematic data collected on public system, in Rio Grande do Sul, a state in south Brazil. For this, we do a review that brought together elements of updated on epidemiological and social indicators: changes in the understanding of the processes health and disease, various public health policies that influence personal and social behaviors, especially for parents and caregivers of children. The findings allow seeing that data about child with low birth weight are inversely proportional to the number of years of parents study, mainly from 8 years of schooling; that actions of Health Education can be aimed at doctors, caregivers and pregnant; and that reference systems ensure correct referrals. As ultimate implications, we suggest public policies that enable reduce neonatal mortality by investing in access more the formal Education, encouraging at least the completion of elementary education. We can also encourage medical continuing processes that can observe continually the data that are contained in several public data systems.**

## Keywords

**Health Education, Continuing Medical Education, Teacher's Education, Public Health, Education**

## 1. Introduction

The infant mortality rate is an excellent indicator for the assessment of quality of life and efficiency of the health system implementation.

The state of Rio Grande do Sul, in the extreme South of Brazil, collected annually epidemiological data, for example about child and adult morbimortality, birth, primary attention indexes, so we can use it for analyzing the evolution of epidemiological indicators and propose some interventions. Our idea was the research about the evolution in these epidemiological indicators related to child development, and complementing with the authors we read.

As we saw observing these data, there were significant results as the reduction in child mortality, in recent decades among Brazilian federal states. Historically, since the 1970s, the infant mortality rate (IMR) showed a steady decline. After 1997, data obtained from the Health Information Center at the State Health Secretariat of Rio Grande do Sul (Rio Grande do Sul, 2005), indicaterd that IMR in Rio Grande do Sul reached 15.9, and that in the next seven years there were no reduction of this indicator, even in this period varying between 15.1 and 15.9 (with the exception of 1998, which showed an IMR of 17.2).

This motivated an act of technical Section of Child Health and Adolescent Health Department shared the Secretariat of Rio Grande do Sul Health, with political support from the state through the Live Program for Children, with the main cities of the State during the years 2005 and 2006, in order to give the opportunity to discuss about local causes and reasons that led to stagnation in infant mortality.

This action did not intend to take ready solutions to these municipalities, but to build with them a continuing educational vision, to a reconstruction management focused on maternal and child health from a reading/re-reading of the local reality.

## 2. Literature Review

According to a study of Duarte (1992: p. 425), "*the different components of infant mortality can react different to the availability of social infrastructure and medical-sanitary interventions*".

Goulart et al. (2003: p. 303) showed that the infant mortality surveillance, by identifying, capturing and monitoring of children at risk, pointed to a favorable evaluation of this type of program.

To study about the data obtained from the municipalities, it is necessary form a group of from some of these realities, as Mosquera & Stobäus (1984: p. 13) say, "*to be able to structure any line of action, it is necessary, first, to have as a reality that assume the basic knowledge to be able to focus on it through a dynamic knowledge and action*".

For this action at the local level, we rely on a prior resolution of the State (Rio Grande do Sul, 2003a) about the need to create a network of child protection risk. Municipalities started to identify, from birth, children with these risk factors. The same from maternity discharge were scheduled for consultation in the Health Units.

Considering the pact for reducing child mortality and the need to reduce child mortality, the Ministry of Health established the National Committee for Prevention of Child and Neonatal Death (Brazil, 2004), adapted to each State.

Research of Formigli et al. (1996: p. 40) showed that the main problems related to infant deaths were rooted in poor organization of health services.

As Mansano et al. (2004: p. 331) observed, describing the experience of another South State, Paraná-BR, the research on infant deaths provides interventions that promote these reduction.

The action research on infant deaths was started in Rio Grande do Sul in the year 2001, however, the percentage of investigations in the early years ranged between 6% and 15%. In 2005 and 2006, as a way to better understanding of the event infant death, the State invested more into this strategy. This action was based on a resolution of the State which regulates research on infant deaths (Rio Grande do Sul, 2003b), carried out by municipalities within 45 days after the occurrence of the event was made by the mother in the hospital and when the death occurred there, following a different preset for neonatal and infant died later.

Investigation of death from prematurity showed a relationship with age (adolescence mothers), not (very high) maternal education, and (few) number of prenatal consultations. To Drumond, Machado & France (2007: p. 162), there is underestimation of the underlying cause of death on the subject of maternal conditions by preventing adequate care during labor.

## 3. Methodology

Of the total of 496 municipalities in Rio Grande do Sul—BR, classified by the occurrence of the average number of deaths in children under one year of age in the last five years, we was found that 75% of infant deaths were concentrated in 51 of these municipalities.

These 51 counties were the largest population and economic representation of the State and have received throughout the years 2005 and 2006, with regular intervals, combined between the technical state and the city, a visit from a technician from the State Department of Health. In this period, 419 meetings were held with these municipalities, with an average of one visit every 13 weeks.

In the first visits we gathered all municipal leaders involved with children's health, such as: Mayor, Municipal Secretary of Health, responsible for the actions of the Child and Woman of the Municipal Secretariat of Health, Municipal Department of Education, Office of the Attorney Childhood and Youth Ministry of Child Health, Lyons Club, Rotary Club, the representative(s) Hospital site(s) and Family Health Program.

With this large group we made an open discussion about why locally infant mortality was difficult to reduce, and sought to relate the reason for the permanence of the level of IMR at the local level, without tendency, relating it to factors associated, with the local reality of every county.

How common features, these municipalities had a higher concentration of deaths in the early neonatal period (up to six days), without, however, being the late infantile mortality (from 28 to 365 days) a solved problem. With that, we encouraged the discussion about what could be done to reduce the deaths of the latter period.

We observed that the deaths occurred in late childhood, in these municipalities, and mostly had some characteristics in common, such as low birth weight, low maternal education (illiterate or have less than three years of study), or multiparous teenage mothers with three or more children and/or history of previous deaths of children, or malformations.

These findings confirmed previous Menezes et al. (1996, 1998), César et al. (1997) and Passebon et al. (2006) researches, about the risk of illness and death in the first year of life.

Thus, we agree with the State and County, to work initially with the creation of a network of protection of children with these characteristics.

This consultation did not occur if the due date was cause for home visits by the health team. After this 1st consultation we guarantee intervals of approximately 30 days, marking the next and so on during the 1st year of life, encouraging to home visit of all these children and, in particular, of defaulting. These service involved multi-professional health team, in an interdisciplinary approach, and could vary by each municipality.

In the constitution of the groups, generally we had the interactive participation of physician, nurse, dietitian, social worker, psychologist and health agent. Another consensual action from the meetings and encouraged by the staff of the state was the investigation of data about infant death, as the rates are part of the Primary Care Indicators agreed by municipalities seeking qualification of municipal management (Brazil, 2001).

This script was standardized by State and previously discussed with the Regional Health and municipalities, perfecting models used in previous years. The information was recorded later in a computerized program, specifically created for this purpose, and sent electronically to the Health Section of Child and Adolescent State Department of Health.

Fruit of the predominant neonatal mortality, especially in the first six days of life, a relevant discussion carried out in municipalities with our presence, with the question: Why this happened?

First we discuss about possible reasons for these deaths, and it was noted as the primary cause related to prematurity, then cases of malformations and perinatal anoxia. However, these causes by itself did not include the complexity of the event death.

We chose at first in how city do prenatal visits. Issues related to the capture of pregnant, the number of queries, the realization of basic tests during prenatal, tetanus vaccine and a puerperal interviews were discussed.

There was a difficulty in obtaining these data from the local level. The Program for Humanization of Prenatal and Birth (named in Portuguese PHPN), developed by the Ministry of Health, is an important tool that has helped the local level for the implementation of their actions (Brazil, 2000). We say again that it is a difficulty of obtaining data from prenatal SISPRENATAL Program, and this encourage the use of a computerized information system and monitoring PHPN. This system allows the monitoring of the above data, facilitating the actions at the local level.

## 4. Results

In 2004 and 2005 a decrease of IMR in the state of Rio Grande do Sul, which was not seen for almost a decade, reaching these years, rates of 13.6 and 13.1, respectively (**Figure 1**).

The reduction was due to the fall of IMR in the two components of infant mortality: late neonatal and infant. In 2005 and 2006, respectively, neonatal infant mortality rate was 9.1 and 8.8 and the late childhood was 4.5 and 4.3 (**Figure 2** and **Figure 3**).

The identification of children at risk in the state of Rio Grande do Sul during 2006 revealed 34.41% of children in this situation (**Figure 4**).

Data on infant deaths have reached percentages above 90% in recent years in the state of Rio Grande do Sul (**Figure 5**).

Regarding pregnant women, considering the users of the Unified Health System in Brazil (named in Portuguese SUS), an increase in uptake of the same for conducting pre-natal, reaching percentages above 70% in the years 2005 and 2006, and more 50% of the pregnant women were taken up to 120 days of gestation (**Figure 6**).

The conclusion of prenatal capture, considering up to 120 days of gestation, conducting at least six consultations during pregnancy, with the realization of all basic tests recommended by PHPN, anti-tetanus vaccination and a puerperal interviews reached more than 20% in the years 2005 and 2006 percentages, suggesting along with important fundraising opportunity for growth in the state (**Figure 7**).
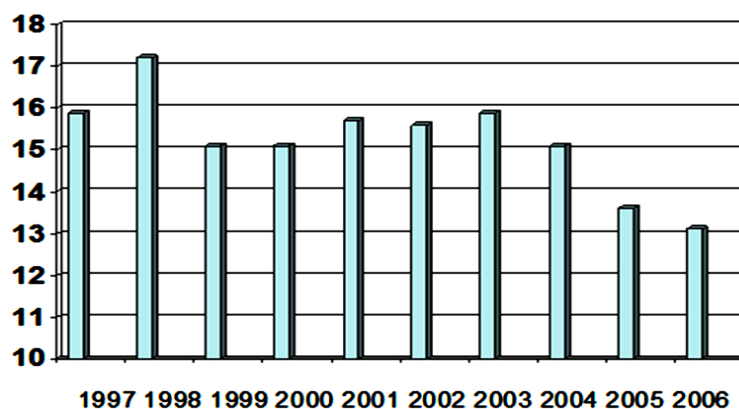


**Figure 1.** Evolution of the rate of infant mortality in Rio Grande do Sul, 1997-2006. Source: Center for Health Information, State Secretariat of Rio Grande do Sul.
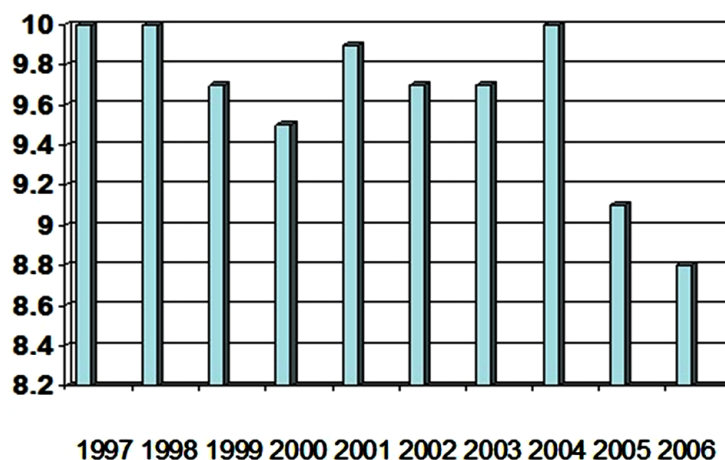


**Figure 2.** Rise of the neonatal infant mortality rate in Rio Grande do Sul, 1997-2006. Source: Center for Health Information, State Secretariat of Rio Grande do Sul.
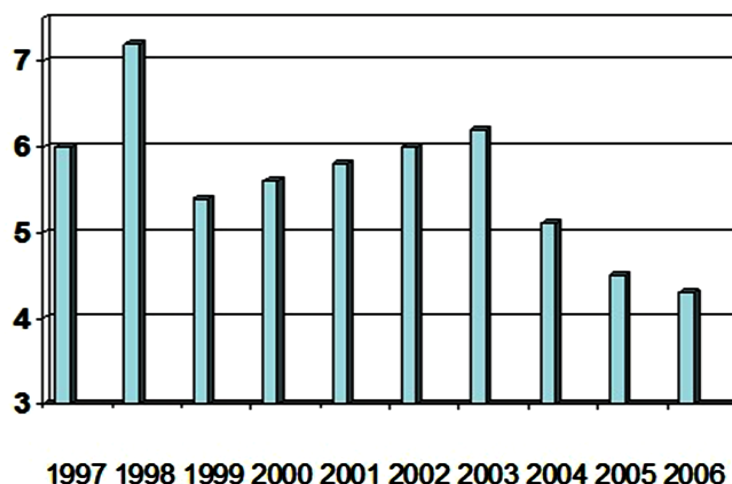
**Figure 3.** Evolution of late infant mortality rate in Rio Grande do Sul, 1997-2006. Source: Center for Health Information, State Secretariat of Rio Grande do Sul.
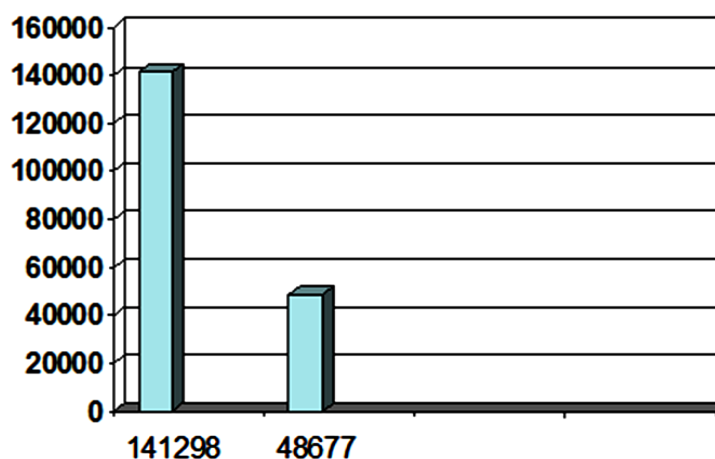


**Figure 4.** Identification of children at risk in the State of Rio Grande do Sul, 2006. Source: Health Section of Child and Adolescent, State Secretariat of Rio Grande do Sul.

