Improving Reasoning using Guided Design or Frameworks

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Abstract

Reasoning skills or problem solving skills are important for any discipline where the practitioner obtains and analyses information using knowledge form several disciplines or modules to arrive at a solution or decision. Students are often expected to know how to combine the knowledge from different modules and how to analyse the information without ever having been introduced to, or practised a process to help them to do it.

Literature suggests that teaching a framework will be effective to acquire information, result in better organised and retrievable information, will develop cognitive and process skills to learn and apply reasoning concepts. Research suggests that group work / peer learning is effective for better cognitive outcomes and developing confidence, and that using cases is most effective in teaching reasoning.

This paper, based on an Action Research Methodology examines the impact of using a guided framework to assist first year Physical Therapy students in their Clinical Reasoning. Clinical Reasoning involves analysing the information obtained from the patients' history, hypothesising a range of different possible diagnoses, analysing the findings of a range of tests, interpreting and making sense of all of the information to arrive at diagnosis. A similar format of framework could be used in any other disciplines where a series of steps and analysis of information is required.

The study which was undertaken under the auspices of the Centre of Teaching and Learning at National University of Ireland Maynooth and was based on a concern I had in my teaching situation that first year students found it difficult to analyse and interpret facts and findings for clinical reasoning, integrating knowledge from several modules. The study implemented four action research cycles of teaching using the framework. The students worked in groups using case studies. In the cycles amendments based on feedback and findings were made to progress and develop the learning. Feedback and results indicate improvement in clinical reasoning, an increase in my students' confidence in their clinical reasoning abilities and development of attributes required for clinical reasoning.

The paper provides useful teaching methods for first year clinical reasoning skills, and identifies lessons learned during teaching.

Keywords: *Reasoning*, *Clinical Reasoning, Teaching a framework or guided design, Groups, Case studies, Physical Therapy*

1. Introduction and Motivation

In my experience by the end of the year, first years generally have adequate levels of skill in carrying out diagnostic techniques but often find it difficult to interpret their findings, become confused, overwhelmed with facts and some have no method of making sense of the facts[1]. I found that while students passed their assessments in other modules (musculoskeletal analysis and pathophysiology) they are not always using and integrating the knowledge they should have gained in these modules. While it is assumed that they will use it, a process to use it is not given focus.

The literature suggests that this problem may be commonplace in teaching clinical reasoning. According to Round (1999) the formal and explicit teaching of clinical reasoning is rarely undertaken in medical schools despite widespread recognition that knowledge acquisition alone may be insufficient to develop good clinical judgement. Delaney describes current clinical education as being "based on a reductionist model in which separate skills are developed but there is insufficient integration or structure" (Delaney et al, 2009).

Exploration of clinical reasoning revealed that clinical reasoning is applied differently by the novice and the expert. Jensen emphasises the mystique of clinical reasoning, describing an expert as "using more intuition, reaching accurate conclusions based on something outside the boundaries of logic and the 5 senses, for example intuition pulls the practitioner to a line of questioning or to palpating an area away from the reported symptoms, that is not logical but ends up leading precisely to the important area of treatment" (Jensen, 1999). Research carried out by Higgs et al (2008) shows that experts in clinical reasoning possess a great stock of tacit knowledge, acquired through experience and while they are able to act on this knowledge they are not always able to verbalise it. Delaney et al (2009) and my own experience shows that trainees expect more certainty about professional knowledge and practice than experts. Students dislike ambiguity, they like definitive 'black and white' answers.

Two main models used in clinical reasoning are 1) the Hypothetico deductive model and 2) Pattern Recognition. Hypothetico Deductive involves the generation of hypotheses based on clinical data and knowledge and testing of these hypotheses through further inquiry. It is deductive reasoning based on specific observations to generate hypotheses. It is used by novices and in problematic situations by experts (Atkinson et al, 2005). In Physical Therapy terms the therapist will come up with a list

[1] Feedback given to students after Summative VIVA exam May 2009 – identifies that Interpretation / Clinical Reasoning was one of the most problematic areas.

of possible differential diagnoses (hypotheses), they will then proceed to carry out tests, ask further questions to 'test' these differential diagnoses.

