ENHANCING HIGHER ORDER THINKING SKILLS THROUGH CLINICAL SIMULATION

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ABSTRACT

Purpose – The study aimed to explore, describe and analyse the design and implementation of clinical simulation as a pedagogical tool in bridging the deficiency of higher order thinking skills among para-medical students, and to make recommendations on incorporating clinical simulation as a pedagogical tool to enhance thinking skills and align the curriculum.

Methodology – A qualitative approach using *interpretative-descriptive* case study design was utilized in framing the research study. Purposive sampling was used to select 20 final year para-medical students and five teaching staff who participated in this study. Data was collected through direct and participant observation, interviews and document analysis. Thematic analysis using Stake's Countenance Model was utilized to analyse and present the findings.

Findings – On the basis of these analyses, the study supports that (i) clinical simulation facilitates the infusion of higher order thinking skills; (ii) clinical simulation that uses thinking pedagogy nurtures the development of higher order thinking skills; and (iii) clinical simulation uses higher order thinking modality to promote, understand and transfer learning. While facilitators play a crucial role in engaging learners with higher order thinking modality and make students' thinking visible by utilizing the use of metacognition and self-regulation abilities, learners become more autonomous, strategic and motivated to apply effort and strategies in a variety of meaningful contexts.

Significance – The findings of this study can assist curriculum managers, college administrators and educators regarding the inclusion of clinical simulation as an instructional approach to enhance higher order thinking skills among para-medical students.

Keywords: Clinical simulation, higher order thinking skills, instruction and learning strategies, para-medical students.

INTRODUCTION

Infusing higher order thinking skills into the mainstream of education, notably analysis, synthesis and evaluation, involves the promotion of thinking, along with teaching methodologies that promote such thinking, taking place at higher levels of the hierarchy (Kuhn, 2009; Nickerson, 1987; Perkins, 1987). In Medical and Nursing education, the teaching of higher order thinking skills is deemed relevant for the enhancement of clinical competence in areas of critical thinking, clinical reasoning and problem-solving skills for rendering quality care (Banning, 2008b; Bridger, 2007; Salvage, 1993; Wong, Koh, Phua, & Lee, 2005). While numerous methodologies have been made available for teaching higher order thinking skills (Rajendran, 2008), selecting appropriate methodology is important for establishing a learning environment that fosters the development of higher order thinking and metacognitive abilities. Current advances in the field of medical technology and artificial intelligence have introduced clinical simulation as a teaching and learning model for improving clinical competency.

Clinical simulation involves an attempt to replicate some or nearly all of the essential aspects of a clinical situation so that the situation may be more readily understood and managed when it occurs in real clinical practice (Cioffi, 2001; Morton, 1995). The use of simulation technology as a tool for experiential learning provides a mechanism by which students can participate in clinical decision-making, practice skills and observe outcomes from clinical decisions (Brannan, White & Bezanson, 2008; Cleave-Hogg & Morgan, 2002). Clinical simulations facilitate a learning process that is active and mimics clinical reality in which the learner has the opportunity to experience the dimensions of clinical practice, ranging from cognitive, psychomotor and affective domains. Simulations promote learning for understanding and meaning rather than rote learning of facts and principles (Higgs, 1992) and extend the subject matter to equip learners with skills that can be directly transferred into the 'real' clinical setting (Paige & Daley, 2009; Wilford & Doyle, 2006). Clinical simulation has been advocated as an excellent instructional tool that binds active participation, provides opportunity for multiple learning objectives to be taught in a realistic environment without harming patients and offers students the opportunity to gain and improve their knowledge in a non-threatening and experiential environment (Medley & Horne, 2005). It also enhances clinical competence and decision-making skills (Alinier, Hunt & Gordon, 2004; Issenberg, Mc-Gaghie, Petrusa, Gordon, & Scalese, 2005).

In simulation training, knowledge is constructed by doing and gathering new experience through experiential learning (Kolb, 1984). The use of *the spiral approach* in designing simulation training helps learners to revisit basic ideas, concepts and principles repeatedly, and building upon them until the students grasp the full formal apparatus that goes with it. Bruner's idea of the spiral approach aids students to construct new ideas and concepts based upon their past and present experiences (Smith, 2002). In addition, incorporating 'think aloud' strategies provides access to student's thought process and insights into the train of thought, the ability to make connections and the ability to use prior knowledge and experiential learning for problem-solving (Banning, 2008a).

