

Signature Pedagogies and the HOTSHOT Educator: A Systematic Literature Review

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Abstract

Higher Education Institutions have made considerable investments both fiscally and in staff engagement with clinical simulation. Professional bodies such as the Royal College of Surgeons, the Royal College of Anaesthetists and the College of Operating Department Practice endorse the use of clinical simulation. Claims that clinical simulation stimulates Higher Order Thinking and therefore contributes to increased patient safety will be examined.

Introduction

The process of the literature review will be elaborated as it was undertaken, addressing such issues as defining the search criteria, and identifying search terms and a hierarchy of evidence as well as searching the literature. A critical analysis of the literature was undertaken and by defining what was known and unknown, the scene was set for the scope of the study. This literature review, undertaken as part of an MA Medical Education, explored and defined 'Higher Order Thinking' and through the use of constructive alignment, how it informs Signature Pedagogies. Mindful of the afore mentioned significance given by the multi-disciplinary colleges to simulation and their insistence of the Higher Order Thinking, simulation relationship, what, if any, is the relationship between Higher Order Thinking and Clinical Simulation will be considered. The results of this review will contribute to a larger mixed methods study. The author is as an allied health professional (specifically an operating department practitioner). The literature review contributed to the formation of a generic Signature Pedagogy framework, this literature review also provided data by which this framework could be populated as a generic perioperative Signature Pedagogy. The second part of the mixed methods study will provide the data for a bespoke Signature Pedagogy for operating department practice.

Methods

It is suggested by Aveyard (2010) that the purpose of the literature review is to justify the research question through the use of a systematic literature search and critique of the literature found. The assertion is that any deficit in the existing research will be explored by the research question. Aveyard (2010, p 22) further expands upon the concept of a systematic literature search by identifying its purpose as a "search in a systematic manner so that all the available information is incorporated into the review". Additionally she offers the caveat that

a narrative review of the literature may lead to papers not being identified; this in turn can result in a biased one-sided review with inaccurate conclusions. In this instance the research question, "What are Higher Order Thinking Skills", is specific and offers a definitive objective for the purpose of this study.

Searching

While undertaking this literature review the search terms related to the research question must be clearly defined (Aveyard, 2010). Therefore, the questions that influenced the literature review were, 'What is the definition of clinical simulation?' which was used to inform the literature review and, 'How will Higher Order Thinking Skills be defined?'

When attempting to define Higher Order Thinking Skills (HOTS) for this study, this author adapted the King, Goodson and Rohani (2008) definition creating a new pyramid of Higher Order Thinking Skills (figure 1). The Kansas State Department of Education (2005, p. 1) similarly observed that "Higher Order Thinking Skills are questioning in discussions or providing activities based on processing that requires analysis, synthesis, evaluation, or other critical thinking skills".

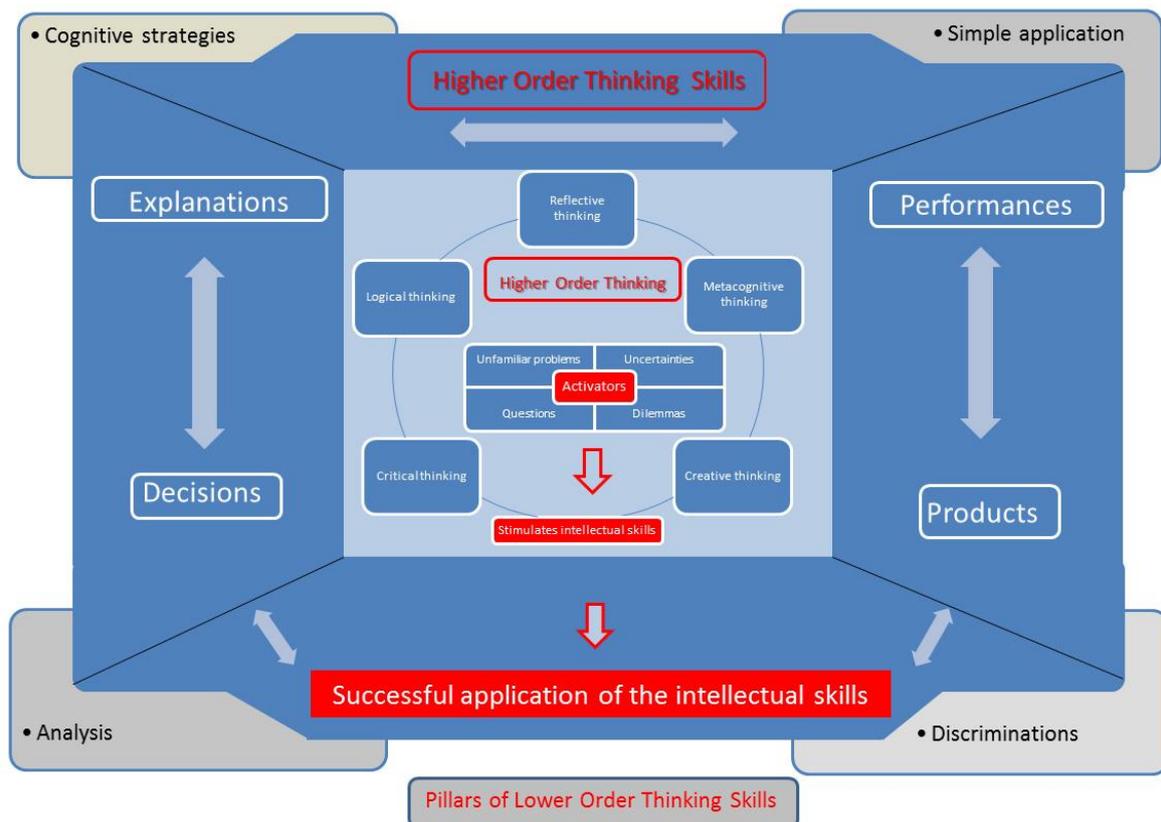


figure 1

Having working definitions of the areas of literature to be reviewed, Aveyard (2010) insists consideration be given to the types of literature that will be accessed citing

