Rising to the Surface: Re-Designing Curriculum to Accentuate Research Skills in Second Year Pathology and Clinical Science

Manisha Thakkar[1]

[1]Endeavour College of Natural Health

Corresponding author email address: Manisha.Thakkar@endeavour.edu.au

Abstract

This paper acknowledges that research and inquiry-based curriculum must commence with the foundational undergraduate years in order for students to acquire research skills and applied knowledge for professional practice. However, whole-of-program realities entailed beginning with a second-year bioscience subject of complementary and alternative medicine degree programmes at Endeavour College of Natural Health. A Model of Engaged Learning and Teaching (MELT) named the 'Clinical Management Pentagon' was integrated into the second year Pathology and Clinical Science 2 & 3 subject to improve students' research and clinical analysis skills through the curriculum re-design approach. The case study assessment and related study materials were modified to incorporate the Clinical Management Pentagon. Improvement in students' perceptions of research and clinical analysis skills was achieved after semester-long exposure to the Clinical Management Pentagon. This study demonstrates the need for long-term exposure to the research framework through whole-of-curriculum re-design, in order to accentuate research skills and enable their transfer and applicability upon graduates' employment.

Background

The traditional lecture-based, authoritative education system does not seem to stimulate the natural human instinct of asking questions and exploring solutions (Ackoff & Greenberg, 2008). Therefore, it fails to promote continuous learning and acquire applied knowledge (Prince & Felder, 2006). However, the higher education journey aims at improving graduates' employability which relies on their ability of critical thinking, problem solving and life-long learning (Willison, Sabir & Thomas, 2017). Consequently, a shift towards research and inquiry-based teaching and learning is observed. Such a shift is learner-centric and ignites active and collaborative learning (Levy et al., 2010). Furthermore, curriculum transformation is demanded in order to embed research- and inquiry-based frameworks in higher education from the very early educational years,

so as to put an emphasis on the hidden research skills in the curriculum and to maximise student learning outcomes, engagement and, ultimately, graduate employability (Levy & Petrulis, 2012, Loveys et al., 2014). The Research Skill Development (RSD) framework (Willison & O'Regan, 2007) is a broadly adapted conceptual framework used at various educational institutes for curriculum re-design. It accentuates research skills and improves students' engagement in their own learning (Pretorius, Bailey & Miles, 2013; Willison, 2012; Lal, 2016). It presents the key research skills central to students' learning as six facets of inquiry, alongside levels of student autonomy ranging from closed to open inquiry. The RSD allows mapping of research skill development across the programme curriculum as well as at a particular subject level within the programme (Walkington et al., 2011). As RSD permits reform to best fit within a discipline specific context, various sister frameworks, including Optimising Problem-Solving Pentagon, Work Skill Development Framework, Clinical Reflective Skills Development Framework and Research Mountain have emerged with RSD adaptations and now conjointly known as Models of Engaged Learning and Teaching or MELT (Research Skill Development for Curriculum Design and Assessment, 2017). Fundamentally, MELT share the parameters with RSD and help in raising the hidden research component of the curriculum to the surface by providing a framework for re-designing learning materials and assessment activities aimed at developing discipline and context-specific research skills in students. At Endeavour College of Natural Health, a MELT named 'Clinical Management Pentagon' (CMP) has been recently developed and implemented to improve research skills specific for clinical case analysis within a second year subject Pathology and Clinical science 2&3 subject. This paper presents the development and implementation process of Clinical Management Pentagon in Pathology and Clinical Science 2&3. The use of this explicit MELT in re-designing assessment, marking rubrics and study materials, and its benefits in improving student's perception of research skills are also reported.

Development of MELT

Pathology and clinical science 2&3 is a second-year core subject for the bachelor of health science degrees in Naturopathy, Nutritional and Dietetic Medicine, Acupuncture and Myotherapy delivered at Endeavour College of Natural Health. This subject is designed to teach and improve students' clinical case analysis skills that allow them to apply the knowledge of basic pathological processes, analyse and evaluate clinical features and investigation tests and understand the basis for differential diagnosis of various diseases to finally reach to a clinical management plan for patients. To achieve this subject outcome, learning activities and assessments in this subject incorporate clinical case studies where students are exposed to clinical scenarios of various diseases and asked to analyse these cases to develop clinical management plan. Their skills of case analysis are then assessed in a case study assignment that falls late in semester and also in the final exam. As case study in itself is a research type (Yin, 2013), students in this subject do require and attain research and clinical analysis skills. However, it is required to systematise the case analysis process and provide a scaffold

for research skill development for students to envisage the skills being gained in this subject. For implementing such systematic approach, the RSD framework was consulted. RSD facets of inquiry were mapped to clinical case analysis process, rephrased to employ clinical language and rearranged in the MELT pentagon to match with the natural case analysis flow. The final MELT emerged with a pathology and clinical science-specific context, and was named the Clinical Management Pentagon (CMP; Image 1).