## 5. Discussion

The actions we propose and done over the years 2005 and 2006, in a educational basis, in collaborative interaction between us, State and local manager, allow us a number of qualitative considerations, which we will do next, and we believe that can be based under theoretical and also practical point of view, the why the results obtained, especially the reduction of infant mortality hitherto stagnant for almost a decade.

The development of action to protect children at risk led to a greater integration of the healthcare team and increased knowledge of family socio-cultural reality of these children, allowing actions planned from this familiar knowledge interventions.

According Gomes & Pereira (2005: p. 362-363), "*it is necessary that public policies come in family support in situations of social vulnerability not only in relation to income, but also in relation to access to goods and social services*". Working with the child under risk approach, who is a multidisciplinary and interdisciplinary approach, meant to increase understanding of health and disease processes to which it is subject, recognizing often the vulnerability and fragility of their family environment because of the risk.

The investigation of child death has the merit to overcome the simple classification of causes of death ob-
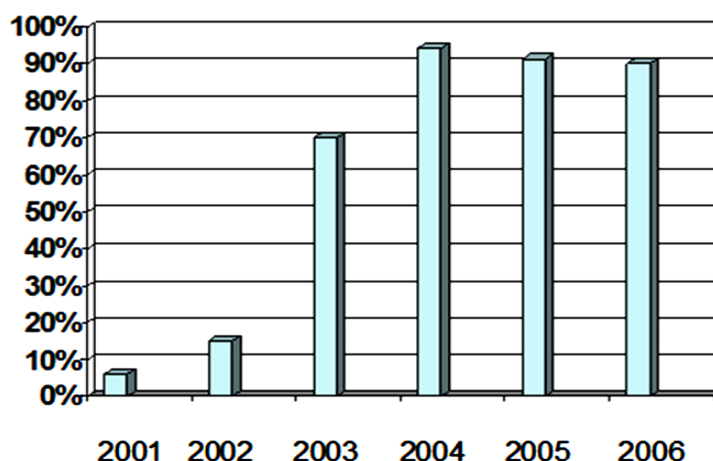
**Figure 5.** Percent of child deaths investigated in the State of Rio Grande do Sul, 2001-2006. Source: Health Section of Child and Adolescent, State Secretariat of Rio Grande do Sul.
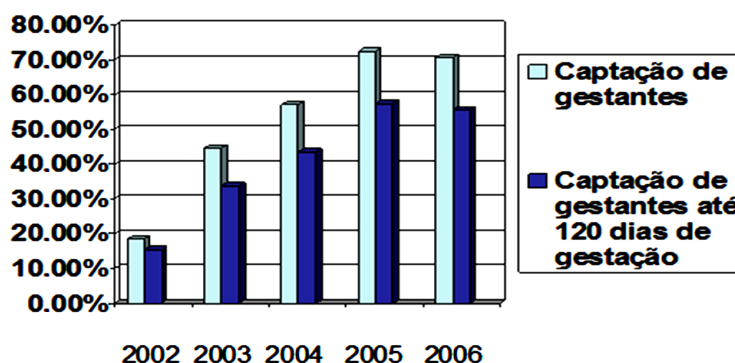


**Figure 6.** Percent uptake of pregnant users of the Health Care System for the realization of prenatal care in the State Rio Grande do Sul, 2002-2006. Source: DATASUS, Report indicators SISPRENATAL.

tained from records of death certificates. The hidden face of death can be revealed, showing its many implications and the complexity of this event, favoring a better local knowledge and making new decisions.

In this sense, we agree with Goulart, Somarriba & Xavier (2005: p. 722) "*detailed investigation of infant death in order to understand it beyond its numerical significance and documentary, appears to be important as a subsidy for the proper planning of interventions*".

These two actions deepened the information SINASC System (Births) and SIM (System Mortality) allowing a wider knowledge of the threats of illness and death in the 1st year of life. The richest of all actions was undoubtedly upon accession to PHPN, fostered by the adoption of SISPRENATAL system.

The adoption and discussion of SISPRENATAL system provided a rich debate about health programs and the population adherence to them. From monitoring the uptake of pregnant women, subsequent consultations, their exams, tetanus shot and puerperal interviews, we can reassess the system of local health as: efficiency and effectiveness, importance of effective communication to achieve goals, intersectional role in the health and participation of the target population as agents of their own health.

According to the data of study of Silveira et al. (2001: p. 138), the monitoring of pregnant women by the public had a "*low adherence to professional records and, probably, to perform the recommended procedures of consultation, as well as poor adherence of mothers to prenatal program*". Our experience has shown that the success of a Health Program depends not only on its "installation".

According to Carvalho (2004: p. 677), "*for the Brazilian reality incorporating assumptions and strategies for*
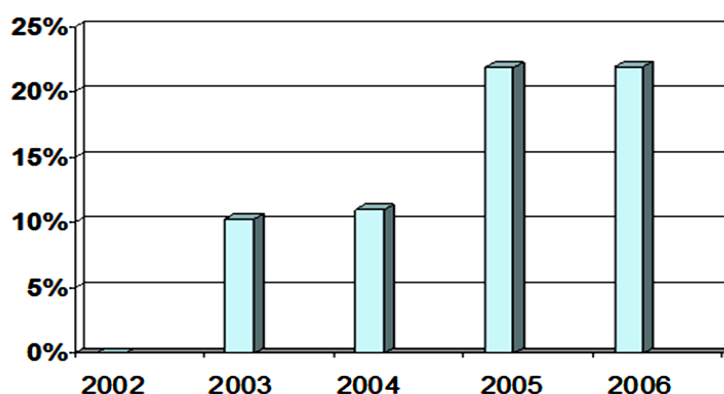
**Figure 7.** Percentage of pregnant women in the state of Rio Grande Do Sul, users of the unified health system, which concluded the pre-natal as PHPN, 2002-2006. Source: DATASUS, Report indicators SISPRENATAL.

*health promotion in SUS should provide answers to the challenges of ensuring access to quality goods and services and the production of autonomous individuals and socially responsible*".

In our experience we have seen the importance of all subjects perform with autonomy, and the role of active agent in this process, with the appropriation of the same by the subjects involved with the health issue, from re-reading and reconstruction adapting it to the characteristics and needs of the local level are critical to your success, and stimulates the creativity of each subject, providing opportunities for new ways of doing.

For Stobäus & Mosquera (2004: p. 157), creativity is not conformity: "*it involves original, new and different points of view and ideas openings. Means seeing with several different ways something which seems to have only one interpretation. The line indicates reproducibility, repeat*".

There should be a special motivation, passing by local managers, healthcare and servers population to be assisted. We had a major qualitative breakthrough in the understanding of health and disease and health management process. Everyone could discuss and review their health systems and see the importance of public involvement in the process to your success.

The early identification of a pregnant woman for your monitoring has two main variables: the possibility of easy access to the health system, and the membership of the pregnant health action. The first is dependent on the local manager, but the second depends on a process of appropriation by these women of the importance of taking care of your health and the health system response to the expectation of receiving a quality service. Here we can see the importance of caregivers and also graduate students, i.e. in their residence, stages, seminars, regular or extension courses.

Spontaneous demand for the service of the pregnant woman is linked to the development of their autonomy with an appreciation of their self-image and self-esteem and the importance of caring for your health. Move with various taboos and concepts, such as, pregnancy poses no risk, I have had other pregnancies without problems.

The search process facilitated the access and delivery of quality of care provided various questions, such as:

Employees are becoming more committed?

- Are all the health systems committed, what are your questions?

- What are the anxieties generated by changes? How to treat the same?

- The Health System is corresponding to what is expected of it?

- When everything seems okay, because the funding does not rise? How are the people watching and participating in this process?

- What do the population adhere (or not) to the management process?

- How is the participation (or not) of the population? There are groups, like teenagers, who deserve special attention. How to reach them?

- How to involve formal education to perform in line with health and working these issues with students?

The reflections motivated by these questions above contributed to the improvement of management at the local level. We can made also links to the graduation courses at Health area, how do they develop this interconnections, in the inter and multidisciplinary way?

The main consequence of the actions developed in meetings with various municipalities, by its character of

Health Education give us the questions in a theoretical order, attempting to provide answers to a bigger "experience": how do we define what is Education Management in Public Health?

From our lived experience we can define it as an intentional action that aims to change management practice within the Public Health from based on reading only official data in direction to rereading also the local reality reflection and necessities.

This (group) decision and definition leads us to a search of the characteristics of an Education for Management in Public Health. But, what are the characteristics that have this intentional action that seeks to change practices from reading (and rereading) the local reality?

Based on our experience, we list the main features of these actions as suggestions to "think and move":

a) The process benefits from the participation of a foreign subject to the local environment (socio-cultural animator).

b) The subject of local realities needs to be motivated to action.

c) A single and complete model to be applied does not exist.

d) The pace of the educational (learning and teaching) processes in the management of health problems, even in such situations, is not uniform.

e) The results can be advances and setbacks, due to the diversity of causes involved in Public Health.

As intentional action, it tends to produce effects. Thus, in our experience, we found the following effects of the process for Management Education in Public Health:

a) Better (critical) knowledge of the health and disease processes, from general to local levels.

b) Making decisions based also on local reality.

c) Questioning critically the practice itself.

d) Participation and consequent commitment of all subjects in the decision making processes.

e) Inclusion of the "users" (citizens) of the Health System as active subjects in their health process, facilitating the development of their autonomy.

f) Reflections in how to introduce and maintain continuing education in Health area courses of graduation and post-graduation.

## 6. Conclusion

The experience about the use of these (short) two years data showed the importance of an educational process for the approximation of the healthcare practices' attention to the management of this assistance, respecting local realities. In the process of Health Education, where it seeks to strengthen the autonomy and the participation of subjects, we think we showed the importance of an action directed to the Continuing Education (management) as a mechanism to enhance the results in the area of maternal and child health.

As we can see, the most important findings are that data about children with low birth weight are inversely proportional to the number of years of parents study, mainly from 8 years of schooling; that actions of Health Education can be aimed at doctors, caregivers and pregnant; and that reference systems ensure correct referrals that can be used for discussion end improve of interventions.

Also we suggest a reflection about the idea of putting into the graduation, post-graduation curricula and extension courses and the idea of manipulating the continuous data obtained at the official public data systems, so we can also encourage in direction of a Medical Continuing Education.

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Scientific Research

# Active Learning Methodologies: An Experience for Faculty Training at Medical Education

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## Abstract

**When studying the implementation movement of active learning methodologies, especially the Problem Based Learning (PBL) at medical schools, it is considered that faculty training is of great relevance and is a weakness to be overcome. In this paper, an experience from a medical school is shared concerning the accession to PBL especially focusing the course on the faculty development during this process. The Faculty Development Program (FDP), made permanent in this institution, is presented, as well as its steps in 17 years of existence: strategies and guidelines for practical support. At first, faculty training programs were based on Continuing Education (CE) and Permanent Education (PE) demonstrating theoretical references and methodologies paying greater attention to the current process of Academic Permanent Education (APE). This study also describes the APE organization, potentialities and weaknesses rates and, following that, broadens reflection on challenges surrounding faculty training programs in medical schools. It is concluded that APE, when promoting operative group activities and active knowledge production, it supports and strengthens team work. When stimulating active attitude for personal and professional teacher growth, APE also collaborates for pedagogical, curricular and humanistic development of the higher education institute.**

## Keywords

**Faculty, Continuing Education, Medical Education, Undergraduate, Problem-Based Learning**

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## 1. Introduction

In this paper is shared an innovative experience of a Brazilian medical school with implementation of active methods of learning in its course, especially focusing practice on faculty development within the process.

The Marilia Medical School was founded in 1967. It followed a traditional learning method based on transmitting and this way has been on its course for 30 years. When the Problem-Based-Learning was used in courses at universities such as McMaster, Maastricht and New Mexico it was more efficient to make students active in the learning process. They allowed the student to give a new meaning to knowledge from professional practice situations portrayed in paper problems; integrating subjects and different knowledge areas and inserted them through reality; at the same time guaranteed, in elective courses, space for specific interests (Barrows & Tamblyn, 1980; Moust, Van Berkel, & Schmidt, 2005).