Pattern Recognition: Expert reasoning in non problematic situations resembles pattern recognition or direct automatic retrieval of information from a well structured knowledge base (Higgs et al, 2008). According to Atkinson et al (2005) it is based on inductive reasoning – a general law is inferred from observed particular instances, e.g. if patient A, B and C walk with gait X, and A, B and C have Osteoarthritis of the hip then it is likely that D who also walks with gait X has Osteoarthritis of the hip.
Novices need to use the hypothetico deductive model because they have some limited knowledge, no experience and no 'illness scripts' on which to base pattern recognition. According to Bransford and Schwartz (1999) cited by Delaney (2009 p.44) "Experts recognise patterns and meanings in information that are not noticed by novices, experts have extensive content knowledge organised in 'deep' ways. Context specificity is vital."

I concluded from this analysis of models and novice to expert methods of clinical reasoning that first year students need to develop a hypothetico deductive model, and that they will naturally with years of experience over time change to a mainly Pattern Recognition model for common problems.
This finding was corroborated by a short survey I carried out with 13 practising Physical Therapists with years of experience varying from 4 to 10+ years.
According to Eraut (1994 p.108) "An effective and efficient approach to the acquisition of information requires some kind of conceptual framework to guide ones enquiry"

Eraut (1994) also puts forward the hypothesis that it was not knowledge in itself which characterised expertise but having it better organised and more readily available for use. Conrick (1997) looks at a 'Framework' or 'Guided design' and "considers the fact that learning reams of facts and memorising pre-established answers will not help the student to deal with "real life" situations and complex problem solving." Wales and Stager (1977) developed the concept of guided design which they describe as an organised problem solving format, integrating the teaching of subject matter while developing decision-making skills. This technique was later developed further as a strategy for use in nursing education. They see this method as utilising many learning theories and say that students are actively involved in their own learning, they receive immediate feedback and simultaneously develop both cognitive and process skills. Guided design does not simply transmit knowledge but encourages the move to the realm of deep learning.

McMinn et al (2003) notes in a study of clinical reasoning skills for dietetic students the ranking of effectiveness ratings to teaching methods in teaching clinical reasoning was: clinical experience, case study, class discussion, lecture, reading assignment, & report/research paper.

Research suggests that group work / peer learning is effective for better cognitive outcomes and developing confidence. According to Mckeachie (2006) peer learning and teaching is extremely effective for a wide range of goals, content and students of different levels and personalities. Miller and Grocia (1997) as cited in Mckeachie (2006) found that cooperative learning produced positive results in ability to work with others as well as better cognitive outcomes. Students are more likely to talk in small groups than large ones, students who are confused are more likely to reveal their problems to another student than a tutor, and students who are not confused need to organise and reorganise their own learning in order to be able to explain it, thus both the confused and the unconfused benefit, (Mc Keachie, 2006). A study conducted by Radomsky and Russell (2009) suggests that the group-based, simulated clinical reasoning process appears to help undergraduate medical students to rehearse, articulate and question their clinical decision-making pathways, offering a professionally challenging, but supportive group learning 'space' for students to practise what it might mean to 'think', 'talk' and 'perform' like doctors in real settings.

From my own experience, discussion with physical therapists and tutors, and from the literature I have identified the skills, learning and other factors (Table 1.0) that are a prerequisite for good clinical reasoning in the novice practitioner.

Skill / Learning / Attribute /Other Factor
A. Good basic subject Knowledge (musculoskeletal analysis, pathophysiology)
B. Ability to integrate and apply subject knowledge to interpretation
C. *Self Confidence*[2]
D. Self Reflection, honesty, humility
E. Open mindedness, flexibility, tolerance for ambiguity

[2] In order to cope with uncertainty novices need self confidence and maybe paradoxically to build up that self confidence they need, at least initially; certainty. Novice and expert alike need self confidence in order to critique and reflect on their own clinical reasoning skills. Pesut & Herman(1999).