Wallace and Wray (2006, p.92) who categorized the literature into theoretical, research, practice and policy, suggesting the formation of a hierarchy of evidence. The hierarchy of evidence process is illustrated by Aveyard (2010) when she cites Sackett *et al.* (1996) who produced figure 2:

Hierarchy of evidence	
1.	Systematic reviews and meta-analysis
2.	Randomised controlled trials
3.	Cohort studies, case-controlled studies
4.	Surveys
5.	Case reports
6.	Qualitative studies
7.	Expert opinion
8.	Anecdotal opinion

(Sackett *et al.* 1996)

figure 2

Having identified the hierarchy of evidence that was to be used, the next stage was identifying a systematic approach to reviewing the literature. Consideration of the research question and the hierarchy of evidence, it was clear that systematic review and meta-analysis were the most appropriate forms of evidence.

Inclusion / exclusion criteria

Hart (2012) theorises that a literature review is more than a summary, synopsis or annotations describing other people's work, but an absolutely necessary step to ascertain that which has been done, and what needs to be done to fill the knowledge gap. Punch (2011) explains that inclusion and exclusion criteria are in fact better described as methodological screening; he determines that we must identify "how much confidence can we have in the evidence reported and the findings in a piece of published research?" Punch (2011) illustrates this with inclusion criteria outlined in figure 3. This was used in conjunction with Sackett *et al.*'s (1996) hierarchy of evidence to inform the inclusion criteria for the literature review.

Methodological screening (inclusion criteria)
Design-is the design appropriate to answer research question?
Sample-is the sample appropriate for the research described? To extent are the findings likely to be generalised (or transferable)?
Data collection-are the data collected of sufficient quality to allow confidence in the findings?
Data analysis- similarly, is the data analysis appropriate and sufficiently thorough to allow confidence in the findings?

(Punch, 2011)

figure 3

Search terms and strategy

Hart (2012) explains that the first stage of planning your search is to define the topic. Having this definition and progressing to stage two, he suggests that you "think about the limits of your topic" (Hart, 2012). Reflecting upon the topic limits, it was evident that the search was restricted to healthcare provision and includes a ten year limitation for primary publications to add currency to the search. In his third stage, Hart (2012, p.23) reveals that you should "identify the main reference tools for your discipline". In stage four Hart (2012) alludes to what he terms as housekeeping: where he expounds the virtues of recording and cross referencing the materials generated by the search. Finally, in stage five, Hart (2012, p.23) returns to the concept of the 'reference tool' and emphasizes that you should create a "list of sources you intend to search in the order in which you intend to search them." Elaborating, Hart (2012, p.23) then reveals that one should "use your notes to construct a list of abstracts, indexes and other reference sources to be searched" creating a discipline specific reference tool. An overview, adapted from Punch (2011) of how the literature review informs the research study can be seen in figure 4.

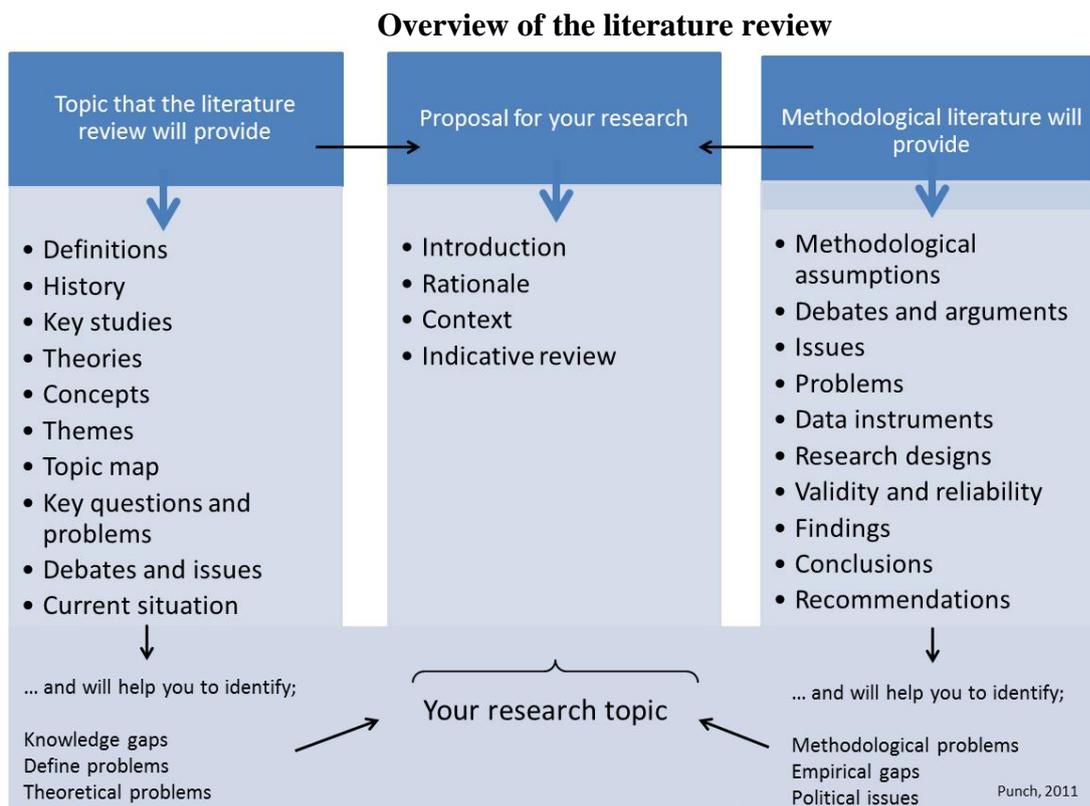


figure 4

Operating Department Practice (ODP) as a profession has a scarce body of knowledge, as any literature review will reveal, due to the ODP being a fledgling profession having only moved

from vocational training to academic study in 2002. Therefore it was required for the purpose of this review and in relationship to Higher Order Thinking Skills to expand the search of the literature outside of the author's profession to include medical, nursing and professions allied to medicine. Due to the relationship between Higher Order Thinking Skills and healthcare related education this literature search was also expanded to include mainstream education. This diverse range of sources are reflected in the search terms used (figure 5).