PBL was implemented in Latin America only in the nineties. In Brazil it was a result of a global policy for health improvement and medical formation, considering initiatives from The World Health Organization (WHO) and the national policy for the Sanitary Reform consolidation—as an inducer and partner respectively, followed by a process of registering and selection of colleges.

Marilia Medical School started PBL implementation as a pedagogical instrument in 1997, based on its proved efficiency for promoting knowledge construction and high capacity to develop skills and affectivity of its students (Albanese & Mitchell, 1993; Newman, 2003; Dochy, Segers, Van den Bossche, & Struyven, 2005; Hoffman, Hosokawa, Blake, Headrick, & Johnson, 2006).

During the method implementation and consolidation process, two large pedagogical movements were carried out: 1) teacher training, for the new teacher role, along with the global curriculum analysis; 2) curricular redesign in order to make easier different subjects and knowledge areas interactions (bio-psychosocial), making possible the necessary instruments for paper problems construction.

Considering teacher training to be of great relevance and at the same time a weakness to be overcome when establishing PBL at a medical school, as pointed out by Perim et al. (2009), the aim of this paper is to present the Faculty Development Program (FDP) implemented in this institution, its strategies and theoretical references, as well as support practical guidelines for its operation.

## 2. Academic Permanent Education (APE) as a Driving Force of the Faculty Development

FDP was started as a Continuing Education (CE) with sequenced offer of basic and advanced training to all teachers. Among the approached topics were: activities in small groups; active learning; the PBL seven steps; formative assessment; and skills in how to give and receive criticism. The CE activities took place in plenary sessions and small groups with the objective of stimulating reflection and insert teachers in labor logic in small groups (Francischetti et al., 2010).

For the past five years more than 90% of teachers have passed through these trainings, and they have been consistently included in curricular activities. When living PBL mediation reality in different course grades, other demands appeared and they made necessary a greater deepening in the training process, thus, the Academic Permanent Education (APE) was grown (Nunes, Rolin, & Lopes, 2014).

The APE, which features longitudinal activity raging all units and grades, became a great driving force of the teacher development process, since it made it possible continuous and consistent elaboration of situations that raised from teacher practice. With pedagogical capacitation technology, APE was made out according to the theory of andragogy, based on Paulo Freire's critical and liberating education (Freire, 1999).

Implementation occurred in a procedural way, aiming meaningful learning (Ausubel, 1963 apud Moreira, 1997). This kind of learning is defined as a process by which new information or knowledge relates itself, in a substantial and non-arbitrary way, to the cognitive structure of the subject (Ausubel, 1963 apud Moreira, 1997). In order to occur, it is fundamental to consider the learner's background knowledge so that new concepts may be incorporated in a meaningful way. Affection and feelings are important for meaningful learning since it is necessary integration between thinking and action, meanings and feelings exchange among the object of study, the teacher and the student, which leads to human empowerment (Novak, Gowin, 1984 apud Moreira, 1997).

Among the uncountable possible strategies to be made to carry out APE, Problematization is used. Silva (2011), from reviews of Berbel (1998) and Bodernave and Pereira (1982), described the steps of Problematization as a process that comes from work practice, where, after task performing and a new experience, in a group

session together with a mediator, participants discuss experiences and levels of difficulty and success in the so-called "experiential confront". From this reflection on, a provisional synthesis is made, with questionings. Later on, a theoretical search is made about those questionings and in the following session the group discusses, shares and builds knowledge and new understanding called "new synthesis", with reality applications.

Aiming meaningful learning and taking into account group particularity and context, some resources and strategies may be used to stimulate or support discussions, such as, small film or text passages, paper cases or problem-situations in order to make learning easier (Vieira, Soares, & Locatelli, 2014).

During APE implementation it is interesting to emphasize activity planning, which includes group formation and how the participants are invited or summoned, for instance. There are several possibilities for group formation and criteria to be adopted, some groups are formed second the year of the course, area of operation, common group of students, or even mixed groups. It is important to guarantee that the sessions are determined under periods when everyone can take part (Vieira et al., 2014).

Sessions are used to occurring in small groups (6 to 8 participants), which provide people with more experience to be together with ones that do not have much of it, the talkative with the quiet, and together they stimulate one another and try to provide full participation so the objective may be reached. On the first session the "group contract" must be carried out, establishing the beginning and end of sessions, use of cell phones and other technology equipment, and also daily or periodic assessment, which includes self-assessment, as well as pair, activity and mediator ones (Vieira et al., 2014). Thus, assessment forms will be applied periodically, subsequently analyzed by the FDP group for diagnosing necessities and proposals for change (Faculdade de Medicina de Marília, 2008).

As a theoretical-technological reference which goes around group practice there are the fundamentals and operative group ideas of Pichon-Rivière (2009). Aim and purpose are summarized by saying that the activity is centered in the stereotyped structure mobilization due the amount of anxiety raised by the change. "On the operative group, the clarification, the communication, the learning and solved task coincide with cure, and then a new reference scheme is generated" (Bleger, Liberman, Pichon-Rivière, & Rolla, 2009: p. 137). This type of group therefore, implies learning to think in terms of problem solving which appears in the group itself. It can appear from a participant who will be the spokesperson of him or herself and of the unconscious fantasies of the group, so the spokesperson will be interpreted at first followed by pointing out what has been presented, bearing in mind it is also about a group problem, and this is the different from the other techniques (Pichon-Rivière, 2009). This way, what the group communicates on each session is worked out inside the group dynamics and the resonance phenomenon described by Zimerman (2007) occurs, many times exemplified by one of the professor's experiences which resounds to another member of the group, who transmits equivalent meaning (Pio & Angeli, 2014). In the group, affective interaction among professors makes fantasies, anxiety, defense mechanisms and transference and contra-transference phenomena come out and that generates a dynamic group area (Zimerman, 2007).

Thus, when APE institutionalizes active knowledge production by its participants, can ameliorate the works groups and relationships that permeate this rich relational conformation supporting and making teamwork easy. The greatest effort is focusing attention on the subjects and their interactions, for performing the proposals to be carried out by the group. In order to have suitable mediation and observation of both relational and pedagogical-assistance aspects in question, APE counts on two facilitators. The choice of a professional from mental health as a mediator allows better work with group conflicts and operative group techniques, permitting theoretical foundation and quality of APE activities (Gomes, Francischetti, & Parpinelli, 2014).

This way, APE tends to work as a dialogue space for experience exchange and meta-critical evaluation concerning professional practice. Reflection is fostered, with opportunity for discovering new personal resources and competence development to teach health under a new training approach (Pio & Angeli, 2014).

It is understood that practice transformation and multiplier formation go through the subjects (group participants), who must bring true motivation for development and desire to carry out a recognized good job. Therefore it is a more political and humanistic approach, hoping to promote citizenship (Gomes et al., 2014).

The results are continuous and perennial, and many times a little slow. Facilitators who go through several teaching-learning scenarios become strong reference among different teaching segments and take part in building this new paradigm; because either as facilitators or professors, they acquire broad view of this construction and contribute to the development of APE work groups (Gomes et al., 2014).

However, in literature several obstacles are identified: a) doctor's interest lack on pedagogical knowledge; b)

exaggerated technical-scientific knowledge valorization; c) fragile employment link professor-institution; d) incompatibility between the professional profile and the course demands (Costa, 2010; Moust, Van Berkel, & Schmidt, 2005).

On the faculty established before the pedagogical innovation is the ones who were not included and the ones who did not let to be included, and the possible causes might be: centered management and conservative professors. Isolation may become a barrier. However, when using effective communication, the manager may promote experience exchange among professors, include them, and allow their engagement in the process (Zeichner, 2008).

## 3. Conclusion

In the newer medical schools, selection processes have been made for a professional profile oriented for: professors with pedagogical experience who work as facilitators, who work on his or her own formation, and who work on curricular construction (Machado, Machado, & Vieira, 2011).

It would be harmful for school image to abandon the old professors and to invest only in new hiring. It is necessary, for pedagogical change, that all teachers: new, old, from initials to those of final course years, should be included in the permanent education process. It is believed that the pedagogical development must pass through socialization of different ideas to transform the institutional culture and curriculum. These are only possible with the valorization of all faculties by the institution and commitment of each teacher.

Many institutions offer CE and do it inconstantly most of the times, and only for first-year professors. There are those that promote multiplier oriented training sessions. The promotion of multiplier is helpful but does not displace the individual professor training.

In Brazil, a study showed that a few schools can promote long-lasting programs and Permanent Education (PE) (Almeida, Maia, & Batista, 2013). Among them are the ones by Marília Medical School with systematized practice and assured by continuous programs for their participants, and those with non-systematized practice in continuous programs (Faria, Nunes, Anastasiou, Sakai, & Silva, 2008; Francischetti et al., 2014).

It is thought that small-group-based practices provided by APE ensure further development of skills for the following student group activities. Its systematic approach enables better monitoring and assessment of the process and the performance of each participant. The non-systematized practice is weak to built pedagogical framework to support the learning tension that exists at the theory-practice and knowledge-behavior integrations, in a new care model.

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Scientific Research

# How the Final Swedish Clinical Exam Prepares the Nursing Students for Their Future Challenges-Qualitative Analysis

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## Abstract

**The national clinical final examination (NCFE) plays an important role in order to measure the level of knowledge and performance of nursing students. Our findings indicate that the design of the NCFE is beneficial for the students' clinical reasoning and problem solution in the caring situation. The aim of this study was to investigate the experiences of the NCFE from lecturers who corrected the written part examination. A further aim was to study the lectures and the RN during observation in the bedside part of the examination. The NCFE is divided into two parts: a theoretical (written) part and a practical (bedside) part. In nursing education it is essential to assess nursing competencies for the future professional role such as the assessment of clinical competence that has become central to evaluate what outcomes are assessed. In addition, it provides a valuable approach to measure the level of knowledge and performance of nursing students. Future development of the NCFE is necessary regarding the degree to which the examination meets learning objectives and educational results.**

## Keywords

**Final Examination, Clinical Competence, Nursing Education, Content Analysis**

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## 1. Introduction

An important prerequisite for nursing students is to acquire theoretical knowledge about nursing and then to convert this knowledge into evidence-based and patient-related practice (Ekebergh, 2011). This means that nursing students must be able to integrate theory and practice into the clinical context. Several international studies have shown that nursing students find it difficult to translate and apply their theoretical knowledge to the clinical context, suggesting the need to develop novel methods of teaching and assessment that improve clinical competence and clinical reasoning in decision making (Banning, 2008). In Sweden, a bachelor's degree in nursing entails 3 years of full-time study (180 higher education credits). The main subject of the programme is nursing science and the secondary subject medical science. Teaching is organised as theoretical lectures and clinical training at several health care facilities (Öhlén et al., 2011).

Nursing students are expected to have the skills and knowledge required to meet the challenges that lie ahead. Throughout the training of nursing students, clinical skills and reasoning are developed, which form the basis of problem solving in the caring situation (O'Connell et al., 2004). Furthermore, experiential learning is important in knowledge development. Students are now able to apply theoretical knowledge when facing practical challenge and after that they realise that theoretical knowledge alone is not sufficiently reflected in the caring situation (Kuiper & Pesut, 2004).

Today's health care service requires effective use of clinical competence in complex caring situations, suggesting that nurses must be able to make the correct decisions based on comprehensive and sound clinical reasoning. It is thus important to develop an examination that tests this competence (Simmons et al., 2003). Clinical competence is important in nursing and is the foundation of nursing education. The term clinical competence also includes other elements of professional practice, such as collecting information about nursing problems and clinical skills, skills in practical procedures, nurse-patient communication, problem solving and decision making (Boursicot et al., 2011). In Sweden, a model, the National Clinical Final Examination (NCFE), has been developed to determine nursing students' clinical competence (Athlin et al., 2012) and is currently implemented in over half of the Swedish universities offering a bachelor's degree in nursing. The NCFE is a multi-method model employing a reflective approach to test theoretical and clinical skills in a natural setting. In summary, the students show the ability to use knowledge in a specific context, for example, in clinical reasoning to solve a patient problem (Miller, 1990).

## 2. The model for the NCFE

The NCFE comprises two parts: a written part and a bedside part, which are described elsewhere (Andersson et al., 2012). The students are administered the NCFE at the end of the last term, i.e. nearly 3 years after entering the nursing programme. The Board of the NCFE has developed written material and routines to guide the execution of the examination and the criteria for assessment. Verbal information is given to the students regarding the way in which the examination will be conducted. Organised and continuous cooperation is maintained between the faculty and clinical practice throughout both parts of the examination (Athlin et al., 2012). The development of the workplace assessment in the NCFE model began before the introduction of the Bologna process, and the focus is currently on maintaining a clear connection between learning outcomes, learning activities and examination (Biggs & Tang, 2011; Norcini, 2005).