Growing interest in the use of simulation in healthcare has provided a strong driving force for embedding clinical simulation as part of the curriculum of health care education. While much has been written about the potential of simulation in supporting the development of professional knowledge and competence at all levels and across all disciplines (McCallum, 2007; McCaughey & Traynor, 2010), this is not likely to be realized without evidence to support and understand how learning is taking place and how it can be supported through simulation (Bradley, 2006). The study aims to explore, describe and analyse the design and implementation of clinical simulation as a pedagogical tool in bridging the deficiency of higher order thinking skills among para-medical students and make recommendations on incorporating clinical simulation as a pedagogical tool to enhance thinking skills and align the curriculum.

LITERATURE REVIEW

Clinical simulation as an instructional strategy has proven to be successful in establishing professional knowledge and clinical competence by bridging the gap between theory and practice (Harder, 2009; Issenberg et al. 2005; Wilford & Doyle, 2006). While most of these studies focused on the usefulness of clinical simulation in achieving clinical competence (Issenberg et al. 2005), exploring how learning takes place in a simulated environment, especially the infusion of higher order thinking skills, remains to be examined. Tennyson, Thurlow & Breuer (1987) postulated that problem-oriented simulation can be utilized to improve higher order thinking skills. For example, problem-oriented simulation requires students to fully employ their knowledge base by generating solutions to domain-specific problems, thus improving the student's cognitive abilities employed in the service of recall, problem-solving and creativity. Enhancing higher order thinking skills involves employment of knowledge in problem- solving and creativity (Gagne, 1985) that can enable individuals to restructure their knowledge by analysing a given situation, working out a conceptual framework, defining specific goals for dealing with the situation and establishing possible solutions (Breuer & Hajovy, 1987). Learning through simulation requires a framework for incorporating educational theories that support the development of knowledge, skills and attributes. Harder (2009) pointed out that educational theories can be used as a guide to learning by way of simulation strategy, whereby scenarios can be grounded in theory that facilitate active involvement in a rich, contextual and multilayered experience. Authentic learning created from simulations provides structured focus on the learning process that encourages learner's self-monitoring, has the potential to be integrated into clinical tasks and can promote deliberation about specific aspects of practice.

According to Cleave-Hogg and Morgan (2002), simulation experience offers an environment that activates the relevant prior knowledge and brings about an awareness of the gaps in their knowledge, provides a context that closely resembles practice and stimulates elaboration of knowledge in a risk-free environment. It provides learners with the freedom to integrate their learning to improve their dexterity and exercise their judgment and decision-making skills without endangering a patient. In simulation-modelling processes, the use of procedural knowledge, i.e., *problem solving capabilities* and some degree of declarative knowledge, i.e., an *understanding of the concepts,* could be attained by specifying learning outcomes during the instructional development stages and by using an effective pedagogical structure (Atolagbe, Hlupic, Taylor, & Paul, 1997). Teaching with simulation requires a skilful use of transformational pedagogies in planning and executing the shift in the mental model of learners from a teacher-centred to learner-centred approach. Meece, Herman and McCombs (2003) reported that learners achieve stronger mastery and performance goals when they perceive their teachers as using learner-centred teaching practices that involve promoting relations, encouraging higher order thinking skills and adapting instruction to individual needs. The use of behavioral principles for acquiring new psychomotor domain skills, cognitive principles for conceptualization of knowledge and constructivist principles for explaining the meaning of the knowledge gained through the affective domain, supports the simulation framework (Harder, 2009; Paige & Daley, 2009).

Embedding clinical simulation as a teaching and learning strategy in the educational process promotes learning for understanding (Higgs, 1992) and hands-on experience in extending the subject matter to equip learners with skills that can be directly transferred into the 'real' clinical setting (Paige & Daley, 2009; Wilford & Doyle, 2006). In addition, simulation-based learning provides reflective practice for transfer of learning for the improvement of clinical competencies (Cioffi, 2001; Morton, 1995; Rosen, 2008) and working in collaboration as part of professional development. Curriculum that incorporates clinical simulation must provide an integrated approach and holistic form of learning, fueled by active participation and interaction and geared towards self-directed approach where assessment is done authentically. Integrating clinical simulation across the curriculum demands flexibility and integration of subject disciplines. Atolagbe et al. (1997) reported that the development of pedagogy for teaching simulation should be centred around a curriculum framework that is based on learning outcomes. In addition, integration of subject discipline should facilitate revisiting and reexamining fundamental ideas so that understanding deepens over time to what is known as a spiral curriculum (Bruner, 1966). As time goes by, students return again and again to the basic concepts, building on them, making them more complex and understanding them more fully. Jeffries (2005) pointed out that simulation-based education must address the five major components, namely teacher characteristics, student characteristics, educational practices, design characteristics of the simulation (the educational intervention) and outcomes of effective implementation. In simulation-based learning, lecturers need to be facilitators of learning with a learner-centred environment where learners are expected to be motivated and responsible for their own learning. The lecturers' paradigm could influence learning outcomes due to their experiences, knowledge, specific beliefs and instructional strategy (Atolagbe, Hlupic, Taylor & Paul, 1997). Educational practices need to focus on promoting active learning, providing appropriate feedback, facilitating social interaction and fostering diverse and collaborative learning to facilitate the development of professional knowledge and competence in providing quality care.

