Chapter 10
A Curriculum Model to Promote (Chiropractic) Clinical Thinking with Video-Case Annotation

Meg Colasante, Amanda Kimpton, and Jennifer Hallam

Abstract A progressive agenda for curriculum change in a chiropractic course in a Melbourne university involved case-based materials and online video annotation. The overall learning objective was to promote clinical thinking earlier in the undergraduate chiropractic students, which did not substantively occur until clinical placement in year 4 of the study programme. Initially the traditional lecture-centred learning mode was infused with paper-based case studies, which then evolved to video-cases and, most recently, to interactive video annotation aided by the introduction of a media annotation tool (*MAT*). This tool positioned the case videos into an active environment requiring small group and scaffolding activities to stimulate clinical thinking in the second year of the programme. Lectures continued, but became integrative with *MAT* activities and ultimately responsive to student work in *MAT*. The resultant integrative curriculum model unfolded over two distinct but interlinked learning cycles over the semester. As part of a larger multiple-case study, data was collected via surveys, combined observation and interview sessions, and post-subject learning artefact analysis. Student feedback was largely positive, with qualifiers such as need for both further articulation of the process and more cases. The teachers also responded positively and are currently integrating further video-cases using *MAT* into the same subject plus within additional subjects.

Keywords Chiropractic • Case-based learning • Clinical thinking • Video annotation • Media annotation tool • Small group collaboration

M. Colasante (✉) • A. Kimpton • J. Hallam
RMIT University, 124 La Trobe Street, Melbourne, VIC 3000, Australia
e-mail: meg.colasante@rmit.edu.au; amanda.kimpton@rmit.edu.au; jenny.hallam@rmit.edu.au

M. Gosper and D. Ifenthaler (eds.), *Curriculum Models for the 21st Century: Using Learning Technologies in Higher Education*, DOI 10.1007/978-1-4614-7366-4_10,

10.1 Introduction

Chiropractic teachers in a university in Melbourne changed the curriculum for their second-year undergraduate chiropractic students by integrating case-based learning in a multimedia format. The decision to integrate video-cases with a new educational technology called *MAT* (media annotation tool) followed a series of prior and progressive steps to promote clinical thinking centred on case-based learning. Case scenarios based on authentic clinical chiropractic practice were developed to help students to vicariously link theory to practice—something the students typically don't start to achieve substantively until they are placed in a clinical learning environment in year 4. (The full 5-year programme is a '3 + 2' model; three undergraduate years, then two postgraduate.) The teachers initially introduced cases in print mode, then in video, which were ultimately rendered as interactive video by integrating *MAT* software.

The video-cases were produced in-house and based on real-life clinical scenarios. Consultation with industry professionals and academic colleagues and cross-referencing to case reports in the literature were integral parts of this process. The videos were professionally produced and filmed using an actor-patient and a practicing chiropractor in the key roles and demonstrate a complete clinical 'workup' (consultation) of a patient presenting with a headache. Each video was divided into two separate clips for student consumption: the patient history (the first part of the consultation) and the clinical examination.

The innovative integration of *MAT* positioned the video-cases into an active environment enabling small group collaborative activities that scaffolded through progressive activities to decision-making. These activities centred on students developing and applying clinical thinking to the case under focus. The lectures became supportive resources to this work required in *MAT*—indeed lectures became responsive to student efforts in *MAT*. Case-based activity in *MAT* and in lectures required students to draw on knowledge and skills concurrently built in corequisite courses (subjects). By using the scaffolding provided by the learning design, the students could ultimately reach their own working diagnosis on the patient in the video-case before knowing the expert diagnosis.

As part of a larger multiple-case study, second-year chiropractic students and their teachers formed one case for examining curriculum integrations of *MAT*. Data collection was triangulated via mixed methods of pre- and postsurveys, observation and interview sessions (students and teachers), and post-subject learning artefact analysis.

The data provided rich fodder to establish models of *MAT* use, of which the chiropractic model is offered in this chapter, as well as evaluation of this model. The chapter also provides issues and implications useful to share with others who may be considering curriculum change involving interactive case-based learning and finishes on further developments and directions for the chiropractic curriculum model. But first, the chapter commences with the rationale for changing the chiropractic curriculum including theoretical perspectives that underpin the changes that were made.