### 2.1. The Written Part

The written part of the examination is performed at the same time by all students at the participating universities. This exam is limited to four hours. The examination is a problem-solving exercise consisting of two patient cases describing realistic care situations in which the patient is followed throughout the care trajectory. As the examination proceeds, the situation and the conditions change and new information about the patient is provided. To ensure fairness and reproducibility in the marking of the examination, the Board of the NCFE provides a template defining criteria for each question. Experienced lecturers in nursing, who are conversant in both clinical nursing care and in the bachelor's programme in nursing, mark the written examination.

### 2.2. The Bedside Part

*The bedside part of the examination is performed after the written part* (*also lasts four hours*). Each student is

examined separately. The bedside test consists of a clinical examination that can be performed in any care unit as long as the requirements correspond to the competence and qualifications required of a registered nurse. Testing students' bedside performance provides an opportunity to evaluate how their theoretical knowledge is applied in practice (Meah et al., 2009). During the bedside part of their annual clinical placement, the students take care of a patient in need of comprehensive medical and nursing care. The clinical placement may involve inpatient care (hospital care) or outpatient care (community care). The choice of patient is decided upon after careful joint consideration between the student and clinical lecturer. The patient must give his or her informed consent. During the examination, the student is observed by nurse, who is guided by a structured assessment tool that reflects the areas of competence required by registered nurses. The bedside test has a clear structure and consists of three steps: 1) assessment of needs and problems, analyses and planning; 2) implementation and evaluation of nursing activities; 3) reflections and final judgment. In the third step the student reflects on steps one and two together with the RN and a clinical lecturer. Based on the scores in the assessment tool and the nurse's oral report, the clinical lecturer decides whether the student has passed or failed the bedside examination.

In a previous paper we described how nursing students experienced being assessed by the NCFE (Andersson et al., 2012), where the students' considered the interactive approach of the written test, in which the correct answer given on the next page, contributes to their learning, and the NCFE, especially the written part, made them reconsider their education as a whole. The aim of this study was to investigate the experiences of the NCFE from lecturers who corrected the written part of examination. A further aim was to study the lectures and the RN during observation of the bedside part of the examination.

## 3. Methods

### 3.1. Study Design

The design of the study was a descriptive, qualitative design. In this study the focus was on the experiences on the use of the NCFE in for a Swedish Bachelor of Sciences in Nursing.

### 3.2. Ethical Consideration

All ethical issues were considered and harm minimised by following the guiding ethical and as the study did not fall under the Swedish Act concerning Ethical Review of Research Involving Humans (SFS, 2008: p. 192), no ethical permission was sought. The participants were fully informed about the voluntary nature of participation, how the data would be treated and the procedures ensuring confidentiality. Informed written consent was obtained from all participants and all participants were informed that they could withdraw from the study at any time without consequences.

### 3.3. Data Collection

Data were collected during two months through study-specific questionnaires that captured also responses to open-ended questions. The participants consisted of four groups: students, lecturers, clinical lecturers and nurses from 10 Swedish Universities collaborating in the NCFE (Table 1). The questionnaire also included open-ended questions where the participants in this study were asked to describe their experiences of participating in both arts of the NCFE: 1) written part and 2) bedside part, and also views of the examinations tools.

In this study we selected from the study-specific questionnaire the participants' answers.

### 3.4. Data Analysis

The text was subjected to qualitative content analysis (Graneheim & Lundman, 2004) was used. The analysis started by reading the participants' answers as a means to acquire an understanding of the overall NCFE, as well as to capture essential features of the text. Relevant parts of the data included their experiences over time, aspects about the organisation and how it is to be an RN. The text was read and re-read to build a general impression of the whole material and then sentences describing the participants' experiences of the examination were identified. Single words or short sentences were used for the coding of vignettes. Codes with a similar content were grouped into categories and outcomes formulated. In this step the main authors (KZ & PLA) condensed the

**Table 1.** Characteristics of the participants in the study.

|  |  | Lecturers N = 28 | Clinical Lecturers N = 98 | Nurses N = 388 |
|---|---|---|---|---|
| Gender | Female; % | 96 | 94 | 94 |
| Age | Median, years (min-max) | 55 (35 - 65) | 52 (36 - 64) | 44 (25 - 64) |
| Qualifications | Reg. Nurse, % | 54 | 42 | 77 |
|  | Advanced Nurse, % | 46 | 58 | 23 |
| Highest academic degree | BSc (180 ECTS), % | - | 8 | 57 |
|  | MSc (60 ECTS), % | 79 | 85 | 8 |
|  | MSc (120 ECTS), % | 4 | 4 | 1 |
|  | PhD (420 ECTS), % | 17 | 5 | - |
| Pedagogical qualifications | Supervisor education, % | - | - | 79 |

codes to filter out irrelevant information. After the authors had reached agreement, the validation was complemented by KZ while PLA selected the most important information from each category. Finally, the information of most importance emerged in the theme and six categories describing the participants' experiences of the written and bedside parts of the examination. The theme was based on the text as a whole, with the contents of the categories reflecting what the lecturers and nurses felt about the two tests of the NCFE. To strengthen the objectivity of the study the other authors went through the entire results and related the findings to the data.

## 4. Results

The results showed participating lectures and RN's experiences of the NFCE. This reflects the six categories and the theme describe a complex of using written part and bedside part of the NFCE, and challenging for nursing education.

### 4.1. Written Part

#### 4.1.1. The Students' Clinical Competence Is Clearly Seen

The written part of the examination provides lecturers with information on the level of the students' clinical competence, the lack of knowledge can be seen in the teacher, which is described in the following example. "Lectures at the university were really provided with a better picture of the students' level of knowledge". The written part was described as a good complement to the bedside part. The written part focused on the knowledge required of a newly graduated nurse. "This is a challenge of the written part of the examination, which systematically tests the minimum level of knowledge required". Despite that this part of the examination is written, the lecturers stated that it helped the students to integrate their theoretical and practical knowledge into clinical reasoning. "I would like to point out that the written examination summarises and combines the different parts of the programme". The written part also represented an actual health care problem and the case was described as realistic, which gave credibility to the NCFE. "This is a strength the students need in order to reformulate their knowledge to solve practical problems in their later working life".

#### 4.1.2. Correction of the Written Examination Is Fair and Reliable

The lecturerswho corrected the written part of the examination stated that they thought that the template used to define the criteria for each question afforded uniformity and reliability in assessing the students' responses. "The examination reflects the diversity of the knowledge in the nursing programme and provides evidence of the areas in which knowledge is most important". The lecturers also stressed that the template contributed to a sense of fairness and uniformity in student performance. "I usually find the marking template clear and reliable, and we often mutually agree on our marking of student answers, which is strength". In the dialogue between lecturers from different universities synergistic benefits were identified in both the level and content in the examination by sharing their marking experiences. "Strength of the written part is the standardisation of the marking template for this part of the examination, which ensures accuracy and reliability". "Our discussions led to thoughts concerning a more reliable marking template for the next written part examination". Another benefit was that the level of education and content of the programme at each participating university could be compared,

allowing for the possibility that the programme could be developed and improved.

Despite the criterion-based marking template, the lecturers identified a weakness in the marking process. In some cases the questions were too general, leaving room for interpretation concerning the grading process. "I sometimes thought the questions were too general and left room for interpretation, which could be a weakness". Another weakness pointed out in the correcting process was the lack of stringency and that the level of difficulty among questions varied. "A small weakness in the construction of the exam is the range in marks for different questions".

## 4.2. Bedside Part

### 4.2.1. Prepare a Student for Future Challenges

The clinical lecturers recognised that the bedside part of the examination promoted the interaction between universities and healthcare organisations during the planning and performance of the examination. The clinical lecturers expressed a strong desire for a valid and reliable assessment of the students' ability to assimilate relevant facts. The evaluation identified a number of opportunities for developed along the examination, which was carried out as both a learning process and as a reflection of future challenges. "I feel that a detailed assessment of the future nursing profession is being carried out". The bedside part of the examination provided the students with an overall assessment of their ability to work according to the structured nursing process. "I believe that the students' clinical competence is elucidated and assessed". The opportunity of involvement in a real care environment during the bedside examination created interactions between health professionals, patients and students. "This can be described as 'assessment in action'", which affords the student challenging yet stimulating experience. The examination was structured and the clinical lecturers gave the students an opportunity to ask questions during the third step, "Reflections and final judgment". "It is important that each student has the opportunity to show that he or she can plan and provide optimal nursing care".

### 4.2.2. Balancing Various Conditions during the Bedside Examination

A number of difficulties were identified during the bedside examination, including finding an optimal and safe assessment as viewed from the perspective of the clinical lecturers. Another weakness that emerged was the diverse knowledge and experience of the nurses. "I feel that several factors affect the result, for example, whether the student feels comfortable with the nurse". The assessment criteria for the bedside examination cause some degree of interpretation as to whether a student will pass or fail. "There are no guidelines regarding what constitutes failure". Other difficulties included non-uniform assessment because of the different levels of ability of the nurses and the varying degrees of difficulty in the actual caring situation. "At our clinic, several of us think that the assessment tool should be revised and improved". The caring situation was perceived at times as an uncertain variable in the evaluation of student knowledge, primarily because the choice of patient meant that different interpretations could be given regarding student performance. "I think the bedside tests can vary depending on the kind of clinic, which is good".

### 4.2.3. Striving for Objective Assessment

The nurses felt there were some weaknesses in the bedside examination, although this was somewhat dependent on the patient care required. The nurses said that the choice of patient, the care setting and the organisation could all affect the assessment of the bedside test. "The nurses should adapt to the way of thinking so that examination reflects the student's ability in real patient situation". The severity of the cases varied depending on the patient chosen for the NCFE, but the nurses made an effort to follow the assessment criteria and to be objective observers during the examination. "Planning the examination requires preparation and it can sometimes be difficult to find cases that cover all areas of care, but it usually sorts itself out in the end". Another aspect affecting objective assessment was variation in the descriptions and interpretations of student performance. "We try to be objective by avoiding subjectivity, but in the end the assessment may depend on the nurse's ability to be objective".

### 4.2.4. How Theory and Practice Create a Potential Nurse

The nurses felt that the NCFE, in the development of student learning, was supportive of nursing knowledge. Moreover, the nurses believed it sufficiently assessed the qualifications required of a newly graduated nurse.

"You can see that theory and practice are brought together in the bedside part of the examination". During the bedside test, students had the opportunity to demonstrate what they had previously learned in the classroom. "The student has the opportunity to show how well he or she can apply theoretical knowledge in a real setting". To obtain confirmation of being ready to work independently and to enhance students, "The students think out loud, so that I get a good idea of how they reason when assessing caring situation".

The theme was expressed in this way: The NCFE is perceived as being beneficial for students as it requires them to solve problems. The written part focuses on the knowledge required of a newly graduated nurse. "This is strength of the written part of the examination, which systematically tests the minimum level of knowledge required". The bedside part included an actual health care problem and was therefore described as realistic, which gave credibility to the NCFE. "This is a strength that the students need in order to reformulate their knowledge to solve practical problems in real life". Taken altogether, the results indicate that NCFE exam suggests that education must be outcome oriented.

## 5. Discussion

The aim of this study was to evaluate the experiences of lecturers who corrected examination papers, the clinical lecturers and the nurses of the NCFE and pay attention to clinical practice. The study showed that the combination of the written and bedside parts of the examination accurately evaluates whether the student has reached the clinical competence required of a graduate nurse. The National Clinical Examination is implemented in collaboration with the university and the students' clinical training unit (Athlin et al., 2012). As the same time, clinical competence of newly registered nurses has become an important issue related to professionals' standards and patient safety (Johansson et al., 2014). Such an approach is valuable because of the identified need for dialogue among staff nurses in preparing them for contact with students and for their supervisory role in modern workplace-based education (Norcini and Burch, 2007). The reliable and valid assessment of clinical competence is complicated, comprising a complex learning process that integrates knowledge, skills and attitudes (Al-Kadri et al., 2012; Smith Higuchi & Donald, 2002). In our study the major finding was the opportunity to test the problem-solving skills of student nurses in a real-life nursing situation. Another finding was that the nursing care situation arranged in the bedside part of the examination was similar to real-life health care interactions. Jerlock et al. (2003) noted that a unique patient and caring situation requires reflection and problem-solving techniques to strengthen clinical reasoning in relation to nursing activities. The results identified in the written part are the reliability in determining the students' level of knowledge on a national scale. In health care education it is imperative to assess the competencies (e.g., clinical competence) that are essential for the professional role in order for nursing students to prepare themselves for future professional duties. According to a systematic review by Rochmawati & Wiechula (2010), there was insufficient evidence to draw any conclusions as to the most effective educational strategies to improve health care professional students' clinical reasoning ability.

However, the written and bedside examinations are more than an assessment of students' declarative knowledge. The format of the examination plays an important role in nursing education in the sense that the problem-solving ability of the student becomes apparent to both the student and the clinical lecturer. Furthermore, the NCFE provides nursing students with a greater degree of confidence and awareness of their clinical competence (Andersson et al., 2012).