Literature Review – Search Terms	
Clinical simulation	Higher Order Thinking Skills
Clinical simulation	Higher Order Thinking Skills
Medical simulation	HOTS
Nursing simulation	Critical thinking skills
ODP simulation	Medical Higher Order Thinking Skills
Hi-fidelity simulation	Nursing Higher Order Thinking Skills
Lo-fidelity simulation	

figure 5

Literature review

An electronic search of databases was undertaken and an overview of the databases used can be found in the figure below, this was followed by a hand search of the most cited papers, journals, and reference lists which informed the discussion stage and subsequently the synthesis stage of the literature review.

Results (Literature review)

Database used	Search results [medical simulation]	Included [Medical simulation]	Excluded [Medical simulation]	Search results [medical simulation]	Included [Higher Order Thinking Skills]	Excluded [Higher Order Thinking Skills]
Academic search elite	861	15	846	239	3	236
The allied and complementary medicine	0	0	0	2	0	2
CINAHL	282	2	280	26	2	24
EBSCOhost	1	0	1	13	0	13
Educational Research Complete	201	5	95	401	3	401
E-Journals	793	3	790	195	2	191
MEDLINE	1,136	11	1,125	36	0	36
Global health	40	0	40	3	0	0
	3,322	36	3,286	915	12	903

figure 6

Overview of the literature review

The literature review included Clinical Simulation as this contextualised Higher Order Thinking Skills as it pertains to this literature review.

Literature excluded (medical simulation)

The systematic review of the current literature returned 3,322 pieces of literature of which 3,286 were excluded, this leaving 36 papers as outlined in figure 6. Having undertaken a cross-reference of the results of the eight databases, nine papers were found to be duplicates, which in turn left 27 papers for review.

Literature excluded for medical simulation (critiquing)

Only one paper Buckley *et al.* (2012) focused on operating department practice albeit as one of five professional disciplines, and although it had simulation in the title, it was in fact a paper about interprofessional education for example taking a blood pressure as a disconnected skill. Disappointingly the focus of the study was, whether the student enjoyed being in the skills room. Other papers followed the medical model for simulation; this involves systematic repetition of tasks with a systematic debrief for example see works by Ziva, Ben-David & Zivc (2005); Mc Gaghie, *et al.* (2009); and Kunkler, (2006). The medical model allows for consistent training with predictable outcomes, however, the model used in this Operating Department Practice is more akin to the airline industry training, whereby the student has a start point and must find their way to the finish, thereby developing reflective critical thinking and thus Higher Order Think Skills.

Literature informed synthesis (medical simulation)

The 27 medical simulation papers were reviewed and themed as follows:

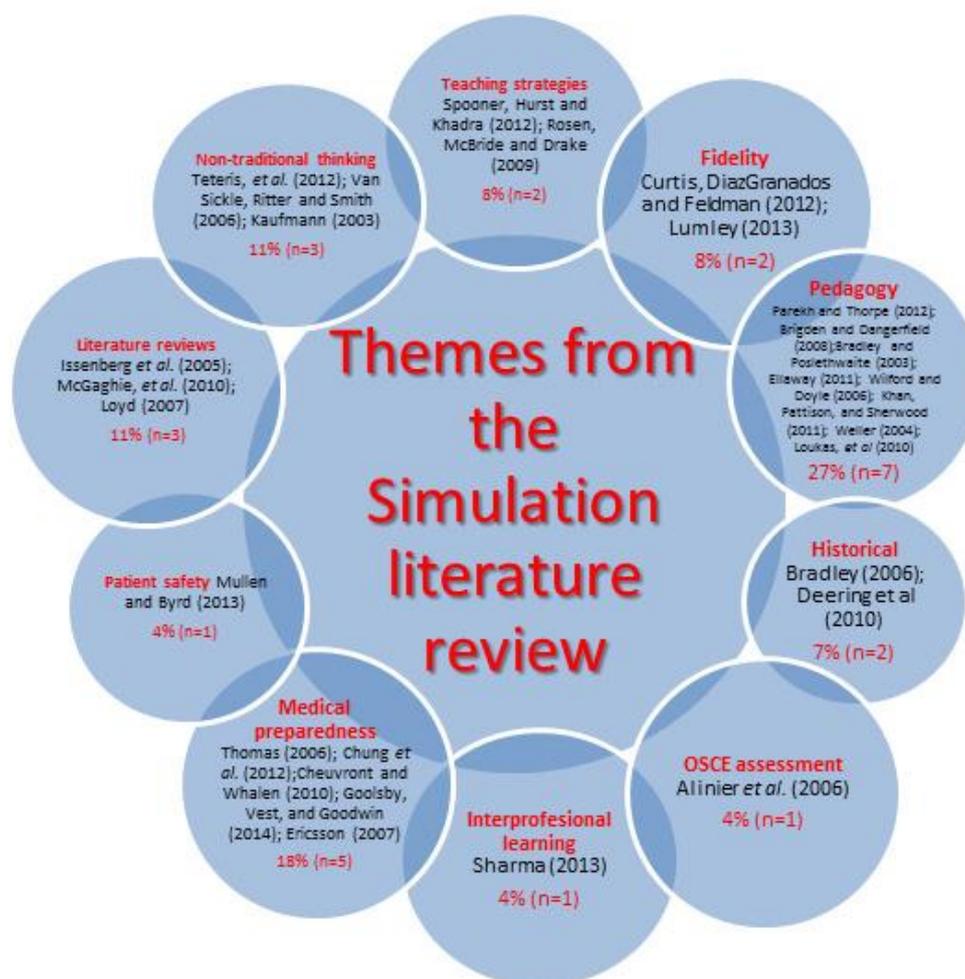


figure 7

As can be seen in the figure 7 many aspects of medical simulation are covered within the literature. The percentage in red highlights the focus of the papers theme, the number in red articulates how many papers are contained that focus, and what percentage of the 27 selected papers those focus represented. One can see that a variety of topics are addressed such as history, pedagogy, equipment, ethics, scenarios and fiscal costs. Surprisingly, the limited literature focused on the student's enjoyment of simulation and their ability to pass tests, not whether these students' skills and knowledge were fit for purpose nor the state of their Higher Order Thinking Skills.

Literature excluded (higher order thinking skills)

The systematic review was again undertaken of the current literature and returned 913 pieces of literature of which 901 were excluded leaving just 12 papers. Examples of the excluded papers are Newmann (1990); Zohar, Degani, & Vaaknin, (2001); Zohar & Dori (2009). Again having undertaken a cross-reference of the results of the eight databases, one paper was found to be a duplicate, leaving 11 papers to review.

Literature excluded higher order thinking skills (critiquing)

Higher order thinking skills in the literature is dominated by the mainstream educationalists, with several papers suggesting that higher order thinking skills are not developed until the teenage years and not achieved until students reach their twenties. Predictably the focus of a majority of the current literature is pre-teen preparation for higher order thinking skills which is inappropriate for this review.

Literature informed synthesis (higher order thinking skills)

The 11 higher order thinking skills papers were reviewed and themed as follows:



figure 8

When figure 8 is analysed, trends can be seen in the literature for Higher Order Thinking Skills. As with figure 7 we see in figure 8 that the percentages in red highlights the focus of the papers theme, the numbers in red again articulates how many papers contained that focus and what percentage of the 11 selected papers those focus represented. This trend includes pedagogy, problem based learning, outcome-based education, logical reasoning, and cognitive load. A somewhat dated paper, Baylor & Ritchie (2002), superficially addresses technology involvement.

Critical analysis of Higher Order Thinking Skills papers

Teaching strategies

Girot (1997) suggested critical thinking needed to move to higher order thinking and looked at two groups of students that undertook the same course of studies, but one group received enhanced study skills. Unfortunately this author did not clearly distinguish between higher order thinking and critical thinking, creating confusion within her findings, and therefore her results offer little to my discussion.

Miri, Ben-Chaim and Zoller (2007) aimed to determine if teaching higher order thinking skills increases the students' critical thinking. In this three-year study, researchers found only 2 out of 10 teachers applied teaching strategies that promoted higher order thinking skills. More worrying was that the teachers attempting to promote higher order thinking also found it difficult to conceptualise critical thinking. Yet, this study may contribute to my discussion. On the contrary, Chabeli (2006) highlighted dialectical and dialogical thinking within outcomes-based education (OBE) (which has been popular in medical education and traditional education within former Common Wealth countries) by superficially drawing on Aristotle's "rational animal" control by reasoning theory of man. Unfortunately, this discussion fails to contribute to this review due to Chabeli's inability to demonstrate that higher order thinking occurs in OBE. However Grossen's (1991) analysis of the limitations of Aristotle's thinking is more relevant when considering specialist strategies for higher order thinking (a theme considered later with similar studies).

Problem Based Learning

Goodwin and Wimer (2010) introduced problem based learning (PBL) into the higher order thinking debate by evaluating the integration of PBL into classroom learning and clinical practice. These researchers were particularly concerned with "... poor long-term recall, lack of clinical reasoning skills, and lack of self-directed learning skills" identified amongst medical and health professionals (Goodwin and Wimer, 2010, p. 23). Goodwin and Wimer (2010, p. 23) admitted that PBL is difficult but "...it has helped students to solidify the link between classroom learning and knowledge application to clinical practice" and "it promotes higher order thinking and critical thinking skills". This may contribute to my discussion due to the parallels drawn between PBL and simulation.

Cabr and Mohamed (2011) examined the effect of PBL on undergraduate nursing students. The researchers drew a comparison between those students who engaged in a 'chalk and talk' delivery and those who engaged with PBL. They found that the use of PBL clearly "...increased knowledge, self-directed learning, and problem solving skills" (Cabr & Mohamed, 2011, p 160). They also found that "students in the PBL group gained more knowledge and were more motivated for learning than those in the lecture group" (Cabr & Mohamed, 2011, p 160.). This paper may support my discussion.

Student motivation

In her editorial titled *Motivating Learning*, Miller (2010) discussed links between motivating learning, 'cognitive load theory', and higher order thinking. She explained that cognitive load theory encompasses the connection between cognition and change through the mimicking of 'real life'. She suggested that linking realistic teaching and assessment stimulates the student to undertake higher order thinking. This paper may contribute to my discussion as well.

Teacher evaluation

In his commentary in *Education Week*, Sawchuk (2012) challenged American teachers' delivery of higher order thinking skills as required by the 'No Child Left Behind Act'. Sawchuk stated that this Act requires that teachers engage in "a good repertoire of pedagogical techniques", but the absence of any further detail offers little to my discussion.