Conceptual Framework

The conceptual framework for this study (Figure 1) is grounded on the theoretical proposition that Bloom's Revised Taxonomy (Anderson & Krathwohl, 2001) provides for infusing higher order thinking skills at the level of applying, analysing, evaluating and creating; while the combination of Gagne's Theory of Instruction (Gagne, 1985) with Dreyfus Model of Skill Acquisition (Dreyfus & Dreyfus, 1986) provides the framework for the simulation learning cycle. In addition, Shulman's model of learning (Shulman, 2004) and Eraut's model of professional knowledge development (Eraut, 1994) that support Gagne's Theory of Instruction and condition for learning (Gagne, 1985) facilitate the transfer of learning through the development of declarative and procedural strategic knowledge.

It is postulated that the infusion of higher order thinking skills in the pedagogical process by using clinical simulation will bring about learning for understanding, hence, nurturing the development of higher order thinking skills among the learners and transfer of learning. To support the development of the conceptual framework, the study is based on evidence that there is a positive relationship between higher order thinking skills, education and performance (Nickerson, 1987; Pasnak, Kidd, Gadzichowski, Gallington & Saracina, 2008).

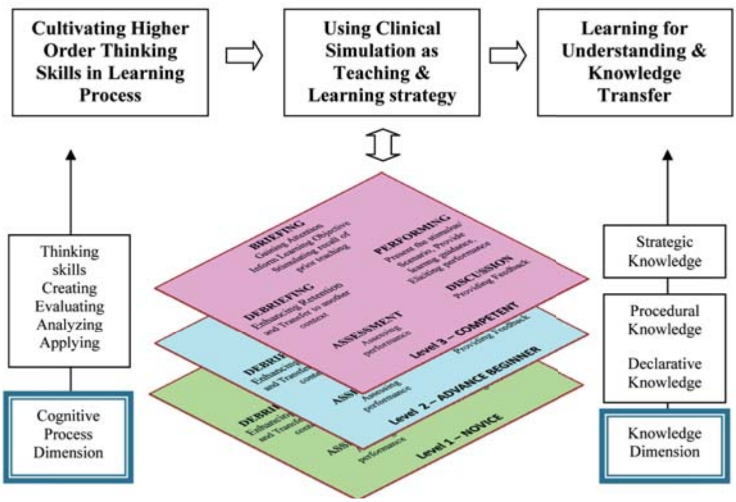

Figure 1. Conceptual Framework for Enhancing Higher Order Thinking Skills using Clinical Simulation (Simulation Learning Model).

METHODOLOGY

Method

An *interpretative-descriptive* case study design was utilized in studying 20 final year para-medical students and five teaching staff chosen via purposive sampling. Case study design provides a comprehensive and systematic framework for generating inductive building of theory (Othman Lebar, 2007), especially when the study is focused on empirical inquiry that investigates a contemporary phenomenon within its real-life context (Yin, 2003) and based on an integrated system (Stake, 1995).

The study participants were final year para-medical students in their sixth semester who were scheduled for emergency care clinical attachment and who had prior exposure to various clinical placements in hospitals as well as skills laboratory in the faculty but have not been exposed to simulation learning. Participating teaching staff had exposure to simulation demonstration, had assisted in developing the simulation laboratory and co-developed the simulation learning modules. The proposition for this study was: ‘Teaching and learning using clinical simulation bridges the deficiency of higher order thinking skills among para-medical students’.

Clinical Scenarios and Simulation Laboratory Setting

The clinical scenarios and simulation laboratory simulated the emergency department in line with students’ learning experience in the triage area, resuscitation bay and post-emergency care. The development of clinical case scenarios utilized problem-based triggers that elicit application of prior knowledge, analytical thinking, synthesizing information, evaluation and creating plans of action. Problem-based clinical scenarios grounded in constructivist learning theory with spiral approach design provided the thinking framework. In addition, student-centred learning, think aloud strategies, interactive simulation technologies, experiential learning, collaborative practices and facilitating role of educators in clinical simulation provided the learning environment that facilitated the infusion of higher order thinking skills.