F.	*Curiosity, diligence*
G.	*Certainty, Organisation of knowledge, A Conceptual Framework*
H.	*Practice, Safe environment for Practice*
I.	*Context specific*[3]
J.	*Being aware of and not making the common errors*[4]*:*
a)	*Unable to correctly interpret results of tests (possibly due to defaults in knowledge base*[5]*)*
b)	*Making assumptions*
c)	*Prematurely limiting the number of hypotheses*
d)	*Making a decision based on biased or limited data*

Table 1.0 Skills for Clinical Reasoning

2. Methodology and Analysis

The framework used was a simple spreadsheet format. In the first column the student lists the hypotheses or possible diagnoses grouping them by system; muscular, neurological and so on. These hypotheses are based on the facts of the case which describe the signs and symptoms and medical history of note of the hypothetical patient. Column 2 – 5 analyses the results of five different types of testing (Posture, Palpation, Active Range of Motion and so on). If a test result strengthened the likelihood of a possible diagnosis then the diagnosis was written into this column and the reasoning briefly noted. If a test result weakened the case for a possible diagnosis then the diagnosis was written in to this column but crossed out and again the reasoning briefly noted. The 6th column was used to identify what possible diagnoses were left (had not been crossed out at all) or were still strong possibilities. Column 7 then required the student to reflect back on all of the information and determine if a diagnosis could be arrived at that was congruent with all of the information, and record his reasoning.

The class was divided into five groups, with six students per group. The case was described and the groups were introduced to the clinical reasoning framework. The

[3] Context specific learning - When students think about material in more meaningful ways underlying brain structures change to promote more enduring learning (Leamnson, 2000 cited by McKeachie).

[4] Doody & McAteer (2002) cited in Atkinson et al (2005) identify a number of errors commonly made by novice practitioners. The error described in a) in table is one commonly exhibited in first year physical therapy students.

[5] Balla (1990) cited by Ramsden (2003) explains that the evidence shows that learning in traditional medical curricula is often unsatisfactory. Students often use basic science knowledge incorrectly or not at all when formulating a diagnosis, and when they become a practising clinician they continue to use their theoretical knowledge only rarely and with difficulty. Investigations show that both students and clinicians make errors and possess systematic biases ignoring probabilities and basic science in favour of other sources of information.

groups worked through the case column by column and then reported their results back to the class. This exercise was run a further 6 times in class (3 cycles with 2 implementations each cycle). Changes were made to the process before each cycle based on feedback and results. The class confidence levels were surveyed before and after each cycle by means of a post-it note survey.

In the first cycle Students reported that they really enjoyed carrying out the exercise. Students were all engaged and all seemed to be contributing. Student confidence levels show that a percentage of students have increased in confidence; the 'mostly confident' category increased from 5% to 17%. I had not expected improvements in confidence as this was their first introduction to the process. The increase may reflect the fact that it was an easy case and that they all got it right. It may also be partly because most did not fully complete all elements of the process due to the time constraints. I underestimated the time it would take to work through the framework and in addition I found that tutor and assistants need to be less involved in group work in order to allow group work to happen. Some students jumped to a conclusion based on one fact. The framework is pointless if students feel they can jump to the conclusion based on one fact and arrive at the correct answer.

Changes were made to cycles 2,3 and 4 to address the problems occurring each time. I found that group work was more effective when tutor and assistants implemented a better facilitator role rather than being drawn into providing the information for the group. To help with the time constraints and to share information I asked groups to go up and fill in their results for each column on a white board. This did not work well as students did not feel confident in their answers and no group wanted to be first. The exercise worked better when each group completed their framework on flipchart paper, and then each group selected two people from their group to remain with their framework to explain it to 'visitors', while the rest went to 'visit' groups to view their framework. To further alleviate the time constraints the cases and semi completed frameworks were put on the VLE (Virtual Learning Environment). Students were asked to finish working through them in their study groups[6]. Many students (75 – 80 %) did not appear to practice or complete the process in study group or on their own and came to class without having completed the homework. Students cited requirement to study for exams in other modules as the reason. This improved in subsequent cycles but was still lower than was hoped and very dependent on student's perceived priorities.