Implementing MELT

To implement this Clinical Management Pentagon (CMP) into the course structure, a three-step curriculum re-design method was used (Australian Learning and Teaching Council, 2009). These three steps included:

1. Reframing the marking criteria of an existing assessment that falls late in semester using the RSD framework, where each research facet is marked up to level 3 or 4 of the framework,
2. Developing a diagnostic assessment where each research facet is marked up to level 2 of the RSD framework, and
3. Modifying and revising the emphasis of other existing resources and assessment tasks according to the two modified assessments.

The first step of this curriculum re-design approach was the main focus of this study. This step of reframing marking rubrics as per the RSD/MELT is a multi-stage process involving mapping of existing assessment to identify a level of student autonomy; considering change in level of autonomy if not at appropriate level; analysing and modifying the assessment task for each facet to make sure that they are appropriately weighted and incorporate all the required levels of autonomy; and, finally, developing marking rubrics based on the RSD format (Australian Learning and Teaching Council, 2009). The third step of modifying and revising the emphasis of other existing resources according to the modified assessment is also followed, side by side. This contributed to the re-design of the curriculum for the whole subject.
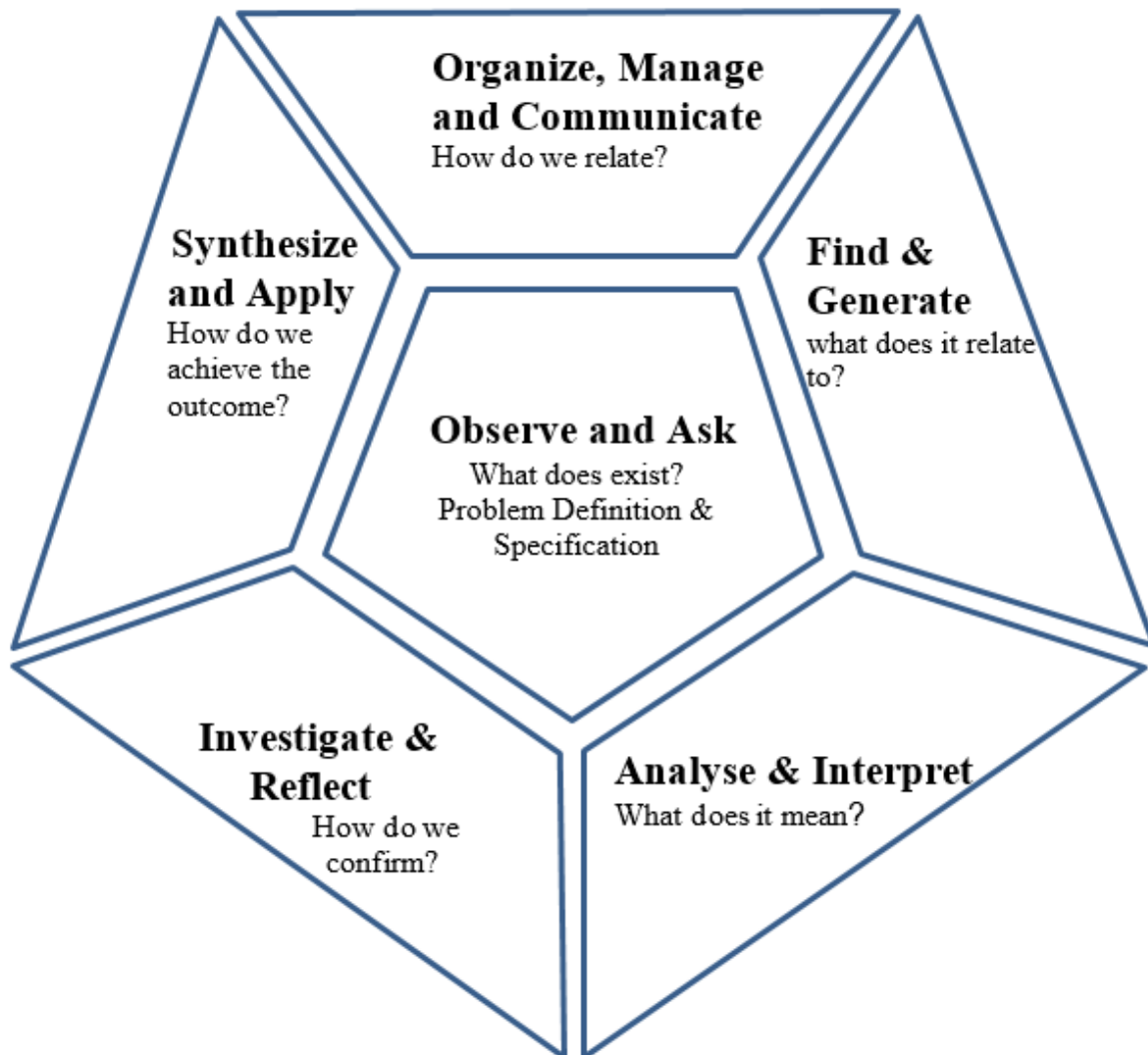
When in doubt, return to the centre