Study Procedure

The study was conducted in the simulation laboratory using clinical scenarios, standardized patients, mannequins and simulators. Six case studies using real-life clinical scenarios were developed and utilized to study the possible infusion of higher order thinking skills within the context of clinical simulation as a pedagogical tool. Validity and authenticity of the simulation scenarios were assessed by a panel of experts from clinical and academic backgrounds. The clinical case study incorporated a scenario that elicits application of prior knowledge, analytical thinking, synthesizing information and evaluation. Pre-evaluation was done to gauge participants’ cognitive and knowledge dimensions using scenario-based questions (clinical case) and to evaluate students’ cognition based on Bloom’s Revised Taxonomy (Anderson & Krathwohl, 2001), in accordance with the objectives of clinical posting. Participants then proceeded through six sessions of clinical simulation in the simulation laboratory using simulation-based learning cycle for a period of two weeks. Both *technological fidelity* and *pedagogical fidelity* were utilized in facilitating simulation learning. Participants' performance was observed, though direct and participatory observation throughout the simulation sessions during the briefing, performing, discussion, assessment and reflection stages. Post-evaluation was done at the end of the sixth simulation session to assess participants' cognitive and knowledge dimensions.

Data Collection

Data were collected through document analysis, direct and participant observation and interviews.

i. Documentation

Document analysis and mapping of the simulation module was done to elicit details of events and references. Document analysis elicited details of simulation module's aim, objectives, content coverage, learning design and learning outcome for the infusion of higher order thinking skills. Investigators retrieved information through content mapping to corroborate information and augment evidence for inference purposes and to achieve identified objectives.

ii. Direct Observation and Participant-Observation

Direct observation and participant-observation focused on how learning and teaching using clinical simulation learning cycle enhanced the development of higher order thinking skills during simulated learning. Direct observation ranged from formal to casual data collection, where incidents of certain types of behaviors were observed using observational protocols. In direct observation, the investigator took up the role of 'outsider' in collecting the data, while the participant-observation technique provided distinctive opportunity to perceive reality from the viewpoint of someone 'inside' the case study.

iii. Interview

Focus group interviews using semi-structured open-ended questions probed about how learners thought in simulated practice, how they learned from experience and how they made connections between different clinical cases. Students and facilitators were interviewed separately to gauge the emerging pattern of views and opinions for the convergence of multiple sources of data. All interviews and observations were recorded after obtaining participants' permission.

Data Analysis

Thematic analysis of manifest content and the interpretation of the underlying meaning of transcription were done to establish the link between the theoretical proposition and the case description. Descriptions were coded and analysed for similarities and differences and regrouped into categories to formulate the themes based upon the research questions. Stake's Countenance Model (Stake, 1967) was utilized to develop the themes derived from theoretical proposition and case description.

Validity, Reliability and Ethical Consideration

Validity and reliability of the study were maintained through the triangulation design, by having a chain of evidence through an audit trail that documented inquiry processes and events in the form of logs, journals and memos of all activities that were implemented in the process of study, and members' check to verify the accuracy of transcribed data. As for ethical consideration, informed consent was obtained after providing all participants with salient information about the study, the voluntary nature of participation, the right to stop at any time and rights for confidentiality.

RESULTS AND DISCUSSION

The study revealed that the use of problem-based clinical scenarios grounded in constructivist learning theory with spiral approach design, student-centred learning, think aloud strategies, interactive simulation technologies, coupled with experiential learning, collaborative practices and facilitating role of educators, were key enablers for the development of higher order thinking skills in simulated learning. Students who were nurtured using a clinical simulation learning model demonstrated higher order thinking pattern, explicit learning through sharing and reflective practices, had confidence in managing clinical cases and demonstrated good leadership and social skills.