10.2 Rationale for Curriculum Change

Rationale for change in the chiropractic curriculum primarily rested on the teacher-identified need to stimulate clinical thinking in students earlier in the 5-year chiropractic programme. Secondly, there was teacher awareness to keep abreast of contemporary higher education teaching theories, including evolving teaching practices and integration of suitable educational technology for the twenty-first-century learner. Thirdly (and somewhat serendipitously) the availability of the university developed *MAT*, plus project funding to support *MAT* integrations, provided a potential match to the identified needs for the chiropractic students. These three factors helped steer curriculum change and are further detailed below.

10.2.1 Clinical Thinking

Many universities recognise the need to develop generic skills in their graduates, to enable them to be professionally capable employees and to continue to be life-long learners. They generally emphasise skills related to 'communication, problem-solving, critical thinking, information literacy and teamwork (ACNielson, 2000; McColl, 2003)' (de la Harpe & Radloff, 2006, p.21). de la Harpe and Radloff (2006) recommend that 'the development of "generic" skills is accepted as a legitimate part of the curriculum, [and] must be acknowledged and respected' (p.31).

'Clinical thinking' is a generic skill required for practicing health professionals, such as chiropractors. By way of definition, clinical thinking may be considered to be the application of knowledge, judgement, and experience in conduct of diagnostic tasks and management. A method of stimulating clinical thinking is 'case-based' teaching. This offers information to students in an integrated manner and encourages students to process information in an active way through context-specific clinical scenarios. Case-based teaching methods espouse theory to practice whereby there is a transfer of skills to vicarious operational settings and participants develop skills in identifying, analysing, and solving problems (Stolovitch & Keeps, 1991). Case-based learners continue into their professional careers as self-directed learners and have the ability and desire to learn autonomously throughout their careers (Sutyak, Lebeau, & O'Donnell, 1998). This method of teaching can enhance integration of the basic and clinical sciences, when basic science information is actively applied to the clinical conditions studied (Hansen & Krackov, 1994).

In recent years, web-based interactive case-based training systems have been used and appreciated in teaching students: medicine (Simonsohn & Fischer, 2004; Shokar, Bulik, & Baldwin, 2005; Reimer et al., 2006), nursing (Yoo, Park, & Lee, 2010), midwifery (Gray & Aspland, 2011), physical therapy (Loghmani, Bayliss, Strunk, & Altenburger, 2011), and paramedics (Williams, 2006, 2009). Additionally, Talmage (2001) integrated case-based teaching into chiropractic lectures and the students reported that they preferred this to traditional lectures in addition to

performing better on integration of material. Literature around the use of case-based teaching in a multimedia format in chiropractic curricula is still emerging.

In the research case under focus, the chiropractic teachers recognised the need for earlier promotion of clinical thinking, to strengthen the students' clinical and diagnostic skills of students in final years, and chose to integrate case-based learning in a multimedia format. The importance of these clinical skills for chiropractors has been recognised by other chiropractic educators (Sandefur, Febbo, & Rupert, 2005; Wyatt, Perle, Murphy, & Hyde, 2005). An underdevelopment of clinical thinking may be due to insufficiencies in both integration of theory into practice and in clinical training opportunities. A number of studies have suggested that patients attending chiropractic teaching clinics may not truly represent the broader case mix seen in general practice (Niyendo & Haldeman, 1986; Niyendo et al., 1989; Niyendo, 1990; Holt & Beck, 2005; Kimpton, Polus, & Walsh, 2011), for example, by attracting a large student population. Hence, student's experiences may not be sufficient to manage patient presentations seen in general chiropractic practice upon graduation. The new curriculum model was designed as a means of potentially bridging this gap.

10.2.2 Evolving Teaching Practice for Contemporary Students

Engagement with content by 'problem solving, critical thinking, or whatever else the learning skill might be' does not automatically mean that students will learn the skills or equip them to describe the processes, and electronic environments are not for transfer of content, but for access, organisation, and evaluation (Weimer, 2002, p.50). The function of content in a learner-centred model can, under a constructivist lens, evolve to 'invention and self-organization … [allowing] learners to raise their own questions, generate their own hypothesis and models as possibilities and test them for validity (Fosnot, 1996, p.29,' in Weimer, 2002, p.13).