Image 1: Clinical Management Pentagon (CMP) [Facet description: **Observe and Ask**: Observe key clinical features in a given case history and frame further questions in the history-taking process to clarify the given presentation, to think of likely differential diagnosis. **Find and Generate:** Collect information on clinical features of various diseases that are relevant and/or match given clinical presentation, and generate differential diagnosis. Find data to identify differences in the symptomatology of the differential diagnosis to generate one definitive diagnosis, and find data to explain the mechanism of disease pathology. **Analyse and Interpret:** Analyse the pathological mechanism to interpret its relation to given clinical presentation**. Investigate and Reflect:** Identify the investigation tests to confirm the definitive diagnosis by reflecting on the test results. **Synthesize and Apply:** Synthesize and apply the knowledge gained to establish appropriate pharmacological and non-pharmacological management plans. **Organize, Manage and Communicate:** Organize, manage and communicate the information collected and knowledge gained to your patient/other health professionals/lecturer in assignments/assessments].

As the existing case study assignment of Pathology and Clinical Science 2 & 3 falls late in the semester and assesses students' clinical case analysis skills, it was chosen for redesign in this study. The existing assignment task was mapped at RSD level 3 of student autonomy and identified as appropriate for the second-year students where they work independently within set structures and guidance. Minor modifications were made

to the assignment task to highlight each CMP facet at RSD level 3 of student autonomy. New comprehensive RSD-based marking rubrics (Appendix 1) in line with CMP were developed for the case study assignment, in order to clearly communicate assessment requirements and provide detailed marking criteria. Tutorial activities and discussion forums were also modified to incorporate the use of CMP and familiarise students with the systematic case analysis approach from the very beginning of the course. Thus, introduction of CMP called for a thorough re-design of Pathology and Clinical Science 2 & 3. The subject (with redesigned curriculum and CMP) was first delivered in semester one of 2017. Students and lecturers were introduced and oriented to the new course materials through webinars and email communications. A video recording was made available to students and lecturers to introduce the CMP, explain each of its facets and its application in case analysis, as well as the new marking rubrics for the case study assignment. Students were also informed that data would be collected in week 1 and week 13 of the course, in order to analyse the improvement in students' perception of research and clinical analysis skills.

Method and Evaluation

This study was approved by the human ethics committee of the Endeavour College of Natural Health in accordance with the National Health and Medical Research Council's guidelines (ethics approval number 20160626). In order to evaluate the impact of the Clinical Management Pentagon in improving students' self-perception of research skills, pre- and post-course student surveys were conducted through a structured questionnaire (Appendix 2) with fourteen five-point Likert scale questions and two open response questions. This structured questionnaire was adopted from Willison, Lievre and Lee (2010), and modified to add discipline-specific context. All the questions on the original questionnaire were framed by the six facets of the RSD (Willison, Schapper & Teo, 2009). The questionnaire included questions on students' self- assessment of research skills specific to this subject (Q 2-9) and their general attitude towards research in the context of the whole degree programme and students' future careers (Q 1, 10-14 and two open response questions). A question on oral communication from the original questionnaire was omitted, as the case study assignment of BIOS222 did not assess oral communication skills. All students enrolled in the subject were invited to participate in this online survey via e-mail notifications and loop posts in weeks 1 and 13 of the semester with informed consent. Students were also provided time during their class sessions to complete their online questionnaire. The results from these pre-and post-course surveys were analysed for statistically significant changes.
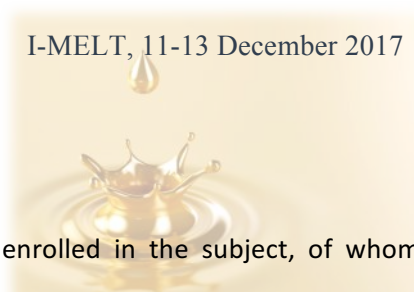
Results and Discussion