Designing simulation-based learning framework requires an appropriate selection of educational theories and learning taxonomies that support higher order thinking. Combining Bloom's Revised Taxonomy (Anderson & Krathwohl, 2001) with Gagne's Condition of Learning and Theory of Instruction (Gagne, 1985) and the Dreyfus Model of Skill Acquisition (Dreyfus & Dreyfus, 1986) into a simulation learning model provided an effective theoretical framework for teaching simulation modelling that supported the infusion of higher order thinking skills. This was evident in the effective implementation of the simulation learning model that provided the framework for simulation intervention and performance evaluation (Refer Figure 1). The present study submits that the developed simulation learning model grounded on Gagne's Condition of Learning and Theory of Instruction (Gagne, 1985) evokes thinking modality, integrates knowledge across various domains of learning and facilitates the attainment of specific objectives, including the learners' paradigm in supporting and accommodating the differences in the way students construct their knowledge and transfer of learning to different clinical settings. One of the research participants taking part as facilitator stated that "simulation-based learning method provides an effective and conducive learning environment that complies with the students' learning needs. Learners can apply knowledge and skills across the board on the simulated patient and in a controlled environment". Grounding Gagne's model into simulation education has provided learning effectiveness through situated learning and constructivism by anchoring instructional activities into meaningful learning to bring about learning efficiency, instructional effectiveness, transfer of learning and learner's interest (Atolagbe et al. 1997; Driscoll, 2000). Cognitive understanding promotes a holistic platform in which situated cognition can be designed for learners to experience the complexity and ambiguity of learning in the real world (Paige & Daley, 2009). By doing so, the simulation framework promotes shifting teacher-led instruction to student-led learning that enhances autonomy, strategic thinking, meaningful learning and learning for transfer.

Combining Gagne's learning theory with a Dreyfus model of skills acquisition (Dreyfus & Dreyfus, 1980) in the development of a simulation design provides an effective framework for transfer of learning at differing stages of competency; and at the same time, supports the development of cognition-based practice. It is noted that grounding problem-based scenarios at various stages of competencies trigger the students' mind in manipulating previously learned information to create new knowledge. A study participant, Danial (*pseudonym*) explained:

> Problem-based simulation triggers an increase in knowledge and skills because it provides the scope and opportunity for students to think, discuss and make decisions supported by the encouragement and guidance by the facilitators in managing the patient. It also provides more opportunities for the learners to use the knowledge and skills in handling clinical cases compared to actual clinical placement.

Tan (2004) claimed that problem-based scenarios promote understanding that is derived from interaction with the problem scenarios and the learning environment, whereby engagement with the problem and problem enquiry process create cognitive dissonance that stimulates learning; knowledge evolves through the process of social negotiation and evaluation of the validity of one's point of view. In addition, the use of cognitive and constructive theoretical orientation provides a broad paradigm for grounding thinking skills (Byrnes, 2008; Slavin, 1991; Rajendran, 2008, Tan, 2004), that have been useful for designing the learning framework for clinical simulation in harnessing analytical skills, reasoning skills and reflective practices. Learning through clinical simulation promotes the development of mental schemes when an individual interacts with the environment, and in using past knowledge in new situations to interpret new experience. This is in line with Piaget's argument that cognition is grounded in the interface between mind and environment and the result of the interplay is the achievement or working towards a balance between mental schemes and the requirements of the environment (Lutz & Huitt, 2004). Subsequently, the combination of maturation and action advances an individual into higher developmental stage and higher cognitive abilities.

Designing simulation module using spiral design facilitates the infusion of higher order thinking skills and scaffolding of learning. The use of abstract thinking and logical reasoning in going through the clinical scenarios, scaffolding students learning experiences to different levels through facilitation, collaborative and reflective practices, facilitates the infusion of thinking skills. In substantiating the above notion, study participant Bani (*pseudonym*) explained:

> Experience in simulation labs gives much space to guide students for the application of what they have learned. If mistakes are identified, it is corrected there and then as compared to practice in clinical placements that require zero defects. Facilitators can identify weaknesses and their strengths and deal with change to correct mistakes before proceeding to the actual patient. Students can learn in simulation practice to explore and discover, interpret findings and provide a diagnosis without the fear of harming the patient.

Smith (2002), in advocating Bruner's idea of the spiral design, postulated that spiral approach facilitates students' learning in a manner in which students continually build upon what they have already learned; it aids in constructing new ideas and concepts based upon their past and present experiences. Interconnection of new experiences with prior knowledge results in the reorganization of cognitive structure that creates meaning and meaningful learning, allowing one to explore further. Hence, meaningful learning goes beyond the simple presentation of factual knowledge and actively engages students in the process of constructing meaning (Mayer, 2002). The study supports Lutz & Huit's (2004) argument on Bruner's idea that learners can acquire certain types of information at certain stages depending on their cognitive readiness; cognitive development occurs when learners select and transform information, construct hypothesis and make decisions, relying on schemes and mental models. Piaget claimed that higher order cognitive functions lie in the arena of abstract thinking and logical reasoning that involve the ability to think inductively, deductively, infer, hypothesize, conclude and judge the validity of these inferences (Byrnes, 2008); while Vygotsky's social cognitive theory suggests that each person has potential for learning in the zone of proximal development, where individuals can be moved to a higher level of thinking through guidance (Lutz and Huit, 2004). Slavin (1991) proposed that it is important to extend the students' level beyond their current level of functioning, but within their ability for abstraction and assimilation. What is important here is the role of the educator to facilitate learning by providing a variety of experiences, allowing students differing cognitive levels to work together and the use of concrete 'hands-on' experience to help learners learn.