Specialist strategies

Grossen (1991) asserted that higher order thinking is syllogism, or logical reasoning, based upon Aristotle's distillation of reasoning as a two-part fundamental process. She also introduced the concept of 'sameness' in curriculum design loosely based around Aristotle's theory that "logical forms do not describe actual thinking, but describe how we ought to think" (Grossen, 1991, p. 1). In his book, *The Philosophy of Aristotle*, McKeon (1941, p.2) explained "Aristotle has been criticized, since the Renaissance, as an unsound influence in science". Grossen (1991) acknowledged this criticism by citing many papers that discredit this theory for developing higher order thinking in main stream education. However, Grossen (1991) is a specialist in curriculum design for children with learning disabilities and her research indicates that whilst it is true that two part Aristotle reasoning has little or no place in mainstream education, there may well be a place for it in supporting children with learning disabilities. In another study, Fernandes, Huang and Rinaldo (2011) attempted to draw a correlation between where the student sits in the classroom and whether higher order thinking takes place. Their study was not related to my research question and the results were inconclusive. Therefore, neither paper may contribute to my discussion.

Technology

Hopson, Simms and Knezek (2002) examined the impact of a technology-enriched classroom on the development of higher order thinking skills. Building on Bloom's Taxonomy, the researchers defined 'higher order thinking' as analysis, synthesis, and evaluation. As part of the study, students were taught how to use spreadsheet, database and word processing software. After students were taught how to use the software, they were assessed. The researchers concluded that successful use of the software indicated development of higher order thinking skills as the researchers believed they identified analysis, synthesis, and evaluation skills within their subjects. But one may argue that students can successfully use

this software without employing analysis, synthesis, and evaluation skills. This paper was of limited value to my discussion.

Historical perspective

In 1993 Lewis and Smith (1993) attempted to draw upon the contemporary theories of the time related to the shift from critical thinking to higher order thinking. They suggested the existence of a dichotomy between higher order thinking skills and critical thinking (Lewis & Smith, 1993). They determined that scientific problem solving was the domain of higher order thinking skills. Lewis and Smith (1993) therefore posited that critical thinking was the domain of the social studies. To confuse their endeavour further, they tried to define higher order thinking as ‘reasoning, critical thought and problem solving’ but their review of the literature available at the time contradicted this definition. They then concluded that higher order thinking was a ‘conceptual swamp’ (Lewis & Smith, 1993). Whilst this paper addresses the concept of higher order thinking, its value is limited to the historical record of how the study of higher order thinking has developed.

Supposition

The literature review has been outlined; its purpose was to inform the structure of the research question. Gaps were identified in the body of knowledge surrounding the chosen topics, both in the context of the author’s profession and that of medicine and the professions allied to medicine. While little could be drawn from the results of the papers reviewed, many of the papers had an evangelical approach with their attempt to convert the reader to an educational and/or political standpoint within their findings, whilst extrapolating these findings to defend their own biases rather than develop the pedagogy. The two literature reviews undertaken demonstrate that there is in fact a deficit in the body of knowledge. One deficit pertains to the development of Higher Order Thinking Skills through simulation in medical education. Subquestions, which come from the literature review, include, ‘What learning and teaching factors enhance Higher Order Thinking Skills in simulation?’ And, ‘How does simulation improve confidence, proactive and preparedness, retention of knowledge, problem solving and the development of mentor and the student interactions?’

Discussion

It was logical, as a research educationalist, to combine the two research interests, clinical simulation and Higher Order Thinking Skills, in this review. The literature review revealed studies related to simulation and to Higher Order Thinking Skills, but were focused upon student satisfaction or equipment. Traditional thinking, when describing Higher Order Thinking Skills, comes from the nouns included in Bloom’s taxonomy, however one of Bloom’s former students, Pohl, exchanged Bloom’s nouns for verbs (Bloom, 1956; Pohl, 2000) (figure 10). The literature review reveals some confusion as to the definition of Higher Order Thinking Skills as demonstrated by the terms extracted from the literature (figure 9). This myriad of words is what Lewis & Smith (1993) describe as the ‘conceptual swamp’.

These descriptive words were grouped into the themes seen in figure 9. Bloom and Phol appear to have an either/or approach to the use of verbs and nouns, whereas the themes in figure 9 suggest that what is traditionally termed Higher Order Thinking Skills, is in fact more than one facet. In this author's adaptation of King, Goodson and Rohani, (2008) definition of Higher Order Thinking Skills there are the pillars of Lower Order Thinking represented by the activity nouns of theme 1. Theme 2 consists of synthesis verbs that represent Higher Order Thinking, with the implementation nouns of theme 3 demonstrating the Skills of Higher Order Thinking.

The conceptual swamp		
Analysis Clarifications Clinical reasoning Compose Conclusions Creation Creative thinking Critical thinking Critical thoughts Deciphering Decisions Deductions Elucidating Enactments Evaluation Explanations Hypothesize Inquiry Justifications Logical thinking Performances Problem solving Production Reasonable thinking Reflective thinking Revise		
Theme 1 (activity nouns)	Theme 2 (synthesis verbs)	Theme 3 (implementation nouns)
Analysis Clinical reasoning Creative thinking Critical thinking Critical thoughts Critical thoughts Logical thinking Reasonable thinking Reflective thinking	Compose Deciphering Elucidating Evaluation Hypothesize Problem solving Revise	Clarifications Conclusions Creation Decisions Deductions Enactments Explanations Justifications Performances Production

figure 9

Selecting two words from each theme provides a continuum from Lower to HigherOrderThinking, in figure 10 when placed Blooms nouns and Phol's verbs.