Nationally, 150 students were enrolled in the subject, of whom 57 completed the pre-course and 62 completed the post-course survey, with 40 common respondents. Both unpaired Student's t-tests and paired t-tests were conducted to assess changes in Likert scale scores between pre-and post-course surveys. Unpaired analysis was conducted to evaluate and compare the impact in relation to prior RSD-based studies. A paired analysis was also conducted to serve more powerful results of student's perception by reducing inter-subject variability, with 40 common responses. This is the first study to evaluate paired results of students' perceptions of research skills with RSD/MELT implementation. The significance level used was p=0.05 for both analyses. The internal reliability of pre- and post-course questionnaire sets was identified as high, with paired and unpaired questionnaire response scores having Cronbach's Alpha scores of 0.83 or more. This was consistent with previous RSD-based studies (Willison, Lievre & Lee, 2010). Pre-post score mean, mean difference and p-value for all questions from both paired and unpaired analyses are indicated in Table 1. Statistically significant changes in scores following the Clinical Management Pentagon intervention are indicated in bold, with effect sizes for significant scores also presented. Statistical analysis of the unpaired sample showed significant differences, with effect sizes ranging from medium to large in question 2-7 (which mainly assessed students' perceptions of research skills specific to this subject). The paired analysis found significant improvement in students' perceptions of subject-specific research skills in questions 2- 8 (with effect sizes ranging from small to large). Significant changes with small-to-medium effect sizes were also observed in question 1 (which looked at general attitude to research in the context of the whole degree programme and future career). Overall, these results suggested that CMP improved students' perceptions of their skills in observing and asking questions, identifying relevant information to generate knowledge and analysing, evaluating, organising and communicating the information by using valid and credible sources for Pathology and Clinical Science 2 & 3.

Table 1: Analysis of Pathology and Clinical Science 2 & 3 students' responses to 14 five-point Likert scale questions about self-assessment of research skills

Q.	Unpaired T-test Pre-Post score/5 (change)	Mean p value n1=57, n2=62,	Effect Size	Paired T-test Pre-Post score/5 (change)	Mean P Value n=40	Effect size
1	3.86-3.97 (0.11)	0.423		3.825-4.075 (0.25)	**0.0396***	0.32
2	3.54-3.90 (0.36)	**0.005****	0.537	3.600-4.05 (0.45)	**0.001****	0.669
3	3.65-3.94 (0.26)	**0.024***	0.394	3.775-4.050 (0.275)	**0.0258***	0.416
4	3.32-3.73 (0.41)	**0.002****	0.743	3.45-3.90 (0.45)	**0.0003****	0.814
5	3.81-4.16 (0.35)	**0.002****	0.586	3.95-4.175 (0.225)	**0.0181****	0.376
6	3.77-4.11 (0.34)	**0.002****	0.421	3.75-4.125 (0.375)	**0.0094****	0.463
7	3.74-4.06 (0.32)	**0.004****	0.435	3.85-4.10 (0.25)	**0.0311***	0.339
8	3.70-3.85 (0.15)	0.253		3.675-3.975 (0.3)	**0.0213***	0.376
9	4.28-4.26 (-0.02)	0.860		4.4-4.375(-0.025)	0.834	
10	3.37-3.55 (0.18)	0.324		3.523-3.525 (0)	0.999	
11	4.51-4.55 (0.04)	0.696		4.575-4.65 (0.075)	0.456	
12	4.02-4.11 (0.09)	0.434		4.075-4.075 (0)	0.999	
13	4.32-4.35 (0.03)	0.718		4.35-4.375 (0.025)	0.8379	
14	4.77-4.58 (-0.19)	0.719		4.8-4.625 (-0.175)	0.0701	

[In table, the statistical significant scores (<0.05) are bolded. * indicates scores <0.05; ** indicates scores <0.01. Effect size: 0.2= small, 0.5= medium and 0.8= large]