Learning through collaborative practices facilitates active involvement of students that lead to sharing of knowledge, exploration, building on past knowledge to new knowledge and transfer of learning. For example, study participant Balu *(pseudonym)* in expressing his view on collaborative practices in simulation learning explained, "For me, the knowledge obtained through the discussion was used to plan and manage the case. Discussion with peers and facilitators helped me in clarification and improvement of understanding. The facilitators mainly probed the discussion to make us think and not just provide the answers".

Discussion through a collaborative approach facilitates sharing of knowledge and improved understanding of clinical cases. Discussion facilitates self-regulation, self-correcting of mistakes and prevents recurrence of similar mistakes. According to study participant Danial (pseudonym), "discussion with colleagues and facilitators that focused on probing for clarification when mistakes were made enhanced self-regulation in preventing clinical errors". Discussion through collaborative practice clarifies what is going on in students' minds, comparing different approaches to problem-solving and decision-making, identifying what is known, what needs to be known and how to produce that knowledge. This notion supports Vygotsky's (1987) idea that intelligence begins in the social environment, and the social dimension of learning supports the cognitive development of an individual, i.e., a student must be free to interact, experiment, articulate and share views and opinions. By socializing and interacting with others, students learn to adapt and to adopt new experiences and learn how to deal with them. When students are allowed to work and reason together, the one who grasps the concept first is certainly operating in the other's proximal zone of development and assists the other to learn to conserve (Slavin, 1991). This allows more advanced students to teach their peers on how to grasp the concept and explain the difficulties to a lesser experienced student.

In addition, using higher cognitive questioning encourages active student participation that requires students to mentally manipulate information previously learned to create and support answers with logical reasoning, hence yielding higher student achievement (Lewis & Smith, 2001; Rajendran, 2008). This has been noted in the present study where the use of 'why' and 'how' questions as a probing approach in the simulation process activates thinking that triggers the use of factual, conceptual, procedural and strategic knowledge for meaningful learning. In supporting the above notion, study participant Elaine *(pseudonym)* explained, "facilitators mainly used 'why' questions in establishing the link with history taking, physical examination, investigations and diagnosis. We can analyse and interpret the findings to diagnose the case". Performance comes with understanding (Shulman, 2004), while Gardner (2008) posits that performance and action can be strengthened by having a creative mind to solve problems by thinking 'out of the box'. Developing the knowledge dimension beyond the present knowledge level through 'why' questions evoke thinking modality of exploring deeper, seeking connection within subject areas and across subject areas for inference and evidences in problem-solving and decision-making. Such practices promote meaningful learning and the development of strategic knowledge. This notion supports Dart, Burnet, Boulton-Lewis, Cambell, Smith and McCrindle (1999) who claimed that deep approaches to learning are significantly related to the learning environment which are perceived to be highly personalized that encourage active learning processes.

The present study also discloses that embedding experiential learning into simulation education provides active learning and hands-on experience that promotes greater interest in the subject material and enhances intrinsic learning satisfaction. This can facilitate understanding and retention of learning, develop desire and ability to be continuous learners, improve communication and interpersonal skills, problem-solving, analytical thinking and critical thinking skills of students. Study participant Ali (*pseudonym*) in reflecting the learning experience in simulated practice explained, "Facilitators ask the rationale for every action taken. The use of small group discussion engages everyone to participate and pay attention. Facilitators guide us on how to analyse, interpret and evaluate. If we made mistakes, facilitators guide us to rectify the mistakes". Experiential learning provides a mechanism by which students can participate in clinical decision-making, practice skills and observe outcomes from clinical decisions (Brannan et al., 2008; Cleave-Hogg & Morgan, 2002). The study supports Dewey's theory that experience and reflection equal learning; where it is not just about experience that has the potential for learning, but the quality of the experience that provides a measure of its educational significance (Fowler, 2007). Acquiring physical knowledge requires facilitation of students to internalize action schemes by repeatedly performing hands-on learning to attain experience and specified goals (Byrnes, 2008); while exploring the logic of actions serves as a template for the development of mental logical structures achieved through reflective practices. In addition, the use of the learner-centred approach in clinical simulation helps students to become more autonomous, strategic and motivated so that they can apply effort and strategies in a variety of meaningful contexts in and beyond didactic teaching. This was reflected by study participant Ali (*pseudonym*) who expressed:

> In the simulation session, we managed the case in total where we clerked the case, performed a physical examination, provided the diagnosis and managed the case prior to referral. We had the autonomy to manage the case and perform in a team. Compared to the clinical area, we merely follow instruction of what needs to be done.