The assessment of the students' clinical competence was affected by the differences in conditions during the bedside part of the examination, which was largely due to human and organisational factors. However, there was also an understanding regarding the circumstances of the clinical lecturer and the nurse. The bedside examination identifies the imbalances between specific requirements and resources. Judgment of the nursing students tends to focus on patients' functional capacities and resources in such a way as to help patients achieve a balance that satisfies them as much as possible, which nurses seem to achieve through an objective assessment of the bedside examination. However, our previous study on the opinions of nursing students (Andersson et al., 2012) showed that this test was more important than other tests and assessments during their training. One of the most useful ways of findings describes how theory and practice in conjunction create a potential nurse. Nursing requires broad knowledge and even nurses have great difficulty defining this concept. For nurses to make sound decisions, they must be familiar with what constitutes the area of responsibility of a nurse, as well as possess strong critical thinking and problem solving skills. The role of the nurse in health care has traditionally involved providing patient care in two domains: to delegate medical care and to comfort and reassure the patient (Ziegert

et al., 2007). The NCFE has been shown to help students make the transition from nursing student to qualified nurse (Andersson & Edberg, 2010). Knowledge and critical thinking play a crucial role in the bedside part of the examination. Smith et al. (2004) also discussed nursing students' use of intuition in their care-providing activities. This aspect becomes clear in the NCFE since the care-providing activities may vary, and the conditions are never consistent due to the human aspect in the care of the patients, which challenges the students' intuition.

Several studies have demonstrated the difficulty in developing high-quality written and bedside exams, especially in the context of clinical training (Norcini, 2011). A few weaknesses were identified in our study regarding the bedside examination, namely choice of the caring situation, place and time of assessment and different caring approaches of nurses. Norcini (2005) described the importance of sophisticated content and skills, which are difficult to implement at the clinical education level. Assessment is a critical component of the educational skills and in addition the relation between nurses and students can adversely affect the validity and reliability of the assessment process. Hatfield & Lovegrove (2012) reported that familiarity with the assessment tool and its application could increase assessor confidence. Preparation of the assessors is therefore important as well as carefully designed information, provided in preparation for the execution of the test. Finally, several significant challenges remain in the NFCE, including reliability of the written part, equivalence, stakes, relationships, the need for an evidence-based scoring model for the written examination and criteria validity in for the bedside examination.

## 6. Conclusion

The present findings show that lecturers, clinical lecturers and nurses believe that the NCFE is beneficial in which it stimulates the nursing students to solve problems and demonstrate their skills and knowledge in a real care setting. The examination must be further developed to ensure that learning objectives and educational results have been achieved, and that the examination is useful in terms of accountability and sustainability. Finally, we suggest that further research is needed to assess nursing education in relation to the level of clinical competence of nursing students.

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# Medical Students' Knowledge of Clinical Practical Procedures: Relationship with Clinical Competence

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## Abstract

Clinical competence is an attribute expected of every practicing doctor while proficiency in procedural skills is a requirement by certifying bodies. To attain competency in the performance of procedural/psychomotor skills, possession of conceptual knowledge has been documented as a fundamental pre-requisite in reference to medical education literature. At the University Of Zambia School Of Medicine, the matter of cognitive knowledge in relation to competence in clinical practical skills for undergraduate medical students was investigated in a project which was conducted in 2013. Fifty-six (56) students from a class of 60 (93% response rate) of the final year medical students' class of 2012/2013 completed a Multiple Choice Question (MCQ) knowledge test which was administered to ascertain the level of knowledge on 14 selected clinical practical procedures. Knowledge levels of clinical practical procedures of the final year medical students were found to be inadequate represented by a 39% pass rate with students' scores lower than the Angoff determined pass mark on most items. Expectedly, students were more knowledgeable in those procedures where they were formally taught and those where there was a high likelihood of being assessed. The correlation between knowledge and self-perceived competence was positive Spearman rho of 0.360, while a negative correlation was recorded between knowledge and manifest competence (objectively measured competence) Pearson r −.116. The positive correlation between knowledge and self-perception of competence is an indication of the role of knowledge in improving self-concept about a skill, which may consequently lead to improved performance.

## Keywords

Medical Students, Knowledge, Clinical Practical Procedures, Psychomotor Skills, Clinical Competence

## 1. Introduction

Clinical competence has been defined as "habitual and judicious use of communication, knowledge, technical skills, clinical reasoning, emotions, values and reflection in daily practice for the benefit of individuals and community being served" (Epstein & Hundert, 2007). Alongside humanistic qualities, clinical competence is an attribute expected of every practicing doctor (Carr, 2004) while demonstration of proficiency and appropriate use of procedural skills pre-registration is a requirement by certifying bodies (Morris, Gallagher, & Ridgway, 2012).

Regarding clinical competence, the undergraduate medical education curriculum aspires to initiate the process of transforming novices to experts, although it is acknowledged that transformation to a large extent happens after qualification (Lai, Sivalingam, & Ramesh, 2007). In order to meet this aspiration, curricula of many medical schools state the clinical practical skills so that students must demonstrate competence by the time they graduate, yet many graduate without learning these mostly common and some potentially lifesaving skills to the detriment of the quality of care for patients (Moercke & Eika, 2002; Colberly & Godenhar, 2006; Elango et al., 2007; Wu et al., 2008; Promes et al., 2009; Institute for Health Care Improvement, 2010).

At the University Of Zambia School Of Medicine (UNZA-SOM), the matter of competence in clinical practical skills for undergraduate medical students had not been studied prior to a PhD project that was conducted in 2013. The project investigated how medical students of the University of Zambia acquire competence in selected clinical practical skills, their knowledge level, self-perception of competence as compared to manifest competence, and self-rated experience in selected set of skills. Although several aspects of clinical competence were studied, this article focuses on the clinical practical procedures knowledge level of Final Year Medical Students of the University of Zambia in the last six months of the undergraduate medical education. The article address one out of the three research questions which were investigated; what is the clinical practical procedures knowledge level of Final Year Medical Students of the University of Zambia in the last six months of the undergraduate medical education?

The role of conceptual knowledge in psychomotor skills is documented in literature (Kopta, 1971; Hamdorf & Hall, 2000; Amin & Hoon-Eng, 2003; Buckley, Manalo, & Lapitan, 2011). Hamdorf & Hall (2000) assert that individuals who are provided with clear description in addition to clear demonstration of a task are more likely to master a skill than those who are not. Description which is cognitive in nature involves explanation of what the procedure is, when it is indicated or contraindicated, where it is performed (anatomical structures involved), and guiding principles, while demonstration involves actual performance or process of undertaking the procedure.

In a study conducted by Buckley, Manalo & Lapitan (2011) at the University of the Philippines, Manila to assess the knowledge and practices of medical interns relating to urethral catheterization and iatrogenic urethral injury secondary to traumatic catheter insertion, findings were that slightly more than half (55.6%) of the respondents stated that they had adequate theoretical training and (66.7%) adequate practical training. Despite relatively high levels of experience, deficits were identified in detailed knowledge of correct catheterization procedures and of risks associated with urethral injury. Those not trained by demonstration and re-demonstration methods were less likely to lubricate the urethra in line with widely accepted good practice. Compared with those who reported adequate theoretical training, those who reported minimal or no theoretical training were less likely to take a history, an aspect considered critical in identifying risk factors for urethral strictures. One limitation of study of the Buckley, Manalo, and Lapitan was that a survey questionnaire was used to assess acquired competence. From a skills' training methodology point of view, direct observation is a better method than a questionnaire survey. Despite the methodological limitation, to some extent findings of this study demonstrated the importance of cognitive knowledge in clinical skills performance.

The role of cognition in skill performance is further demonstrated by Miller (1990) in the Pyramid of clinical competence. The pyramid conceptualizes the essential facets of clinical competence. It illustrates four levels of demonstrated learning as shown in **Figure 1**.

The base represents the knowledge component of competence; the student has factual knowledge of a skill or field "Knows". At level two, the learner "Knows how" the skill is performed in theory (applied knowledge). At level three the learner "Shoes how" to do so in a controlled environment or simulated environment and finally in stage four, the leaner "Does" in actual clinical practice. The first two levels of Miller's Pyramid (Knows and Knows how) are more cognitive in nature while the last two (Shows how and Does) are psychomotor in nature,
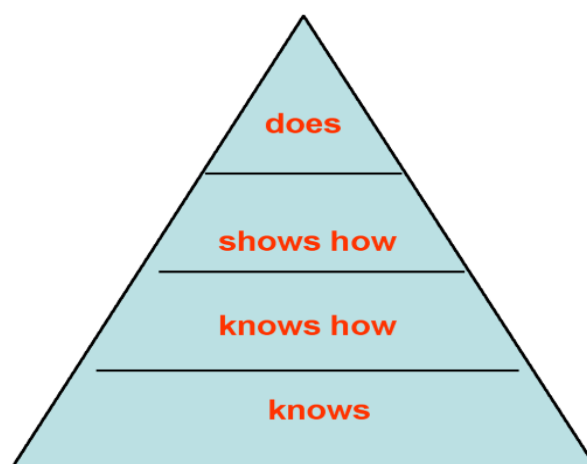
**Figure 1.** Miller's 1990 pyramid of clinical competence-adapted from miller 1990.

implying that for an individual learner to "Show how" a clinical procedure is done and consequently perform it "Does", one should possess the cognitive knowledge as a foundation for the psychomotor activity.

Birnbaumer (2011) clearly delineated the role of cognition in teaching and learning procedural skill in medical education.

"To teach procedures successfully, medical educators must focus on teaching both a thorough understanding of the cognitive aspects of the procedure and the 'hands on' component. Before picking up an instrument, learners must understand the proper indications, contraindications, alternatives, steps involved, complications, and documentation needed for its use. Teaching this cognitive component should precede the student using that instrument or device. In fact, the learner should never attempt a skill until after a successful verbal 'walk through' of the procedure. Many procedures are taught in the clinical environment with the teacher simultaneously demonstrating and describing the skill to the learner. To maximize acquisition of the cognitive information, however, some educators suggest that mental and manual skills should not be taught in the same session because learners tend to focus on the hands-on skill at the expense of understanding the thought processes involved. To facilitate learning the cognitive component, checklists provide an organized approach to teaching and learning the components of a procedure. These checklists should include a series of detailed, simple, sequential steps for the procedure being taught. They provide a reference for the learner to review and for the teacher to use while teaching the procedure as well as while watching the learner performs it".

It is on the basis of such documented relationships between conceptual knowledge and skill performance that the clinical practical procedures knowledge level of Final Year Medical Students of the University of Zambia was investigated and correlated to both manifest and self-perceived competency in clinical practical procedures. It is however acknowledged that Possession of cognitive knowledge is, not the only factor underlying adequate skill performance. There are other factors that determine both acquisition and development of clinical competence including: curricular model and sequencing, clinical teaching and assessment and skill/procedure related factors (AAMC, 2008). Others are deliberate practice, quality of clinical supervision and feedback (Griffith et al., 1997; Ericsson, 2006; Wimmers, Schmidt, & Splinter, 2006; Duvivier et al., 2011). Discussion of these factors is beyond the scope of this article.

## 2. Methods

### 2.1. Design

The overall design of the project from which this article stems was a non-interventional cross sectional correlation study that utilized a concurrent transformative with concurrent embedded mixed method strategy. The overall study was correlational due to the determination of relationships among four variables (knowledge, self-perceived and manifest competence, and self-rated experience with selected skills), and transformative because it was underpinned by theoretical models. The study was also concurrent embedded due to the use of both quantit-

ative and qualitative methods with the smaller qualitative component nested within the large quantitative component. In addition, the simultaneous collection of both qualitative and quantitative data qualified it as "concurrent" embedded. The qualitative arm was used to investigate how medical students of the University of Zambia acquire competency in clinical practical procedure, while the quantitative component investigated the students' knowledge level regarding procedural skills and their levels of manifest versus self-perceived competence. This article however focuses only on one component of the quantitative arm of the project that is the clinical practical Procedures knowledge levels of final year medical students of the University of Zambia although correlations to both manifest and self-perceived competence are presented.

## 2.2. Data Collection

A Multiple Choice Question (MCQ) knowledge test was administered to ascertain the level of knowledge on 14 selected clinical practical procedures. The knowledge test had 14 categories of questions based on the 14 selected clinical practical procedures that is: 1) lumbar puncture; 2) cardiopulmonary resuscitation; 3) endotracheal intubation; 4) urethral catheterization; 5) nasogastric intubation; 6) gastric Lavage; 7) examination of the new-born; 8) vaginal delivery; 9) vaginal examination; 10) examination of the placenta; 11) intravenous cannula insertion; 12) suturing; 13) intramuscular drug administration; 14) intravenous drug administration. Fifty-six (56) students from a class of 60 (93% response rate) of the final year medical students' class of 2012/2013 at the University of Zambia completed MCQ test.