The two open response questions were analysed for common themes, to identify the facets of research, and facilitating and impeding factors for research skills development from students' perspective. A large variation was noticed in response to the question about what research involves from pre- to post-course. Almost all students in the pre-survey thought research involved searching for credible information to gain a better

understanding, with only two students listing "analyse and interpret" and one identifying "evaluating". So in the pre-course survey, mainly one facet of inquiry ("find and generate") was acknowledged as research. However, in the post-course survey students saw research as multi-faceted, with "find and generate" as a common theme, and "analyse and evaluate" equally well presented. The synthesis of information and application of knowledge were two new themes which emerged in the post-course survey. This shift may be suggestive of improvement in students' understanding of or attitude towards research. The second open-ended question asked for facilitators and barriers in research skill development. Common supportive factors identified in both pre-and post-course surveys were repeated use of research-based assessments and study materials, practice and support/feedback from academics. The two main obstacles noted in both surveys were access to credible information and lack of time. Lack of clear criteria, direction and knowledge was another common barrier identified. This suggests that students would like to see more research-based curriculum across their degree courses to improve their research and analytical skills. Implementing RSD/MELT-based curriculum throughout the whole degree would allow repeated exposure to research-based assessments and study materials. Such implementation would help to support students by providing clear criteria and detailed feedback through RSD-based marking rubrics and also highlight the transfer of skills across the degree programme.

Conclusion

Overall, this study of CMP supports the results of previous studies (Willison, Lievre & Lee, 2010) where semester-long exposure to RSD and MELT frameworks have been found effective in improving students' perception on subject specific research skills. The improved perception of research skills may benefit students in improving their clinical case analysis skills for their future clinic-based courses, where they will observe real patients. However, no substantial change was observed currently in students' general attitudes towards research and its applicability to their future studies or career. It is recommended that interviews with students be conducted after one year, to investigate the long-term impact of CMP on their future studies and practice. Students in this study have also indicated that research skill development may be explicitly supported by repetition, practice and clear directions.

Research skills are very basic required and acquired skills throughout the educational journey. However, they are an unseen part of every course curriculum. These hidden skills must be accentuated appropriately in the curriculum in order for graduates to achieve the best in their professional practice. For raising the sunken treasure of otherwise hidden research skills in the curriculum demands developing a discipline-specific model of engaged learning and teaching. Such a model must aid curriculum re-design in order to highlight the

research skills acquired in each subject, underline the transfer of skills from one subject to the next throughout the degree programme, help students attain the graduate attributes of the programme, and improve graduates' employability. This ultimately calls for incorporating RSD/MELT-based curriculum in all courses from the foundational years through to the whole degree programme.

References

Australian Learning and Teaching Council. (2009). *A Handbook for Research Skill Development and Assessment in the Curriculum.* Retrieved from http://www.adelaide.edu.au/rsd/docs/rsd_Handbook_Dec09.pdf

Ackoff, R.L., & Greenberg, D. (2008). *Turning learning right side up: Putting education back on track*. Upper Saddle River, New Jersey: Pearson Prentice Hall.

Bandaranaike, S., & Willison, J. (2010). Work Skill Development Framework: an innovative assessment for Work Integrated Learning. In *The Australian Collaborative Education Network National Conference,* Perth, Australia.

Lal, H. (2016). *Implementation of Research Skills Development (RSD) in Courses – Executive Summary*, Research office, University of the South Pacific. Retrieved from http://www.research.usp.ac.fj/wp-content/uploads/2013/12/RSD-Implementation-Executive-Summary-29.10.2013.pdf

Levy, P., & Petrulis, R. (2012). How do first-year university students experience inquiry and research, and what are the implications for the practice of inquiry-based learning?, *Studies in Higher Education*, 37(1), 85-101.

Levy, P., Little, S., McKinney, P., Nibbs, A., & Wood, J. (2010). The Sheffield Companion to Inquiry-based Learning. *Centre for Inquiry-based Learning in the Arts and Social Sciences*, Sheffield: University of Sheffield.

Loveys, B.R., Kaiser, B.N., McDonald, G., Kravchuk, O., Gilliham, M., Tyerman, S., & Able, A.J. (2014). The Development of Student Research Skills in Second Year Plant Biology. *International Journal of Innovation in Science and Mathematics Education*, 22(3), 15-25.