Clinical simulation facilitates an active learning process of experiential learning and peer group learning that provides opportunity for learners to explore and experience dimensions of clinical practice that support the development of higher order thinking skills. Grounding problem-based approach in clinical simulation has shifted the learning paradigm to a learner-centred approach, placing students as the focus of learning. Brandes and Ginnes (1986) cited that student-centred learning allows learners to take full responsibilities for their learning, promotes growth and development and develops a higher conception of learning. Students perceive clinical simulation as a useful learning paradigm in providing learning experiences and opportunities, autonomy of practice and improved clinical guidance in enhancing higher order thinking skills, as it offers a range of learning opportunities that are not always available in real practice. When students are given the time, opportunity and guided autonomy in bringing theory into practice, the outcome of learning reflects on the ability to improve their learning curve, moving away from rote learning towards meaningful learning. Baumfield (2004) argued that the development of thinking skills requires that students are given the time and opportunity to talk about thinking processes, to make their own thought processes more explicit, thus enabling them to clarify and reflect upon their strategies and gain more self-control. Personalized learning environment encourages active learning process (Dart et al., 1999), and fosters the development of higher order thinking and meta-cognitive abilities (Billing, 2007). Learning culture that places importance on learner-centred education promotes critical thinking, logical reasoning and problem-solving skills (Pogrow, 2005). The strongest driving force to bring about the transformation of thinking in education is the students themselves since they must be empowered to demand excellence and realize that education is a means for preparing them to be the kind of graduates needed for the future (McLean & Gibbs, 2009).

In addition to focusing on making students' thinking visible by utilizing think aloud strategy, meta-cognition and self-regulation abilities further harness the development of thinking skills. Banning (2008a) proposed that think aloud approach provides access to students' thought process and insights into the train of thought, the ability to make connections and the ability to use prior knowledge and experiential learning for problem- solving. Using think aloud approach facilitates learners to develop skills in problem-solving, heuristics and verbalized reasoning and enhances their experience of using and applying both clinical reasoning and cognitive operatives. At the same time, educators can access what is going on in the mind of the student in making the connection between received stimuli and managing clinical scenario, while learners develop clinical competence through articulating inference and rationale for decisions.

The outcome of simulated practice is to bring about learning for understanding and transfer of learning. Transfer of learning from Gagne's perspective (Gagne, 1985) involves the extent to which the students have the required prerequisite knowledge and skills, the ability to recall prior learning and develop those cognitive strategies appropriate for the task. This was noted during simulated practice and debriefing sessions where students demonstrated better understanding of clinical cases through self-regulation and scaffolding of knowledge and cognitive dimension to become strategic thinkers that facilitated learning for understanding and transfer of learning. Study participant Anil (*pseudonym*) who participated in the debriefing sessions explained:

> Debriefing session is particularly helpful for identifying the level of students' knowledge, skills and their ability in making decisions when handling patients. Students themselves will realize that mistakes have been done and at which level of their knowledge and skills. When there is a mistake made inadvertently, it will be raised by the facilitator during debriefing sessions. Students will also tell what needs to be done to ensure that mistakes are not repeated on real patients. Students can also express their strength in dealing with the case and this will strengthen their confidence levels when they are on the field. They can also indicate new learning acquired during simulation exercises. This will enable the students to check and balance what they have learnt.

Perkin and Saloman (1992) illustrated that transfer of learning can be a result of reflexive transfer that requires well automated patterns of response that are easily triggered by a similar stimulus condition or mindful transfer that involves active abstraction and exploration of possible connections. Bond et al. (2008), in reviewing several empirical studies, pointed out that learners trained in the performance of procedures by use of simulation models, can transfer the taught skills to the workplace. Performance comes with understanding (Shulman, 2004), and the development of professional knowledge and competence takes place immediately when knowledge is put to use (Eraut, 1994). This argument supports Eraut's (1994) idea of developing professional knowledge and competence by strengthening propositional knowledge with procedural knowledge through performance, practice and action in different contexts. The simulation environment provides a learning paradigm for students to acquire hands-on experience that bridges learnt theory and practice from varying contexts and situations in developing the professional knowledge. The ultimate aim of clinical simulation is to tie factual, conceptual and procedural knowledge with strategic knowledge to bring about the development of the student's potential and to enhance the development of higher level cognitive abilities.