Despite significant shifts to integrate various interactive media forms in contemporary student-centred learning practices, the lecture-centred model has not been entirely supplanted. Recent uses of lectures as resources for students, rather than the main source of learning, are evident in inverted or 'flipped' classroom curriculum models. Institutes such as Penn State University, for example, (see The Pennsylvania State University, 2012) enable students to access their lectures online at a time and place that suits them. Scheduled lectures/tutorials become the forum for students to discuss the content, raise questions, explore examples and applications, etc. Innovative ways of using lectures to increase understanding, rather than transmit knowledge, have potential for extending a learning-centred approach (e.g. Black, 1993).

The chiropractic teachers in the study had evolved their teaching practice, aiming to meet the learning/eventual professional needs of their student cohorts. This included awareness for the twenty-first-century learner to be actively engaged, facilitated by integration of suitable educational technology. The teachers sought interactive, student challenging activities with authentic rational underpinning them,

where students put in the effort to get the learning rewards. They saw the potential of video as choice media for providing student access to realistic and authentic clinical case examples and aimed to render the video scenarios interactive rather than passive learning.

10.2.3 Availability of MAT

The educational technology used in the chiropractic model is a relatively new *MAT*, which is currently enabled to annotate video. 'Video annotation tools are online or offline programs that allow a user to mark portions of video and reflect on it by adding written, spoken or visual comments to that section of video' (Rich & Trip, 2011, p.16). Some of these tools include guiding frameworks compared to others with open architecture, and some have collaboration enabled (Rich & Trip, 2011). The guidance framework and collaboration options in *MAT* are enabled according to the learning objective:

> *MAT* allows video-based artefacts to be uploaded and annotated online, and… enables learner selection and categorisation of areas of video, with each selected area marked with a coloured 'Marker' along the video timeline. Each Marker links its video segment to its own annotation area, which comprises text-entry/dialogue panels structured to build into a cycle of learning. The various panels are titled: 'Notes', 'Comments', 'Conclusion', 'Teacher Feedback', and 'Final Reflections', and can be progressively opened and closed depending on the learning activity. (Colasante, 2011, p.66)

A preceding pilot study examined *MAT* integration into third-year undergraduate physical education (PE) curriculum and found that the intervention of *MAT* was largely effective in the PE study: 'The tool provided a structured learning cycle… [and] promoted active learning with meaningful materials to construct meaning from them' (Colasante, 2011, p.85). Challenges in using *MAT* for this educational purpose included the technological framework of *MAT*, which 'curtailed some flexibility by the learners under observation, e.g. inability to add a new Marker' after settings changed to streamline activities across the class (Colasante, 2010, p.218). Additionally, some students noted vulnerability on seeing/sharing own performance in video, and others valued or criticised peer feedback depending on the level of quality (Colasante, 2011). The latter lead to a finding that '[t]he need for personal versus shared annotations in *MAT* should be determined per learning activity, by considering benefits for others to read and collaborate, compared to inhibitors' (Colasante, 2011, p.84)

MAT and project supports became available at a time when the chiropractic teachers were ready. They had well-developed student-tested video-case studies and were seeking ways to enable students to interact with them meaningfully. Activities would require collaborative student effort to stimulate clinical thinking towards the scenario and to later apply and practice this clinical thinking. The teachers were able to take advantage of an internally funded project which supported a number of integrations of *MAT*, supporting teacher and student training in *MAT* use, set-up and design, plus research and data collection.

10.3 Methodology

The methodological approach involved a multiple-case study where the chiropractic case was one of several. The research sought to examine the effectiveness of *MAT* as integrated in a variety of new curriculum models. Therefore, while the chiropractic study was not a classic single case, it was analysed in isolation to present as the case study in this chapter.

Data collection methods employed in the study were observation and interview in the form of 'interactive process interviews' (IPIs), pre- and postsurveys, and artefact analysis. The mixed methods yielded both qualitative and quantitative data. The research framework and instruments were developed and trialled in a preceding pilot study (Colasante, 2011), and therefore, the study benefited from pretested research instruments with minor design adaptation, plus additional data from learning artefact analysis.