[6] Each student is assigned to a study group of between 3 to 7 students based on geographical location. They are encouraged to meet weekly in their study groups to practice their techniques and carry out group work.

In the second cycle at least one group still arrived at a conclusion without demonstrating that they had fully used the framework and considered all possibilities. In the subsequent cycle I used a case that had an unexpected diagnosis; students were not able to assume the condition from any one finding. After this cycle a survey showed a general reduction in confidence. The 'mostly not confident' category increased to 24% from 8%. Despite this I feel, and students acknowledged that using the case with the unexpected diagnosis was worthwhile as it has demonstrated the danger of making assumptions and jumping to conclusions. Dropping confidence levels may also represent growing awareness of what is required. However it was noted that students have now become faster at working through the process and completing the framework. This time saving allowed us to incorporate a role play element, whereby a student carried out the diagnostic tests and another student role played the case findings. This worked well and most groups had become comfortable with analyzing and completing the framework. By this stage we were in the 4th cycle and felt it was time to encourage students to perform individually. Individual students were asked to explain and interpret different elements of the findings and the case diagnosis. In this exercise students were found to generally perform quite poorly.

Findings

Average results in the Diagnosis and Practice VIVA exam improved and more students achieved higher marks compared to previous years. There are many variables that could have impacted these result, however examiners agreed that in comparison to previous years clinical reasoning skills had improved.

	2008	2009	**2010**
Min Mark	26	13	**20**
Max Mark	75	74	**89**
Attended	42	39	**56**
No Passed	36	29	**43**
No Failed	6	10	**13**
Pass Mark	40	40	**40**
Average Mark	51	46	**54**
Pct. Passed	86	74	**77**
St. Deviation	12	13	**17**

Table 2.0 Results for VIVA[7] – Diagnosis and Practice Module

The results show an improvement in Diagnosis and Practice module average mark increasing to 54% compared to 46% in 2009. More students achieved higher marks –

[7] VIVA - Practical examination conducted by spoken communication

9 students achieved marks of 70% or over and 5 of these achieved 80% or over. Note that of the 13 fails, 11 of these passed 2 out of the 3 clinical reasoning outcomes. However all 13 failed the interpretation learning outcome which involved verbalizing their findings and interpretation. Students own confidence levels in their clinical reasoning abilities improved after regular implementation of the framework.

Students found summative VIVA exam stressful and examiners feel this may have impacted on results. Formative VIVA and the Framework did not adequately prepare students to reduce stress.