Pretorius, L., Bailey, C., & Miles, M. (2013). Constructive alignment and the Research Skills Development Framework: Using theory to practically align graduate attributes, learning experiences, and assessment tasks in undergraduate midwifery. *International Journal of Teaching and Learning in Higher Education*, 25(3), 378-387. Retrieved from https://www.adelaide.edu.au/rsd/evidence/related-articles/Pretorius_2013.pdf

Prince, M., & Felder, R.M. (2006). Inductive teaching and learning methods: Definitions, comparisons, and research bases. *Journal of Engineering Education,* 95(2), 123–138. Retrieved from http://www4.ncsu.edu/unity/lockers/users/f/felder/public/Papers/InductiveTeaching.pdf

Research Skill Development for Curriculum Design and Assessment. (2017). The University of Adelaide. Retrieved on 1/06/17 from https://www.adelaide.edu.au/rsd/framework/

Willison, J., Lievre, K. L., & Lee, I. (2010). Making research skill development explicit in coursework, *Australian Learning and Teaching Council.* Retrieved from https://www.adelaide.edu.au/rsd/evidence/study/RSD_in_coursework_with_appendices.pdf

Willison, J., Sabir, F., & Thomas, J. (2017). Shifting dimensions of autonomy in students' research and employment, *Higher Education Research & Development*, 36(2), 430-443.

Willison, J. (2012). When academics integrate research skill development in the curriculum. *Higher Education Research & Development,* 31(6), 905-919.

Willison, J. (2017). *Models of Engaged Learning and Teaching*. Retrieved on 20/2/17 from http://www.adelaide.edu.au/rsd/i-melt

Willison, J., & O'Regan, K. (2007). Commonly known, commonly not known, totally unknown: A framework for students becoming researchers. *Higher Education Research & Development*, 26(4), 393-409.

Willison, J., Schapper, J., & Teo, E. (2009). Multiple methods of improvement of research skills in Business Ethics and Business Law. *Quantitative Assessment of Teaching and Learning in Higher Education in Business, Economics and Commerce Conference*. Melbourne, Australia. Retrieved from https://www.adelaide.edu.au/rsd/evidence/related-articles/Willison_Schapper_Teo.pdf

Yin, R.K. (2013). *Case study research: Design and methods* (5th ed). USA: SAGE Publications.

Appendix 1: Case study assignment marking rubrics:

Facets of clinical management pentagon	*Marking Rubrics*	Level 0 *Student attempts task but do not achieve minimal requirements*	Level 1 *Student requires a high degree of structure/ guidance*	Level 2 *Student requires some structure and guidance*	Level 3 *Student works independently and satisfactorily fulfil the requirements*	Lecturer's comments and marks
A. *Students **Observe and ask** on inquiry and so determine a need for knowledge/understanding* *(5 marks)*	Ability to **observe** the key points in a given case (2 marks).	Unable to identify any key point in a given case. (0 mark) **OR** Identifies all points that are not helpful in reaching to the correct differential diagnosis. (0 marks)	Identifies few key points along with other points that are not relevant for the differential diagnosis process. (0.5 mark) **OR** Identifies only 1 key point relevant to the correct differential diagnosis without any irrelevant points. (0.5 marks)	Identifies up to 3 key points relevant to the correct differential diagnosis without any irrelevant points. (0.5 mark per point with maximum 1.5 marks)	Identifies 4 or more key points relevant to the correct differential diagnosis without any irrelevant points. (2 marks)	
	Ability to **ask** appropriate questions in the	Unable to ask any question in the	Asks all general questions that are not directing to	Asks up to 2 questions that are directing to the	Asks 3 or more questions that are all directing to the	

12

	history taking process (3 marks)	history taking process (0 mark) **OR** Asks general questions that are not directing to the correct differential diagnosis (0 marks)	the correct differential diagnosis but related to the diseased body system. (0.5 mark per question with maximum 1.5 marks)	correct differential diagnosis (1 mark per question with maximum of 2 marks) **AND** Asks rest of the questions that are not directing to the correct differential diagnosis but related to the diseased body system (0.5 mark per question with maximum of 1 mark).	correct differential diagnosis (3 marks)	
B. *Students **Find and generate** needed information/data using appropriate methodology* *(22 marks)*	Ability to **find** information to **generate** differential diagnosis with appropriate rationale (6 marks)	Unable to identify any correct differential diagnosis (0 marks) **AND** Unable to provide appropriate rationale for all the correct differential	Identifies at least one correct differential diagnosis (1 marks) **AND** Provides appropriate rationale for one correct differential diagnosis (1 mark)	Identifies at least two correct differential diagnosis (2 marks) **AND** Provides appropriate rationale for up to two correct differential diagnosis (1-2 marks)	Identifies three correct differential diagnosis (3 marks) **AND** Provides exceptional rationale for up to three correct differential diagnosis (1-3 marks)	