An emphasis was placed on capturing the chiropractic case as accurately as possible by harnessing the opinions of student and teacher experiences. However, the research deliberately avoided relying solely on perceptions by including observation/demonstration and artefact analysis. While some research may choose an approach solely reliant on user perception, for example, e-portfolio application in Carroll, Markauskaite, and Calvo (2007), and potentially reign in useful detail, this is countered by others who indicate scepticism for educational technology research that does not follow some empirical principles. Muller, Eklund, and Sharma (2006), for example, caution against purely qualitative approaches that harness only user attitudes. By triangulation of data or 'the act of bringing more than one source of data to bear on a single point' (Marshall & Rossman, 2006, p.202), the value of the research is potentially increased—albeit triangulation is not necessarily 'about getting "truth" but rather about finding the multiple perspectives for knowing' (Marshall & Rossman, 2006, p.204).

10.3.1 Chiropractic Study Participants

The chiropractic cohort was purposively selected as one case in a 2011 multiple-case study, where teaching cohorts who identified as integrating *MAT* into their curriculum were invited to participate.

Seventy-eight students were enrolled in the class, with 75 active during the semester of the study. The number of survey participants approximated 50 % (see Table 10.1). Eight students participated in the IPIs (observation/demonstration followed by interviews; further explained below), as did both teachers. Twenty-nine students consented to access to their learning artefacts of *MAT*-related activities. Survey and IPI student participant numbers represent those who both consented and then presented for participation.

Class demographics were harnessed from the presurvey, representing 50 % of the class. This sampling shows an age range predictable for second-year undergraduate students with most in the 18–25 age bracket (86 %); the remainder in either the

Table 10.1 Chiropractic cohort research participation levels

No. of students in course (subject)	Presurvey participants	Postsurvey participants	IPI participants	Access to learning artefacts
78 (75 active)	39 (50 %)	37 (47 %)	8 students (10 %) 2 teachers (100 %)	29 (37 %)

31–40 age bracket (8 %) or 41–50 (6 %). The gender breakdown was almost even (51.5 % male). English was the first language for most (just over 90 %), and all reported daily access to computers and the Internet. Over three-quarters of the students reported medium to moderately high Information and Communication Technology (ICT) skill levels (78 %), while minorities at either extreme reported high ICT skills (17 %) and moderately low or low skill level (6 %).

Overall, this sample illustrated a relatively positive attitude to online learning in their course. Three-quarters nominated liking online learning and few reported they do not (3 %), the remainder liking online learning some of the time (22 %). These numbers were similar when asked more specifically if they 'would like to use an online tool to help me understand the presentation and assessment of headache conditions' (79 % agreed, 18 % neutral, and 3 % disagreed).

The university ethics committee gave permission for the research to be conducted. Pseudonyms are used in this chapter to help support the narrative; to reference quotes from interviews and employ a consistent format, where '[S1, Lani]' refers to 'student one' and pseudonym, the 'T' in '[T1, Isabella]' refers to teacher, and numbers are randomly assigned across the eight student participants and two teachers.

10.3.2 Data Collection Methods

The data collection methods involved:

- Pre- and postsurvey
- Interactive process interviews
- Artefact analysis

The survey was administered to the students in two parts. The presurvey at semester starts harnessed-base demographics plus student attitudes to online learning. It sought primarily quantitative responses, with additional space to write comments. The postsurvey was administered towards the end of semester, when their work in *MAT* was substantially completed, harnessing student opinions of their experiences of learning in the new model. Comprising mainly Likert-styled questions, it additionally sought qualitative responses to several open-ended questions.

The chiropractic students and their teachers were invited to participate in 'IPIs'. These involved half-hour observation (and/or demonstration) and interview sessions, involving 10–15 min of direct/participant observation while using *MAT* and thinking aloud, followed immediately by 10–15 min discussing their learning experiences in the course. Where students or teachers had completed their active work in

MAT, they were asked to demonstrate and verbalise their activities during the first part. Eight students participated in individual IPIs, although the final two essentially proved that data saturation was reached. However, all student interviews added to the rich voice of the project and further IPI volunteers would have been welcome. Both teachers participated in individual IPIs, which provided depth on issues of activities undertaken and the user experience.

Student participants were also invited to allow their *MAT*-related learning artefacts to be used for purposes of the study, as were the teacher participants who provided feedback in *MAT*. Evidence of student online interactions related to *MAT* activities was analysed only after the completion of the semester and all results were submitted.

Substantial data were collected and the data mined for this chapter were illustrative and evaluative of the curriculum model employed.