The MCQs were purposively selected from relevant published question banks on each category. The questions in the test focused mainly on the indications/contraindications, equipment used, principles of performing the procedure, correct technique, volumes or ratios, correct positions/sites/landmarks, and precautions while performing the procedures. The Q-Q plot test for normality revealed a normal distribution and Cronbach alpha for reliability was 0.774. Using a criterion referenced pass mark set at 60%, each answer script was manually scored for the right answer on all the items and totaled into a percentage to determine the knowledge level for each students.

The 60% pass mark for the knowledge test in our study was determined using the original Angoff Procedure. Angoff method is a criterion-based method of standard setting. This method was initially developed by Angoff in 1971.The method uses experts in the field to determine the cut-off point/score. The cut-off score is defined as a score that a minimally competent candidate is likely to achieve (Canadian Association of Medical Technologists, 2006). Scores below the Angoff cut off point are deemed as failure. Using this method, five local experts two from internal medicine, one from surgery, one from obstetrics and gynaecology and one from Paediatrics and Child Health determined the pass mark depending on the difficulty level of each question. Two out of the five Angoff Panelist were Consultants while the other three were Senior Registrars; therefore they were considered experts in their medical fields. The inter-rater agreement for all questions was above 85%.

## 2.3. Data Analysis for the Knowledge Test

Each answer script for the 56 student was manually scored for the right answer on all the test items and totaled into a percentage to determine the knowledge level for each student. Following marking, responses from the MCQ knowledge test scripts was entered into SPSS version 17. The marking key was used to identify the correct answer for each question which was entered as the correct option for each respective question in SPSS. Following data entry, frequencies were computed for correct scores for each question. Computation of frequencies for each question determined the performance (Pass rate) of students on each individual question. The Q-Q plot test was performed which revealed a normal distribution. Given that the data for the knowledge test was normally distributed, descriptive statistics that is the Mean, Standard Deviation and Range were computed.

Since the MCQ knowledge test tool also had questions on demographic characteristics and clinical medical education context, responses on the other two components were entered onto SPSS at the same time as the knowledge test. Consequently, frequencies for the demographic variables and clinical medical education context were computed.

Based on documented relation between cognitive knowledge and practical skills performance, and the correlational nature of the overall study, apart from simply determining the knowledge levels of students, tests for association between the knowledge test scores and manifest-competence (OSCE scores). **Correlation coefficient (Pearson r) test was performed.** To facilitate rank order correlation of knowledge which was originally

measured at interval level with self-perception of competence and self-rated experience with procedural skills which were measured at ordinal level, the knowledge test scores were re-categorized from the specific numeric scores in percentage form to ordinal level with three categories. The categories were; Fail (scores of 0% - 59% [below pass mark]), Bare Pass (score 60% - 80% [pass mark up to mid-point between pass mark and total]), and absolutes pass (score of 81% - 100% [above mid-point between pass mark and total]). Following re-categorization, rank order correlations (**Spearman rho)** test were performed between knowledge and self-perceived competence, and knowledge and self-rated experience with procedural skills.

## 3. Results

Out of the 56 medical students who participated in the study, majority 38 (67.9%) were male compared to only 18 (32.1%) females. Only 5 (8.9%) of the respondents had training in other health care related fields prior to undergraduate medical education while 49 (87.5%) had not had. All the 56 (100%) had had clerkships in all the designated medical disciplines and their sub-specialties; Internal Medicine, Surgery, Obstetrics and Gynaecology, Peadiatrics and Child Health, Ophthalmology, Community Medicine, Dermatology, ENT/Maxilofacial, and Radiology. Major variations were noted regarding the numbers of students who were formally taught in the 14 selected practical procedures. The least formally taught was administration of intravenous drug with only 8 (14.3) of the students reporting having been formally taught. Procedures that received the highest score for being formally taught are Cardiopulmonary Resuscitation and normal vaginal delivery at 46 (82.1%). Others where at least two thirds of students were formally taught were examination of new born, Lumbar puncture and vaginal examination. Similarly, majority of students had no formal assessment in most of the clinical practical procedures. The least formally assessed was wound suturing where only 7 (12.5%) of participants indicated having been formally assessed followed by intravenous drug administration at 8 (14.3%). The highest formally assessed practical procedure was lumbar puncture where 52 (92.9%) of participants reported having been formally assessed.

Overall, the knowledge levels of clinical practical procedures of the final year medical students were found to be inadequate represented by a 39% pass rate on a 48-item MCQ test. The Angoff determined pass mark was 60%, Mean Score was 53.38, Standard Deviation 10.44 and Range 50. Most scores were skewed to the left or below average (Skewness of −124). **Figure 2** shows the pass mark on the MCQ Knowledge test, while **Table 1** shows the Knowledge Scores (Percentage) on Selected Questions on the 14 Clinical Practical Procedures.

Using criterion referencing for grading with Angoff Pass mark at 60%, only 22 (39.3%) of participants passed the knowledge test.

**Table 1** shows the proportions of students with correct scores on selected Multiple Choice (MCQs) from the knowledge test in comparison to the Angoff determined pass mark. The best performance with 80.4% pass rate was on a question about vaginal examination (correct interpretation of fetal presenting part for a head that is visible at vaginal introitus), followed by knowledge of recommended CPR compressions where 78.6% of the respondents knew the recommended compression rate for adults. The worst performance with 12.6% pass rate was on a question on endotracheal intubation regarding the best clinical sign that the ETT is in the trachea and not the esophagus. Other poor performance were noted on questions regarding intramuscular injections (21%
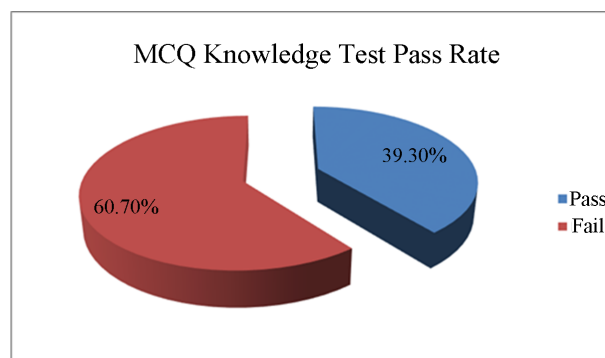


**Figure 2.** Criterion referencing (pass/fail rate). Angoff pass mark at 60%. N = 56.

**Table 1.** Knowledge scores (percentage) on selected questions on the 14 practical procedures.

| Practical procedure | Question(s) | Number of students with correct score (N = 56) | Angoff pass mark for each question | Percentage of student with correct score | Level of difficulty |
|---|---|---|---|---|---|
| Cardiopulmonary resuscitation (CPR) | Recommended rate of (CPR) compressions | 44 | 57.5% | 78.6% | 0.78 |
| | Recommended universal compression-to-ventilation ratio for all ages (except newborn infants) | 29 | 56% | 51.8% | 0.52 |
| Intravenous cannula insertion | Correct technique to follow as one advances cannula into center of the vein | 43 | 40% | 76.7% | 0.76 |
| Urethral catheterization | During catheterization, once urine flows, how much further should the catheter be advanced in females | 20 | 57% | 35.7 | 0.35 |
| Nasogastric tube insertion | Correct technique when inserting an NG tube | 17 | 60% | 30.4% | 0.30 |
| Gastric lavage | Contraindications for gastric lavage | 34 | 70% | 60.7% | 0.60 |
| Lumbar puncture (LP) | Actions to take if you encounter bone resistance while advancing LP needle | 25 | 66.2% | 44.6% | 0.44 |
| | The indicator that one has reached the subarachnoid space While advancing a LP needle | 16 | 61 | 28.6% | 0.28 |
| Endotracheal intubation | Minimum recommended distance above the carina for proper placement of ETT | 23 | 33.3% | 41.1% | 0.41 |
| | The best clinical sign that the ETT is in the trachea and not the esophagus | 7 | 68.3% | 12.5% | 0.12 |
| Suturing | Correct technique for tying a surgical knot | 37 | 58.7 | 66.1% | 0.66 |
| Vaginal examination | Correct interpretation of fetal presenting part for a head that is visible at vaginal introitus | 45 | 84 | 80.4% | 0.80 |
| Normal vaginal delivery | Regularity of assessing uterine contractions in the first stage of labour for normal labour | 38 | 73% | 67.9% | 0.67 |
| Examination of placenta | Most likely diagnosis for a greenish appearance of fetal surface of the placenta on gross inspection | 38 | 82% | 68.9% | 0.68 |
| | Most likely diagnosis for an umbilical cord length 100 cm for a normal full term newborn infant | 27 | 63% | 48.2% | 0.48 |
| Examination of the newborn | APGAR score one minute after birth for a newborn appearing blue in color, heart rate of 40/minute, no respirations, is flaccid with no movement, and does not respond to stimulation. | 28 | 65% | 50% | 0.50 |
| Intramuscular (IM) drug administration | Correct angle for administer an intramuscular injection | 29 | 61% | 51.8% | 0.51 |
| | Maximum volume of drug allowable per IM site | 28 | 65% | 50% | 0.50 |
| | Recommended muscle for IM injection in infants | 12 | 60% | 21.4% | 0.21 |
| Intravenous drug Administration | Determining rate of flow for 1000 mls or normal saline with 300 mg of aminophyline to be administered in 8 hours | 33 | 57.5% | 58.9 | 0.58 |

Angoff pass mark = proportion of students who according to experts are expected to get the item correct; Level of difficulty = proportion of students with correct scores on an item.

pass rate), lumbar puncture (28% pass rate), nasogastric tube insertion (30%), and urethral catheterisation (36%).

Table 2 shows a negative correlation between knowledge test scores and OSCE scores. Pearson r −.116 and *p* value .395. With the negative correlation, regression analysis of the two variables was not performed.

Table 3 shows the comparisons in terms of knowledge, self-perception, manifest-competence and self-rated experience with the three procedures included in the OSCE. Despite 65.2% of students getting correct scores on questions on CPR, majority of them (>50%) were not competent and had low self-perception probably due to low-experience with the procedure. On the other hand, despite students reporting high experience with intravenous drug administration, majority were only barely competent with moderate self-perception.

All the participants who had bare passes (score of 60% - 80%) had either moderate 12 (54.5%) or high 10 (45.2) self-perception of competence while the three with low-self competence failed the knowledge test. In addition, all the participants who passed had either moderate or high self-perception. Therefore, a significant association was observed between self-perceived competence and knowledge *p* = 0.007 with rank-order correlation Spearman rho of 0.360.

## 4. Discussion

The role of cognition in skill performance is well documented in medical education literature (Kopta, 1971; Miller, 1990; Hamdorf & Hall, 2000; Amin & Hoon-Eng, 2003; Buckley, Manalo, & Lapitan, 2011). In addition, cognition (mastery of a body of knowledge) is regarded as one of the dimension of clinical competence as can be construed from Newble et al. (1994) and Epstein & Hundert (2002) definition of clinical competence. Therefore in order to fully understand the concept of "clinical competence", an understanding of cognitive attributes was inevitable. The role of cognition in skill performance is further demonstrated by Miller (1990) in the Pyramid of clinical competence. Miller's pyramid of clinical competence together with two other conceptual models underpinned the present study (Figure 1). Miller (1990) demonstrated the value of cognition in skills performance by placing the knowledge component of clinical competence at the base of the pyramid; "Knows" = possession of factual knowledge of a skill or field and "Knows how" = applied knowledge before the "Shoes how" = performance in a controlled environment and "Does" = performance in clinical practice. The first two levels of Miller's Pyramid (Knows and Knows how) are more cognitive in nature while the last two (Shows how and Does) are psychomotor in nature. The implication being, that for an individual learner to "show how" a clinical procedure is done and consequently perform it "Does", one should possess the cognitive knowledge to underline psychomotor activity.

**Table 2.** Correlation coefficient (Pearson r) of overall manifest competence (OSCE scores) and knowledge of clinical practical procedures.

| | OSCE Scores | Knowledge Scores |
|---|---|---|
| OSCE Scores (Pearson r) | 1 | −.116 |
| N | 56 | 56 |
| Knowledge Score (Pearson r) | −.116 | 1 |
| | 56 | 56 |

**Table 3.** Relationship of knowledge, self-perception, manifest competence, and experience with the three practical procedures included in the OSCE.

| | Cardiopulmonary resuscitation | Insertion of a nasogastric tube | Intravenous drug administration |
|---|---|---|---|
| Knowledge level (% of students with correct answer | 65.2% | 30.4% | 57.5% |
| Self-perception category for majority (>50%) of respondents | Low self-perception | Moderate self-perception | Moderate self-perception |
| Manifest-competence category for majority (>50%) of respondents | Not competent | Absolutely competent | Barely competent |
| Self-rated experience with procedure | Low experience | Low experience | High experience |

It is with the above understanding that a knowledge test was administered. Using Angoff pass mark of 60% only 39.3% of students passed the test (**Figure 2**). Mean Score was 53.38, Standard Deviation 10.44, Range 50 and Skewness −124. With most scores skewed to the left or below average (Skewness of −124). The mean score of 53.38% was low considering that the students assessed were in their last six months of medical education and are expected to possess adequate cognitive traits of common core clinical practical procedures. When the student pass rates for each question were compared to Expert (Angoff) determined pass rates, the Angoff pass mark was high on most questions compared to actual student scores (**Table 1**). This entails that teachers expected their students to know more than what actually students knew.