Educators as facilitators of learning play an important role in expediting the potential of clinical simulation as a teaching and learning tool to enhance higher order thinking skills. The modelling process portrayed by educators in probing, problem-solving, providing feedback and being non-judgmental creates a positive perception on educators in enhancing the culture of thinking. The role of facilitators in clinical simulation is to carefully select and guide learning experience that suits learner's background and capability, and structure learning situations relevant for realizing the human potential for rational thinking. Education is a process of unfolding and developing the potential of the individual (Hamilton, 1996), whereby teaching thinking skills in simulated practice is not only about making students' thinking visible (Perkins, 2003) but creating a learning environment and conditions that stimulate thinking (Costa, 2001). The implication for educators will be the need to facilitate learning through the process of reflection on their experiences, making learning explicit through sharing and recognizing it as a basis for future learning.

Integrating clinical simulation across the curriculum demands flexibility and integration of subject areas that would enhance cognitive abilities and knowledge dimensions in steeping the learning curve. The present study supports the teaching and learning paradigm of clinical simulation in integrating knowledge across various specified learning outcomes which accommodate differences in the way students construct their knowledge and facilitate creative problem-solving. Blending thinking pedagogy with simulation technology can be a very effective tool to help students learn complex skills, critical thinking, clinical reasoning and judgment (Howard et al., 2010; Wilford & Doyle, 2006). For that, the development of pedagogy for teaching simulation should be centred around a curriculum framework that is based on learning outcomes (Atolagbe et al., 1997), which places emphasis on valuing, decision-making, Socratic dialogue, reflective practice and humanism. In addition, integrating clinical simulation across the curriculum involves developing pedagogy that goes beyond situating the learning experiences within the experience of the learner through the process of dialogue and reflection. In this approach, the curriculum utilizes dynamic interaction of action and reflection that supports the notion of praxis (Stenhouse, 1975) or the concept of thinking out of the box (Gardner, 2008). Grounding the curriculum in praxis enhances critical and creative thinking that encourages educators and students together to confront clinical problems of their existence and relationship and solving them amicably. Smith (2000), in supporting the notion, cited that commitment to praxis fosters collective understanding and sharing of values through teamwork and collaboration with emphasis on human emancipation. Incorporating simulation across the curriculum has important administrative implications that need to be addressed. Our present experience in developing and maintaining a simulation center in the College supports Howard et al.'s (2010) claim that implementing simulation across the curriculum requires a dedicated simulation coordinator or champion, technological support, adequate facilities, standardized programming forms, funds for supplies that enhance realism and workload release time for faculty to gain understanding related to the use of this innovative yet highly technical teaching technique.

CONCLUSION

In concluding this study, the results suggest that the unique experience of clinical simulation can be effectively used as a teaching and learning tool in bridging the deficiency of higher order thinking skills among para-medical students. The study reveals that the use of problem-based clinical scenarios grounded in constructivist learning theory with spiral approach, student-centred learning, think aloud strategies, interactive simulation technologies, coupled with experiential learning, collaborative practices and role of facilitators are key enablers in facilitating the infusion of higher order thinking skills in Pre-medical Education. Integrating Bloom's Revised Taxonomy with Gagne's theory of Instruction and Learning and the Dreyfus Model of Skill Acquisition provide an effective theoretical framework for teaching simulation modelling that supports the infusion of higher order thinking skills.

Students have perceived clinical simulation as a useful learning paradigm in providing learning experiences and opportunities, autonomy of practice and improved clinical guidance to enhance higher order thinking skills, as it offers a range of learning opportunities not always available in clinical practice. In bridging theory and practice, facilitators play an important role in helping students to become more autonomous, strategic and motivated in applying effort and strategies in a variety of meaningful clinical contexts to bring about the discovery, transmission and the use of knowledge. Simulation can be a parallel system in creating an authentic clinical environment that matches the real clinical setting to provide a range of learning experiences leading to cognitive abilities, clinical competence, social cognition and transfer of learning to real clinical setting. The design and employment of effective simulation education programs will improve training and can be an integral part of the curriculum to contribute to quality improvement of patient care.

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