13

		diagnosis (0 marks)				
	Ability to **find** data to identify differences in the symptomatology of the differential diagnosis to **generate** one definitive diagnosis (10 marks)	Unable to identify any differences in the symptomatology or just provided a list of symptoms of the 3 differential diagnosis of the correctly identified differential diagnosis (0 marks)	Identifies similarities and compares few differences in the symptomatology of one correctly identified differential diagnosis from other incorrect differential diagnosis and/or the given case (0.5 mark per difference with maximum of 6 marks)	Identifies similarities and compares key differences in the symptomatology of the correctly identified 2 differential diagnoses (1 mark per difference with maximum of 8 marks)	Identifies key differences in the symptomatology of the correctly identified 3 differential diagnosis (2 mark per difference with maximum of 10 marks)	
	Ability to **find data to explain** the mechanism of disease pathology (6 marks)	Unable to explain the mechanism of disease pathology for the chosen definitive diagnosis (0 marks) **OR** State incorrect pathological mechanism for the chosen definitive diagnosis (0 marks)	Explains up to two correct key point in the mechanism of disease pathology for the chosen definitive diagnosis (1.5 mark for explaining each point on pathology) **AND/OR**	Explains and links at least two correct key point in the mechanism of disease pathology for the chosen definitive diagnosis (1.5 mark for explaining each point on pathology; 1 mark for linking them together=4 marks)	Explains and links three or more correct key point in the mechanism of disease pathology for the chosen definitive diagnosis 1.5 mark for explaining each point on pathology; 1.5 mark for linking them together=4.5	

			Only lists one or more correct key points in the mechanism of disease pathology for the chosen definitive diagnosis (0.5 mark per point for listing with maximum of 2 marks)		to maximum of 6 marks)	
C. *Students* ***Analyse and Interpret*** *information/data* **(5 marks)**	Ability to **analyse** and **interpret** the information of diseases pathology in relation to the clinical presentations in the given case (5 marks)	Unable to analyse interpret or incorrectly interprets the impact of disease pathology of the chosen definitive diagnosis contributes to the clinical presentations and the investigation results of the given case (0 marks)	Co-relate the disease pathology of the chosen definitive diagnosis to up to 3 clinical presentations of the given case (1 mark per co-relation 1- 3 marks)	Interpret and co-relate the disease pathology of the chosen definitive diagnosis for 4 clinical presentations of the given case (1 mark per co-relation = 4 marks)	Interpret and co-relate the disease pathology of the chosen definitive diagnosis for all clinical presentations of the given case (5 marks)	
D. *Students* ***Investigate and reflect*** *on information*	Ability to **investigate t**he information through further diagnostic tests	Unable to select any/ selected incorrect investigation test relevant to chosen	selects all investigation tests relevant to chosen differential diagnosis but they	Selects at least 1 confirmatory investigation tests relevant to chosen	Selects 2 confirmatory investigation tests relevant to chosen definitive diagnosis (2 marks)	

15

collected or generated (6 marks)	and imaging techniques (2 marks)	differential diagnosis (0 marks)	are not confirmatory investigation for the definitive diagnosis (0.5 mark per test with maximum of 1 mark)	definitive diagnosis (1 mark) **AND/ OR** Selects 1 non-confirmatory investigation tests relevant to chosen definitive diagnosis (0.5 mark)		
	Ability to **reflect** on the information through the test results to confirm the chosen definitive diagnosis (4 marks)	Unable to reflect on the test results from the correct test to confirm the chosen definitive diagnosis (0 marks) Reflects on the incorrect tests to confirm the chosen diagnosis (0 marks)	reflects only on non-confirmatory test results of the test results (0.5 mark per test with maximum of 1 mark)	Reflects at least on one confirmatory test results (2 mark) **AND/OR** Reflects on one non-confirmatory test results (0.5 mark)	Reflects on two confirmatory test results (4 marks)	

16

| E. Students **apply and synthesize the knowledge gained** (6 marks) | Ability to **apply and synthesize the knowledge gained** to establish appropriate pharmacological treatment plans for the chosen definitive diagnosis (3 marks) | Unable to establish appropriate pharmacological and medical treatment for the chosen definitive diagnosis (0 marks) | Only lists pharmacological treatments for the chosen definitive diagnosis. No explanation on mode of action provided Not related to the patient's presentation. (0.5 marks per treatment measure with maximum of 1 marks) | Names and partially explains mode of action of up to 2 pharmacological treatment for the chosen definitive diagnosis and co-relates to the patient's presentation (0.5 mark each for naming treatment measure; 0.5 mark for explanation of mode of action and co-relation=1-2 marks) | Names and fully explains mode of action of up to 2 pharmacological treatments for the chosen definitive diagnosis and co-related to the patient's presentation. (0.5 mark for naming treatment measure; 1 mark per explanation of mode of action and co-relation=1.5-3 marks) | |