When Item analysis was performed to determine the level of difficulty of each question, there were major variations in the levels of difficulty for different questions. Level of difficult is defined as the proportion of students who answer the question correctly (Amin & Hoon-Eng, 2003). The lower the proportion is, the more difficult the item. From the knowledge test administered in our study, the highest correct score of 80.4% was obtained from a question on Vaginal Examination (VE) followed by 78.6% on a question on Cardiopulmonary Resuscitation (CPR) (**Table 1**). The lowest correct score of 12.5% was from a question on endotracheal intubation (**Table 1**). Consequently the level of difficulty for VE (0.80) and CPR (0.78) were lower than that for endotracheal intubation (0.12). The results therefore meant that students found the question on endotracheal intubation more difficulty than the ones on VE and CPR. Several reasons can be advanced for variations in the pass rates for different questions; probably the question on VE and CPR were truly less difficulty compared to that on endotracheal intubation or probably students had better understanding of VE and CPR compared to endotracheal intubation, as both VE and CPR were among the top five formally taught procedures.

Wass et al. (2001) and Epstein (2007) assert that assessment drives learning. With this assertion, the three procedures; vaginal examination, CPR and endotracheal intubation, were considered in terms of the number of students who had been formally assessed during the clinical years. It was established that 44.6% of students were formally assessed on VE, 30.4 on CRP compared to 19.6% who were formally assed on endotracheal intubation. Literature alerts us that students feel overburdened by work and respond by studying only the parts of the course that is assessed (Hakstian, 1971 cited in Epstein, 2007 and Wass et al., 2001). Therefore, the likelihood of being formally assessed could have lead students to study more literature related to vaginal examination and CPR compared to endotracheal intubation consequently resulting in high pass rate in VE and CPR.

In our study, there was also a negative correlation (Pearson r −.116) between knowledge of clinical practical procedures and overall manifest competence on the seven practical procedures (**Table 2**). Disagreements were also recorded between knowledge and manifest competence for two out of the three practical procedures that were in both the knowledge test and manifest competence test (OSCE) (**Table 3**). Whereas 65.2% of students had correct scores on CPR knowledge questions, more than 50% were not competent on the CPR OSCE station (manifest-competence). For nasogastric tube insertion, only 30.4% had correct scores in the knowledge test, whereas more than 50% were absolutely competent on the OSCE station. For intravenous drug administration, more than half (57.5%) of students had correct scores in the knowledge test, similarly more than 50% were barely competent on the nasogastric tube insertion station of OCSE, (**Table 3**). With these finding, it could be concluded that knowledge of a clinical practical procedures is not related to actual performance. However, caution should be taken in applying this conclusion because for our study, manifest competence was measured using the end of year final OSCE results. OSCE being a final examination, students could have studied compared to the knowledge test which was not part of the School evaluation systems. On the other hand, OSCE being a final examination could have caused anxiety among students compared to the knowledge test which was not. These factors could have therefore caused variations in performance between the knowledge and OSCE performance.

With the assertion that high self-efficacy (self-perception) is related to high achievement in educational settings (Bandura, 1997), self-perception of competency was correlated to the knowledge of clinical practical procedures (**Table 4**). A positive association was established between self-perception of competency and knowledge of clinical practical procedures Spearman rho 0.360. Although the correlation was relatively weak (0.360), this finding still supports assertions by Bandura (1997) that individuals who perceive themselves highly, are likely to work hard and subsequently get better scores in examinations and tests. This was probably the reason why students who had high self-perception on clinical practical procedures got better scores in the knowledge test, consequently the recorded association between self-perception and knowledge. Similarly, the high knowledge related to clinical practical procedures would have led to high self-perception.

**Table 4.** Cross tabulation and rank-order correlation between self-perceived competence and knowledge of core-clinical practical procedures.

| Level of self-perceived competence | Knowledge level (Ordinal) | | | Total | Spearman rho = 0.360 |
|---|---|---|---|---|---|
| | Fail | Bare pass | Absolute pass | | |
| Low | 3 (9.4%) | 0 (0%) | 0 (0%) | 3 (5.6%) | |
| Moderate | 24 (75%) | 12 (54.5%) | 0 (0%) | 36 (66.7%) | |
| High | 5 (15%) | 10 (45.5%) | 0 (0%) | 15 (27.8% | |
| Total | 32 (100%) | 22 (100%) | 0 (0%) | 54 (100%) | |

## 5. Conclusion

From our study, we concluded that knowledge of clinical practical procedures was inadequate represented by 39% pass rate. Teachers' expectations (Angoff pass marks) were higher than actual student scores on most questions and the entire MCQ knowledge test. For specific MCQ items, the pass rate was high on those items from practical procedures that were formally taught. Students were more knowledgeable in those procedures where there was a high likelihood of being assessed, thus supporting the assertion that assessment drives learning. If you desire students to learn some concept, you need to find means to assess such a component. We also concluded that self-perception of competence is related to the cognitive knowledge that one possesses as there was a positive correlation between knowledge of clinical practical procedures and self-perception. The positive correlation between knowledge and self-perception of competence is an indication of the role of knowledge in improving self-concept about a skill, which may consequently lead to improved performance.

## Acknowledgements

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Scientific Research

# A Five-Year Institutional Study of the Effectiveness of Fourth-Year Clinical Anatomy in Promoting Musculoskeletal Education

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## Abstract

**Despite the increasing prevalence of musculoskeletal disease in the population, studies continue to show deficiencies in the duration and extent of musculoskeletal education. From 2009-2013, senior medical students enrolled in a clinical anatomy elective at our institution's medical school completed pre- and post-course examinations related to musculoskeletal education with associated radiographic interpretation and physical examination correlates. A control group of fourth-year students who did not participate in a clinical anatomy elective completed a comparable exam. Student pre-course and control group test scores averaged 54%. The control group scored at the same level for the radiographic (pre-course average 65%, control-group average 61%, $p = 0.21$) and physical exam sections (pre-course average 56%, control-group average 53%, $p = 0.28$), and lower in the musculoskeletal portion (pre-course average 50%, control-group average 39%, $p < 0.001$). Students completing a clinical anatomy elective scored significantly higher on their post-course examination compared to their pre-course examination on all sections ($p < 0.001$) and scored higher than their classmates in the control group, with mean test scores of 84% for the combined sections, representing a 28% improvement. Senior medical students demonstrated deficits in knowledge related to musculoskeletal medicine. Following a focused fourth-year anatomy elective providing students with the opportunity to focus their learning of anatomy in a clinical context, students' knowledge in musculoskeletal medicine increased substantially.**

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## Keywords

**Applied Clinical Anatomy, Musculoskeletal Education, Medical Education, Anatomy Curriculum**

## 1. Introduction

Musculoskeletal (MSK) injuries weigh heavily on society as it represents the most common health condition in the United States (Musculoskeletal Diseases: Leading Cause of Disability and Health Care Cost). Multiple national studies have identified that musculoskeletal diseases now constitute 20% of complaints and injuries in the emergency room (De Lorenzo, Mayer, & Geehr, 1990) and at least 15% of primary care visits (Pinney & Regan, 2001). With the aging population (Public Health and Aging: Trends in Aging United States and Worldwide, 2003) and increasing prevalence of obesity, (Overweight and Obesity, 2012) future physicians will need to be adequately trained to diagnose and treat musculoskeletal conditions.

Recent studies, however, suggest that medical schools in the United States are not effectively addressing MSK medicine within their curricula (DiCaprio, Covey, & Bernstein, 2003; Freedman & Bernstein, 1998; Schmale, 2005). A recent study by LaPorte et al. found that only 24.7% of graduating medical students passed a validated orthopedic examination developed by Freedman and Bernstein (Skelley, Tanaka, Skelley, & LaPorte, 2012). MSK medicine requires a solid understanding of 3-dimensional anatomy along with its clinical significance. One growing trend, however, is a reduction in time spent on human gross anatomy, one of the core foundations of medicine. The average time allocated to gross anatomy in United States allopathic medical schools has fallen from 249 hours to 144 hours from 1967 to 2001 (Gartner, 2003). The reduction raises concerns about whether the current state of anatomy education properly equips graduates for residency and beyond, (Waterston & Stewart, 2005) especially since the first year of medical school is often the only time specifically devoted to teaching anatomy.

While many have documented the reduction in hours, investigators have not thoroughly explored the consequences and potential remedies in both the United States and the United Kingdom. A US survey attempted to quantify the adequacy of medical student preparation in gross anatomy after the significant reduction in hours. The survey investigated residency programs in family practice, emergency medicine (EM), diagnostic radiology, and general surgery regarding anatomy, its usefulness, and the quality of student preparation. The majority of program directors chose anatomy among the most important basic sciences in undergraduate medical training. In addition, 57% of program directors felt students needed a refresher in anatomy and only 29% thought students were adequately prepared (Cottam, 1999). In the UK, studies demonstrated that students who learned under a prior, more rigorous anatomy curriculum performed better on anatomy exams than students who participated in a reduced anatomy curriculum (McKeown et al., 2003).

Investigators have put forth two solutions to address the problem: the Stealth Approach and Reclaiming the Fourth Year (Bernstein et al., 2003). In the Stealth Approach, MSK medicine is woven throughout all four years of medical school, with each year reinforcing and adding to the depth of knowledge. Reclaiming the Fourth Year provides students with the opportunity of revisiting MSK medicine during fourth-year electives. In this study, we evaluated the feasibility and impact of the latter approach in improving knowledge in MSK medicine by developing and implementing two fourth-year electives in applied clinical anatomy. Student knowledge was assessed using a written examination composed of questions from the Freedman and Bernstein examination, American Association of Anatomists (AAA), and the corresponding author of this study. We hypothesized that gaps in knowledge in clinically relevant anatomy would be demonstrated among fourth-year medical students and a focused fourth-year anatomy elective would significantly improve students' knowledge.

## 2. Materials and Methods

We developed and offered two fourth-year electives at our institution's medical school: "Applied Clinical Anatomy: The Musculoskeletal System" and "Applied Clinical Anatomy: Emergency Medicine Procedures". We have offered the musculoskeletal (MSK) course for five years (2009-2013) and the emergency medicine (EM) course for four years (2010-2013). Before the start of each elective, all students took a pre-course exami-

nation that consisted of three parts: MSK anatomy, radiographic interpretation, and physical examination correlates. The MSK and physical exam portions each consisted of 25 questions; whereas, the radiology portion consisted of 18 questions. We allotted one hour to complete each portion. The same students, upon completion of the elective, took a post-course examination with identical form at consisting of different questions based upon a similar discrimination level. Questions used on these examinations were not revealed to instructors of the course.

We also administered an examination of identical format and similar difficulty to a control group of graduating fourth-year medical students in 2011 who had not taken an anatomy elective. We recruited students by email, provided monetary compensation for their time, and informed them that we would use examination scores only for a study on anatomy education and that we would keep all personal information anonymous. In addition, we obtained student residency matches by specialty for the intervention and control groups. IRB approval was obtained (HUM00090388).

## 2.1. Assessment Instrument

Each item on our knowledge examinations required a single-best fill-in-the-blank answer that encompassed either identification of an anatomical structure/radiographic finding or the description and clinical significance of a particular physical exam correlate. Examination questions were of similar discriminatory value and randomly selected from a question bank comprised of 350 test questions incorporating those formulated by Bernstein et al., American Association of Anatomists (AAA), and Zeller et al. (Gross Anatomy, 2008; Freedman & Bernstein, 1998) Bernstein et al. worked additionally with program directors from internal medicine residency programs and identified a passing score of 70% for their validated examination. (Freedman & Bernstein, 2002)

## 2.2. Course Design

MSK and EM courses were comprised of morning didactic sessions followed by afternoon labs. The MSK course uses cadaver dissection with a focus on applied anatomy with clinical and radiographic correlations. It has specific focus on the execution and anatomy behind eleven common orthopedic procedures (below-knee amputation, surgical exposure for rotator cuff repair, plating of midshaft humeral fractures, surgical exposure for forearm both-bone fractures, open reduction and internal fixation of bimalleolar fractures, hip arthroplasty, knee arthroplasty, joint arthrocentesis, carpal tunnel release, cubital tunnel release, and tarsal tunnel release). The EM course has the same core foundation of knowledge but instead focuses on eleven common EM procedures performed in our simulation center (cricothyroidotomy, tracheostomy, needle throacostomy, chest tube placement, intubation, slit lamp exam, lumbar puncture, arterial line placement, central line placement, peripheral IV line, and paracentesis). These fourth-year electives approach anatomy as taught during the first year of medical school but in a more clinically orientated manner intended to significantly bolster 3-dimensional anatomy education.

## 2.3. Statistical Analysis

We compared pre-course and post-course exam scores of the intervention group using a paired t-test. We compared the control group scores to the pre-course exam scores of the intervention group using an independent groups t-test. Statistical significance was set at $p < 0.05$.