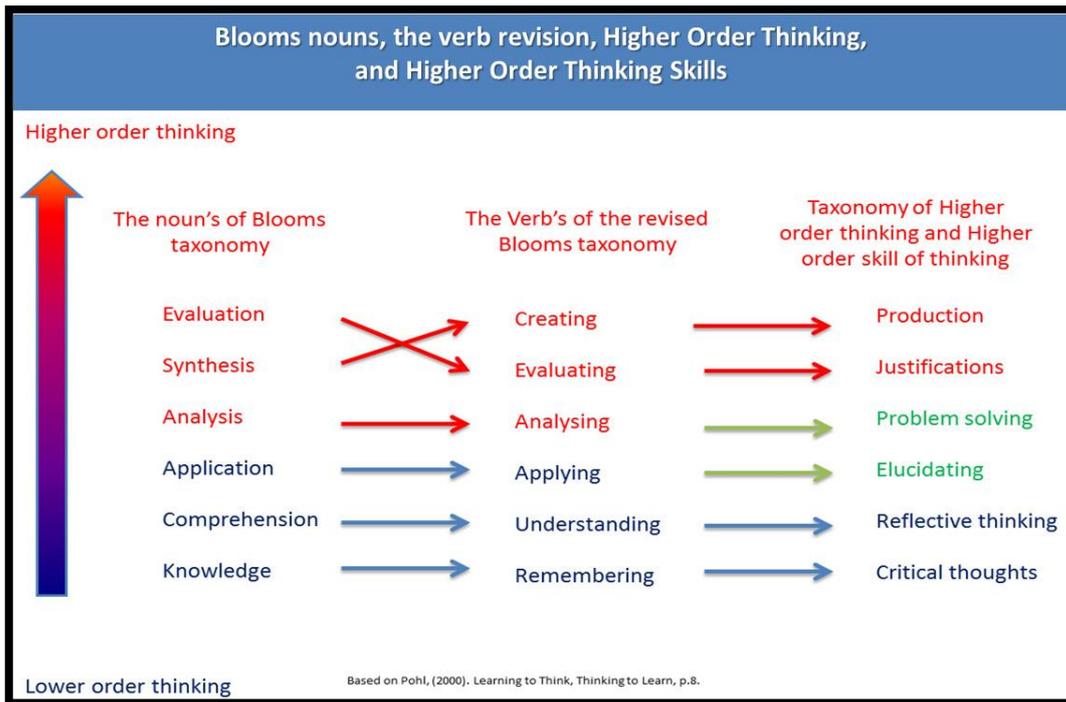


figure 10

This new taxonomy of Higher Order Thinking and the Skills of Higher Order Thinking (HOTSHOT) brings order to Lewis & Smith's (1993) 'conceptual swamp', this in turn allows a structure to be formed with as can be seen in figure 1 the Lower Order thinking generating the activator, which in turn stimulates 'HOTSHOT' figure 11.

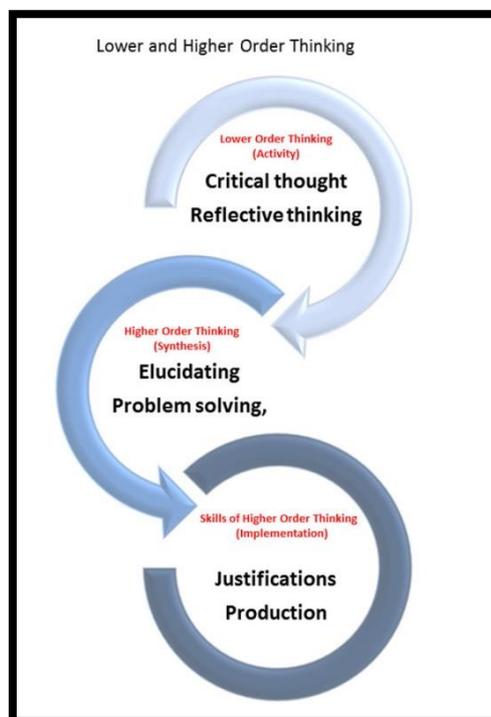


figure 11

Lower Order Thinking - Activity

In figure 11 the Lower Order Thinking criteria is defined as critical thought and reflective thinking. Figure 12 offers an adaption of the critical thinking asylum's (2009) description of Higher Order Thinking; this description has been refined into a thinking model. This model offers a transition from the lower order thinking (activity) to the higher order critical analysis, this transition being the 'activate' seen in figure 1.