17

	Ability to **apply and synthesize the knowledge gained** to establish appropriate non-pharmacological treatment plans for the chosen definitive diagnosis (3 marks)	Unable to establish appropriate non-pharmacological and medical treatment for the chosen definitive diagnosis (0 marks)	Only lists non-pharmacological treatments for the chosen definitive diagnosis. Not related to the patient's presentation. (0.5 marks per treatment measure with maximum of 1 marks)	Names and partially explains up to 2 non-pharmacological treatments for the chosen definitive diagnosis and co-relates to the patient's presentation (0.5 mark each for naming treatment measure; 0.5 mark for explanation=1-2 marks)	Names and fully explains up to 2 non-pharmacological treatments for the chosen definitive diagnosis and co-relates to the patient's presentation. (1 mark for per treatment measure; 1 mark for explanation=1. marks)	
F. Students **organise communicate an manage information** (6 marks)	Ability to **organize, manage and communicate** the information collected and knowledge gained. **Research skills (2 marks)**	Use of resources inappropriate/ irrelevant to the case study/ likely differential diagnosis	Use of at least 2 resources relevant to the case study/ likely differential diagnosis under each section	Use of at least 3 resources relevant to the case study/ likely differential diagnosis under each section	Use of 4 or more resources highly relevant to the case study/ likely differential diagnosis Resources reflect current / important	

18

		Use all non-credible resources (e.g. marketing web, Wikipedia etc.) (0 mark)	Use few credible sources along with some non-credible resources (e.g. marketing web, Wikipedia etc.) (1 mark)	Use all credible sources of information (1.5 mark)	critical debates within the discipline Use all credible and wide range of source (e.g. textbooks, academic journal articles, database etc) for finding high quality academic information (2 marks)	
	Presentation and writing skills *(2 marks)*	Inadequate presentation and fails to follow instructions for presentation Major problems with spelling, grammar and academic writing style (0 mark)	Adequate presentation and partially follows the instructions for presentation. Major spelling and grammatical errors with inconsistencies in academic writing Style (1 mark)	Generally appropriate presentation and Generally follows instructions for presentation Major spelling and grammatical errors with generally appropriate academic writing Style (1.5 mark)	Professional presentation Completely follows the instructions for presentation Consistently accurate spelling and grammar with Consistently appropriate writing style (2 marks)	
	Referencing *(2 marks)*	Lack of /Minimal referencing and/or in-text citations (less than 6	At least 6 in-text citations provided with inaccurate formatting or	All in-text citations generally accurate and in appropriate referencing style but	Correct in-text citation using the correct referencing style	

19

		resources other than prescribed readings).	incorrect referencing style At least 6 References provided in list with inaccurate formatting or incorrect referencing style	some minor errors exist. All references in the list generally accurate and in appropriate referencing style but some minor errors exist.	Full and correct reference list using the correct referencing style.	
		(0 marks)	(1 mark)	(1.5 mark)	(2 marks)	

Appendix 2: pre- and post-course survey questionnaire:

Likert scale questions:

	Question	1 Strongly Disagree	2 Disagree	3 Unsure	4 Agree	5 Strongly agree
1	My general research skills are good					
2	My Research Skills in pathology and clinical science are good					
3	I am able to ask clear, researchable questions in pathology and clinical science					
4	I can devise procedures in pathology and clinical science to generate relevant and high-quality information					
5	I can effectively evaluate the credibility of sources of information in pathology and clinical science					
6	I can organise information from multiple sources effectively in pathology and clinical science					
7	I am able to analyse information from different sources effectively in pathology and clinical science.					
8	I can clearly communicate in writing what I understand from my research in pathology and clinical science					
9	By researching pathology and clinical science I am more able to understand it.					
10	I would like to be more involved in research.					
11	My studies at Endeavour college require me to do research.					
12	Pathology and clinical science research is an activity that has trustworthy outcomes					

13	Pathology and clinical science research is an activity which influences practices in my discipline					
14	The ability to research is important in my career					

Open-response questions:

1. What do you think research involves?
2. Up to now, what has helped you to develop your research skills, and what has been a barrier?