## 3. Results

From 2009-2013, 49/51 (96%) students who enrolled and completed the MSK course completed both the pre-course and post-course exams. Two students did not complete pre-course exams and were thus excluded from the analysis. From 2010-2013, 50/50 (100%) students who enrolled and completed the EM course completed both the pre-course and post-course exams. Aggregated over the two electives, 99 students completed the MSK portion, 80 students completed the radiographic interpretation portion, and 80 students completed the physical examination correlates portion. There were 19 less students taking the latter two portions because those sections were not included in the battery of exams until 2011. The control group consisted of 61 graduating seniors from our institution's medical school class of 2011. **Figure 1** summarizes the performance on the knowledge test of

the students in the control group to that of the students participating in a clinical anatomy elective, prior to and after their participation in the course.

## 3.1. Control Group and Intervention Group Pre-Course Examination Performance

The mean pre-course examination scores for the students participating in a clinical anatomy elective for the MSK, radiographic, and physical examination correlate portions were 12.5/25 (50%), 11.6/18 (65%), and 14.0/25 (56%) respectively, with a cumulative mean score of 38.1/68 (56%). Mean scores for the control group were 9.6/25 (39%), 11.0/18 (61%), and 13.3/25 (53%) respectively, with a cumulative mean score of 33.9/68 (50%). For the radiographic and physical exam portions, there were no statistically significant differences in comparing performance of the intervention and control group students ($p = 0.21$ and $p = 0.28$ respectively). There was a statistical difference between the two groups for the MSK portion ($p < 0.001$). The range and confidence intervals for these data are summarized in **Table 1**.
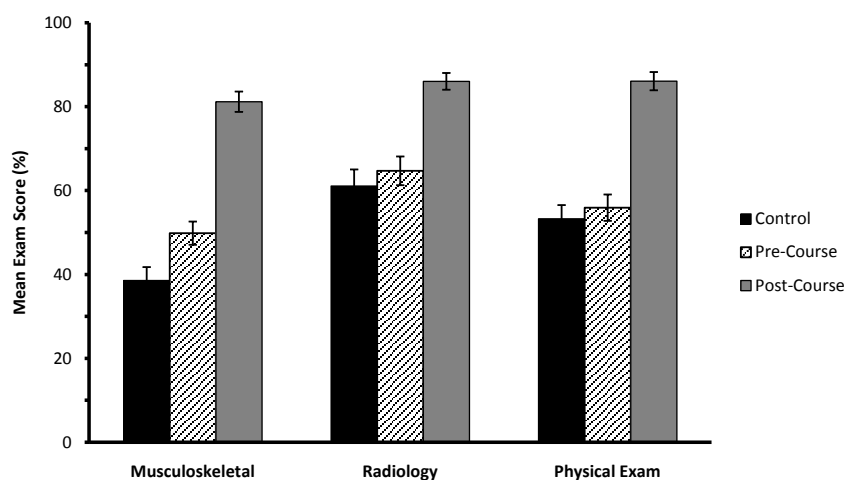


**Figure 1.** Exam scores for the control group and for the pre- and post-elective intervention group on the MSK anatomy, radiographic interpretation, and physical examination components among fourth-year medical students at our institution between 2009-2013. For the control group, n = 61. For the intervention group, n = 99 for the MSK portion and n = 80 for the radiographic and physical examination portions. Reporting of performance scores shows mean % correct performance, with 95% confidence intervals shown with error bars.

**Table 1.** Numerical values of knowledge examination scores for the control groups and for the pre- and post-elective scores of the intervention group on the MSK anatomy, radiographic interpretation, and physical examination components among fourth-year medical students at our institution between 2009-2013. For the control group, n = 61. For the intervention group, n = 99 for the MSK knowledge examination portion and n = 80 for the radiographic and physical examination portions. Reporting of performance scores shows mean % correct performance, with 95% confidence intervals shown in brackets.

| M4 Student Group | Mean % Correct Examination Score | | |
|---|---|---|---|
| | Musculoskeletal | Radiology | Physical Examination |
| Control Group | 9.6/25 = 39% [35 - 42] | 11.0/18 = 61% [57 - 65] | 13.3/25 = 53% [50 - 57] |
| Intervention Group Pre-Course Score | 12.5/25 = 50% [47 - 53] | 11.6/18 = 65% [61 - 68] | 14.0/25 = 56% [53 - 59] |
| Intervention Group Post-Course Score | 20.3/25 = 81% [79 - 84] | 15.5/18 = 86% [84 - 88] | 21.5/25 = 86% [84 - 88] |
| % Change from Pre- to Post-Course | +31% | +21% | +30% |
| Control Group vs. Intervention Group Pre-Course Score | $p < 0.001$ | $p = 0.21$ | $p = 0.28$ |
| Intervention Group Pre-Course vs. Post-Course Score | $p < 0.001$ | $p < 0.001$ | $p < 0.001$ |

## 3.2. Intervention Group Pre- and Post-Elective Examination Performance

The mean examination scores on the post-course testing of students participating in a clinical anatomy elective for the MSK, radiographic, and physical exam correlates portions were 20.3/25 (82%), 15.5/18 (86%), and 21.5/25 (86%) respectively, with a cumulative mean score of 57.3/68 (84%). For the MSK, radiographic, and physical examination portions of the exam, the mean post-elective scores were significantly higher ($p < 0.001$) for all three sections. The magnitude of the improvement represented a 28% increase. Post-elective participation scores met and exceeded the pass score level (70%) (Freedman & Bernstein, 2002). The range and confidence intervals for these data are summarized in **Table 1**.

## 3.3. Profile of Student Residency Matches

The residency choices for both the students participating in a clinical anatomy elective and their colleagues in the control group are summarized in **Table 2**. Of students participating in a clinical anatomy elective, 23/99 (23%) chose primary care specialties (Family Medicine, Internal Medicine, Internal Medicine-Pediatrics, OB-Gyn, Pediatrics). In the control group, 32/61 (52%) chose primary care specialties. Outside of primary care, there was a wide distribution of residency programs in both the intervention and control groups, with the intervention group showing a large number of matches in emergency medicine and orthopedics.

## 4. Discussion

This study shows that gaps in MSK knowledge of fourth-year medical students are amenable to improvement through clinical anatomy electives. Although the number of hours of curriculum exposure provided by the fourth-year electives is less than the number of hours of anatomy curriculum in the M1/M2 years, the fourth-year electives in our study nonetheless promoted levels of improvement that were statistically significant and met and exceed recommended pass levels on the Bernstein examination (Freedman & Bernstein, 2002).

**Table 2.** Distribution of residency choices for medical students in both the intervention group and control group. The intervention group consists of graduating students from our institution's medical school between 2009-2013. The control group consists of graduating students from our institution's medical school class of 2011.

| Residency | Intervention Group | Control Group |
|---|---|---|
| Anesthesiology | 10 | 4 |
| Dermatology | 2 | 4 |
| Emergency Medicine | 25 | 0 |
| ENT | 2 | 2 |
| Family Medicine | 7 | 7 |
| General Surgery | 1 | 8 |
| Internal Medicine | 9 | 12 |
| Internal Medicine-Pediatrics | 5 | 0 |
| OB-Gyn | 0 | 3 |
| Ophthalmology | 0 | 3 |
| Orthopedics | 25 | 0 |
| Pediatrics | 2 | 10 |
| Psychiatry | 0 | 2 |
| Radiology | 9 | 4 |
| Urology | 2 | 2 |
| Total | 99 | 61 |

The importance of this finding should be acknowledged in the context of the practice relevancy of MSK knowledge, given that the burden of MSK conditions on society represents a growing problem, which will be exacerbated with the aging population and increasing prevalence of obesity. Medical specialties ranging from internal medicine, family medicine, pediatrics, and emergency medicine encounter patients with MSK conditions on a daily basis, so adequate training of medical students in MSK medicine is essential. Our study demonstrates an objectively determined deficiency in senior medical students' MSK knowledge as confirmed by cumulative exam performance less than the pass score identified by recent Internal Medicine residency program directors, in both the pre-course intervention and control groups of fourth-year medical students (56% and 50% respectively).

Exam scores from the control group and pre-course intervention group were similar for both the radiographic interpretation and physical exam correlates portions of the exam ($p = 0.21$ and $p = 0.28$). We conclude students who did not take a clinical anatomy elective and those who enrolled in one of the courses had similar baseline knowledge on these areas of medicine. There was, however, a statistically significant difference ($p < 0.001$) between the two groups with regards to the musculoskeletal anatomy portion of the exam, with higher scores for the intervention group (50%) than the control group (39%). This portion of the exam addressed structural anatomy in a clinical context. The difference between the student groups likely reflects a greater inclination towards anatomical knowledge for those students taking a clinical anatomy elective. However, pre-course examination scores from the intervention group and in the control group revealed knowledge deficits with performances below recommended passing levels (Freedman & Bernstein, 2002).

The similar low performance in the intervention and control groups is indicative of the knowledge base of MSK medicine of M4 students at our institution. Other medical schools have documented a lack of knowledge among fourth-year students in these same areas. Bernstein et al. showed that seventy of eighty-five (82%) recent medical school graduates from their medical school failed to meet passing standards, set by 157 chairpersons of orthopedic residency programs, on an MSK competency exam (Freedman & Bernstein, 1998). Sixty-six students (78%) failed the exam when passing standards were set by 244 program directors of internal medicine residency (Freedman & Bernstein, 1998, 2002). Studies by LaPorte et al. found 75% of fourth-year medical students at their respective institution failed the original Freedman and Bernstein examination (Skelley et al., 2012).

After completing a clinical anatomy elective, students showed a significant improvement in their examination performance. For all three sections of the exam (MSK anatomy, radiologic interpretation, and physical examination correlates), the mean score increased by 20 percentage points or higher ($p < 0.001$). Similar results were obtained by LaPorte et al. who showed that students who participated in elective musculoskeletal education had a higher pass rate (67.5%) than those who did not (43.9%) (Skelley et al., 2012). Even students entering more anatomy-focused fields such as orthopedics and EM had initial deficits in understanding MSK pathology. After completing either clinical anatomy elective, however, students met or exceeded recommended pass scores in all three areas. These students, we feel, are well equipped to enter their residency with a solid foundation in clinical anatomy and are better suited to address MSK conditions in their future practices.

One limitation of the study involves the composition of the intervention group, with a majority of those individuals entering either orthopedic surgery or EM (50/99, 51%). These students may have had more initial interest in MSK medicine and thus gained more knowledge from the courses than students not selecting either clinical anatomy elective. Although students in the intervention group had inclinations towards anatomically oriented programs, there were, however, a number of individuals entering primary care specialties (23/99, 23%). This is in contrast to the composition of the control group, whose range of specialties concentrated in internal medicine (12/51, 24%), pediatrics (10/51, 20%), and family medicine (7/51, 14%).

Second, this is a single institutional study. It depicts the experience at our institution's medical school and may not be representative of students at other institutions, especially with the wide variety of medical school curriculums. However, the length of time that our medical school allocates to MSK education two weeks during the second year—represents the national mean hours devoted to MSK medicine (DiCaprio et al., 2003). Thus, we feel our institution does not emphasize MSK education any more or less than other institutions.

Revisiting anatomy during the fourth year provides the advantage of teaching students who have significant clinical experience. First and second-year students lack the exposure to clinical medicine compared to fourth-year students. Thus, senior students are likely better able to understand the relevance of the anatomy. Having an understanding of the relevance is one of the 10 principles of effective clinical learning identified by Rofle and Sanson-Fisher (Rolfe & Sanson-Fisher, 2002).

Teaching in context is not a new idea. The context used for teaching anatomy can be divided into four categories: clinical skills (physical examination), pathology (cancer, neurological diseases, musculoskeletal problems), radiology, and surgical procedures (Bergman, van der Vleuten, & Scherpbier, 2011). Our MSK and EM electives directly address these four areas. In our two clinical anatomy electives, anatomy was taught as it pertained to understanding physical examinations, diagnosing and treating musculoskeletal injuries, interpreting radiographic images, and carrying out common medical procedures. These skills are invaluable to a medical student about to enter his or her internship. Culminating all the clinical skills acquired in four years and revisiting salient points in context should help promote MSK education.

## 5. Conclusion

In summary, we see fourth-year electives as a solution to multiple problems. It bolsters anatomy education in a clinically significant way, prepares students about to begin their residency, and provides training in important areas of medicine. Very few articles have investigated a vertical integration of anatomy (Bergman et al., 2011). There is much potential benefit in fourth-year clinical anatomy electives. Adding such electives can bolster anatomy and MSK education without significantly disrupting the current curriculum.
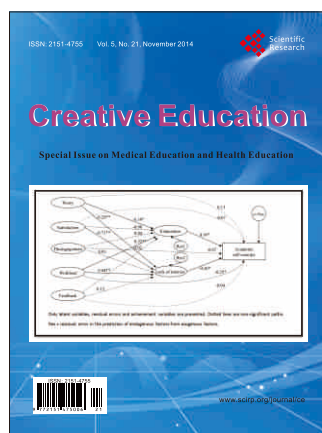
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