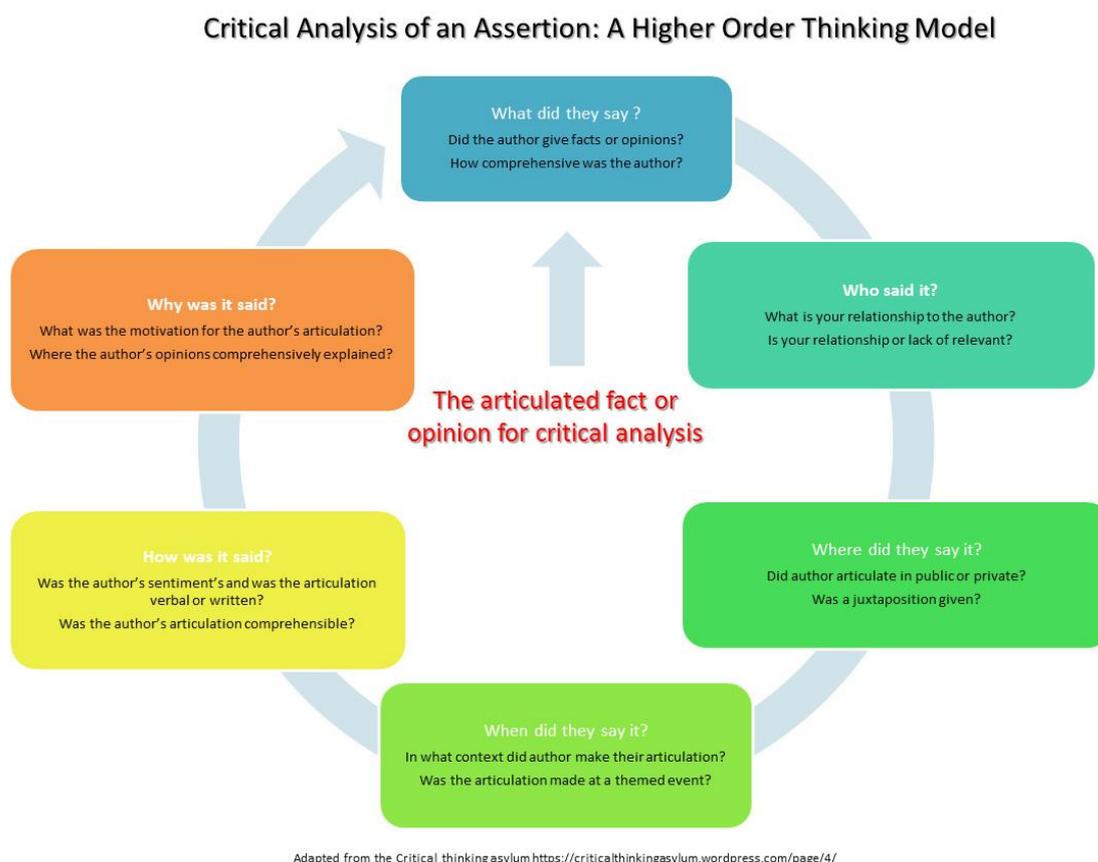


figure 12

Beckwith (2016) offers the Reflection-for-Learning model of reflection (figure 13) as a solution to the needs of a student searching for a reflective model. Reflection-for-Learning affords the student a non-threatening model that has them at its centre, with their development as its focus. Beckwith (2016) articulates how the five stages of the reflective cycle may be used to understand and contextualise the event, happening or assertion. This understanding is the activator identified in figure 1, which informs the resulting Higher Order Thinking and the subsequent Skills of Higher Order Thinking.

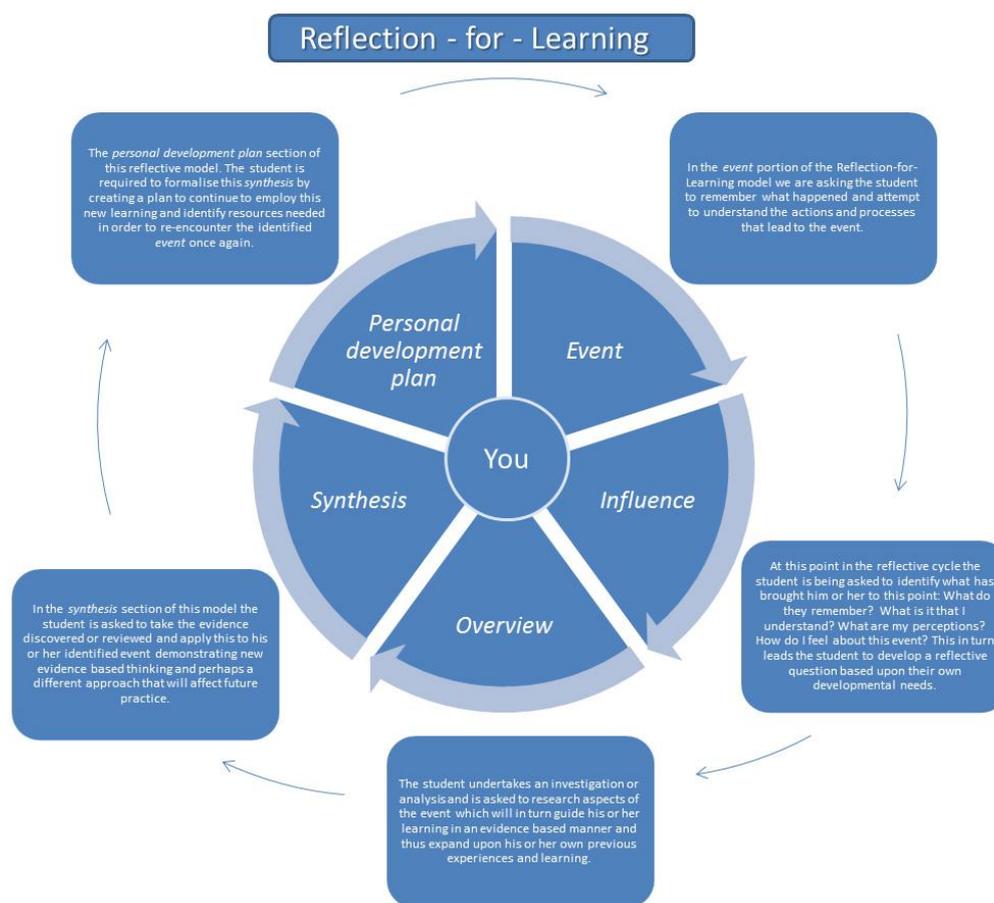


figure 13

(Beckwith, 2016)

Higher Order Thinking – Synthesis and Skills of Higher Order Thinking – Implementation

The HOTSHOT taxonomy suggests that it can be incorporated within an adaptation (figure 14) of Biggs (1999) work which described his constructive alignment theory.