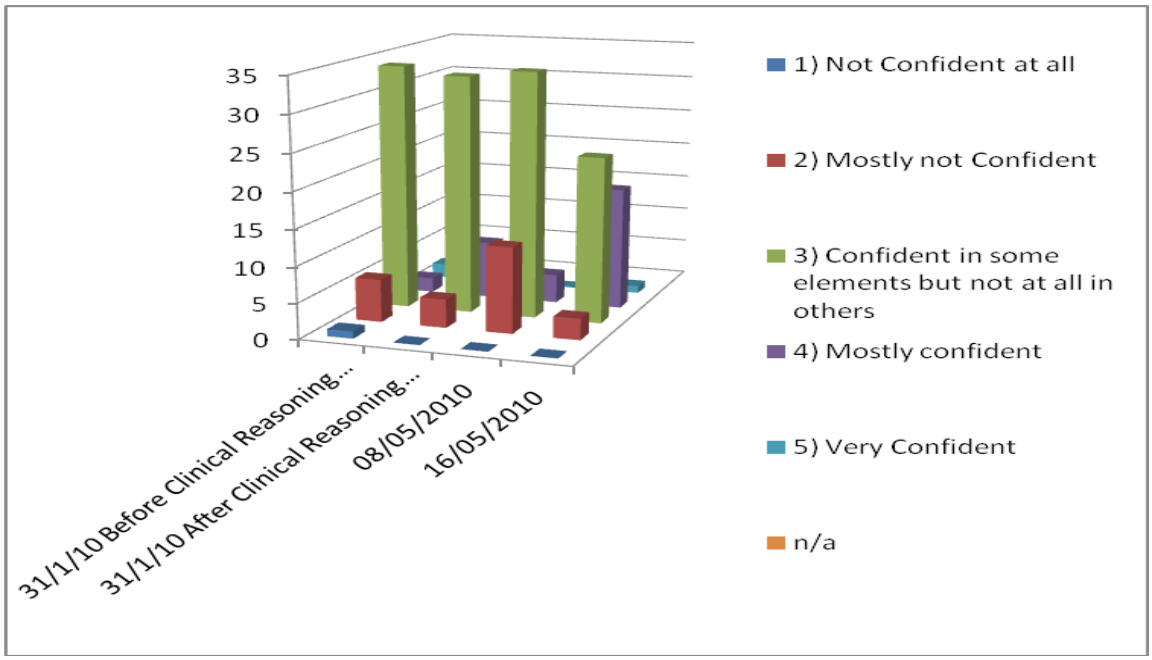

Table 3.0 Student Confidence levels

At the end of the year an exercise was carried out to find out from students what specific skills, knowledge and attributes they thought were required for effective clinical reasoning. Students identified the same or similar skills, knowledge and attributes identified by my research (table 1.0). They were then asked to analyse if these had changed by implementing the framework. Students' feedback indicates that these skills and attributes improved to some extent after regular implementation of the framework.

I found that while all students were able to arrive at the correct diagnosis and to use the framework, in formative assessment and summative VIVA they performed generally poorly[8] in briefing us with their findings and verbalizing their interpretation.

[8] In the VIVA exams I found that students who had quite good communication skills already (identified through interaction in class throughout the year) performed better in these areas.

Students found the exercise worthwhile but suggest including history taking, actual assessment / role play of findings plus verbalization of interpretation to increase learning and make more real. They also suggest introducing it earlier and in a simpler way initially, integrating it across modules.

Group work – In group work I found that we (Tutor and Assistants) needed to be aware and purposely take care not to be drawn into assisting and effectively doing the exercise for the group.

The time taken to allow students to work through every element of the framework in their groups can be considerable, due partly to poor preparation by the students. The students themselves acknowledged this and suggested having a mandatory assessment to make them carry out the framework. Expecting students to do preparation work for a module when they have an exam coming up in another module can be futile.

Several students tended to arrive at a diagnosis based on one fact without considering the other findings. They need to understand that real cases are not often 'text book' and that they need to keep an open mind.

Students were reluctant to share their analysis on Whiteboard. Discussion with students revealed that they were not confident enough in their answers to do this and were not used to writing on the white board.

Conclusions and Future Work

My findings support studies that 'guided frameworks', group work and use of case studies help develop cognitive and process skills in learning and applying reasoning concepts, improve cognitive outcomes and develop confidence. The main challenge in regard to implementing this approach was the time involved in class to carry it out fully and effectively. Suggestions from students obtained in feedback should help alleviate this problem to some degree in the future. Better coordination across modules of home assignments taking into account forthcoming exams should mean students will practise the framework more outside class and be better prepared for class.

A possible oversight in the research was that no critique of the actual framework and how it was used took place. In addition very little initial work went into designing the framework. It is possible that a tool more efficient than a simple spreadsheet is available, and that the columns used, and the process of completing it could all be improved.

An unexpected outcome was the positive attitude of the students. I had not expected that students would be so appreciative of the efforts being made. The students seemed to understand that we really cared about them and their learning and this seemed to motivate them. In student clinic I noticed that more than any other year students were really seeking feedback and striving to improve. This may also have had some impact on retention levels this year (94% retention this year in comparison to 67% last year). This suggests that using the action research approach helped to develop a culture of participation within the class.

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