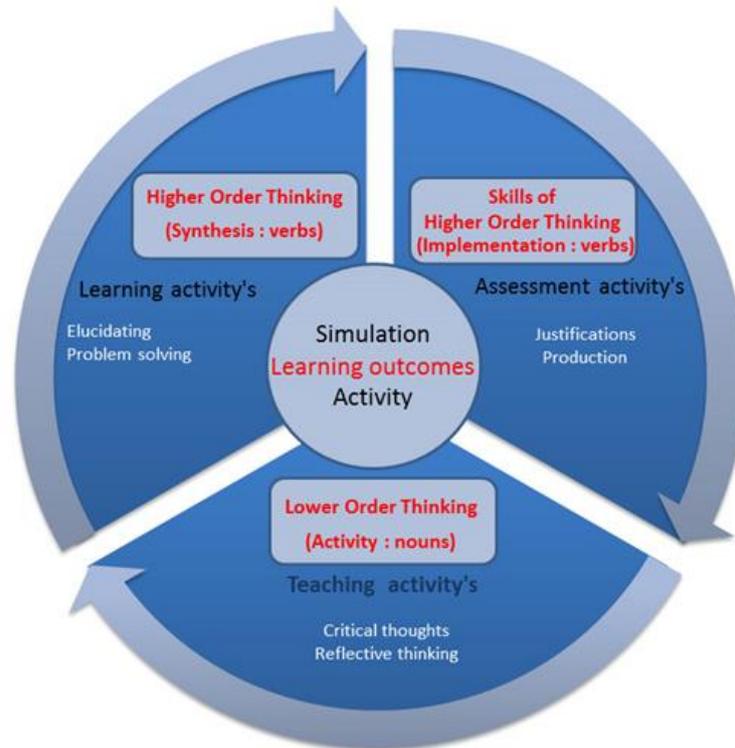


figure 14

This incorporation and adaptation of the HOTSHOT taxonomy in turn informs the creation of signature pedagogy. Shulma (2005, p. 14) positions signature pedagogies as pedagogy of engagement and habits of the mind, further explaining that these are pedagogies of action, because exchanges typically ended with someone saying, “That’s all very interesting. Now what shall we do?” By way of a caveat he suggests that deep content knowledge cannot be replaced by the signature pedagogy, the juxtaposition being that the signature pedagogy can support the deep content knowledge (figure 15).

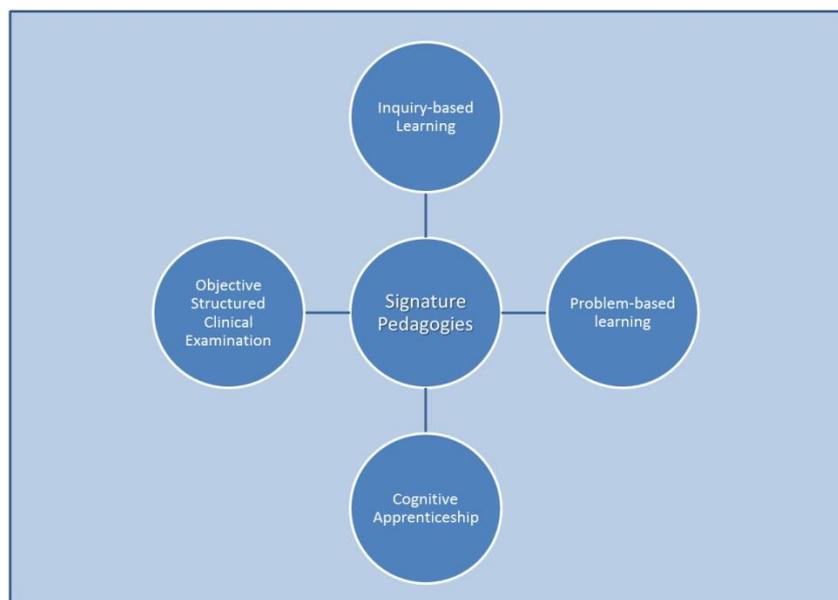


Figure 15

Coughlin, McElroy and Patrick (2009) observe that when guiding students to transfer their analytical powers into professional skills, a Socratic dialogue is often used. However, due to the lack of opportunity to debate in this delivery style, this can be limiting. They draw upon medical education citing the adage ‘see one, do one, teach one’ attributing this maxim to the early development of reasoning skills in the professional context while asserting this to be applicable to both students of law and medicine. It is clear from Coughlin, McElroy and Patrick (2009)’s debate that the dictum ‘see one, do one, teach one’ whilst characterizing traditionally held beliefs for the teaching of clinical skills is in fact suboptimal. They counter offer that ‘do many’ with the sequence unchanged may well improve the students’ performance whereby the pedagogy’s potential benefits overshadow any perceived drawbacks. Coughlin, McElroy and Patrick (2009, p.379) cite the Best Practice report whereas “in addition to experience, students can more rapidly develop problem-solving expertise by...observing how experts solve problems”. In figure 14 the activity nouns ‘critical thought’ and ‘reflective’ are synonymous with the cognitive apprenticeship concept of ‘observing how experts solve problems’. This then leads to the synthesis verbs ‘elucidating’ and ‘problem solving’ synonymising ‘develop problem-solving expertise’. Coughlin, McElroy and Patrick (2009) offer that a student may well merely mimic the learning activities, thereby learning enough to pass the exam without understanding. However, the implementation verbs of the HOTSHOT taxonomy ‘production’ and ‘justification’ require the student to justify and therefore demonstrate understanding. This demonstration of understanding negates Coughlin, McElroy and Patrick’s fear of mimicry, giving both robustness and credibility to the signature pedagogy.

Conclusion

Through analysis of the pertinent literature the HOTSHOT taxonomy has been developed. Having established, through the use of constructive alignment, a framework for defining a generic signature pedagogy, the next stage of mixed the methods study is to populate the framework with data collected from a hermeneutic phenomenological study. This study, its

findings, recommendations and sampler signature pedagogy will inform a bespoke paper, the purpose of which will be to define the Perioperative Signature Pedagogy.

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