10.4 The New Curriculum Model Developed

The chiropractic curriculum model was drawn from the data, in particular the teacher 'IPIs', cross-validated with data from student IPIs and artefact analysis to ensure accuracy. This model is presented in both 'macro' and 'micro' levels, that of curriculum design (overall for course/subject) and the learning design (structure of the learning and teaching activities within the curriculum) (Dalziel, 2012).

Overall, the chiropractic model had a base of two discrete but interlaced and dependant cycles of learning across the semester, both comprising micro activities, and each leading to specific learning goals. This fitted into a larger picture, the whole second semester, as it took advantage of and fed into concurrent learning in other subject areas. The course (subject) was redesigned to allow the students a consistent flow of study for their professional clinical thinking skill development as they moved through various activities of orientation tutorials, lectures, and online learning in *MAT*. For a sense of this approach, including prepreparedness and how they linked to other subject areas, see a teacher's view in Vignette 1.

Vignette 1: Pre-commencement: Teacher View

this is Natalie's subject area, she's presenting the theoretical material about headaches, so we're actually getting the students to think about that, think about the history-taking skills, thinking about the examination skills that they're learning elsewhere [in concurrent subjects], and analyse and develop their clinical thinking… we were able to get them to do that in *MAT*… we made sure it was all delivered at the same time, we got it all prior to *MAT* coming on and then obviously the process to get the students to be able to use *MAT*. [T1, Isabella]

The chiropractic teachers uploaded two videos to *MAT*, one related to each learning cycle, which were essentially a single video of a clinical scenario divided into two parts:

- 'Consultation' (Part I): the first part of the consultation to establish the patient history
- 'Examination' (Part II): the physical examination of the patient

Following learning design preparations and training on how to use the new technology, the two chiropractic teachers created small group access in *MAT* by dividing the class of 78 (75 active) into 13 groups of five to six students, uploaded the first video, and entered analysis categories, ready for the students to begin. See Fig. 10.1a, b for an overview of the model, with more later on each of the embedded learning cycles.

10.4.1 Learning Cycle 1

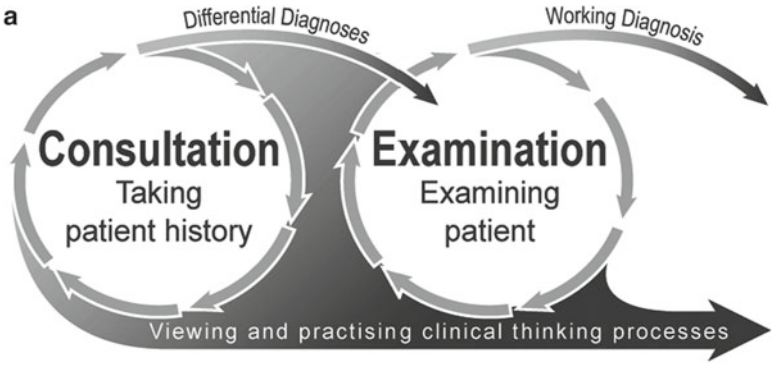
The first learning cycle, 'Consultation', was activity intensive and occurred over the first-half of semester. The students were required to analyse the consultation video, that of the patient presenting with a headache and an experienced chiropractor taking her medical history. Initially individual work, the settings were then adjusted in *MAT* to allow peers to view each other's analyses within their small groups, to compare and contrast and commence discussion. They had collective group goals of (1) arguing for and choosing one member's analysis to represent their group for teacher feedback (mid-cycle) and (2) providing a short list of possible diagnoses (end cycle).

Course resources included the concurrent on-campus lecture series on headache presentations, expert chiropractic modelling in the video, peer collaboration, and teacher feedback within *MAT*. Additionally, scaffolding and guidance were provided by teacher-prepared instructions, and the guidance of the analysis categories created in *MAT* to help the novice structure their thinking using a chiropractic professional framework. General resources (textbooks) were also utilised. Figure 10.2a illustrates the range of activities that the students engaged with during the first learning cycle, supported by the descriptors provided in the 'key' (Fig. 10.2b).

10.4.2 A Closer Look at the Analysis Categories and Activities for 'Learning Cycle 1'

The marker types established by the teachers in *MAT* for the first learning cycle set the categories of analysis and effectively guided the learning. Fourteen categories were created to frame the student analysis of the headache presentation and to

a



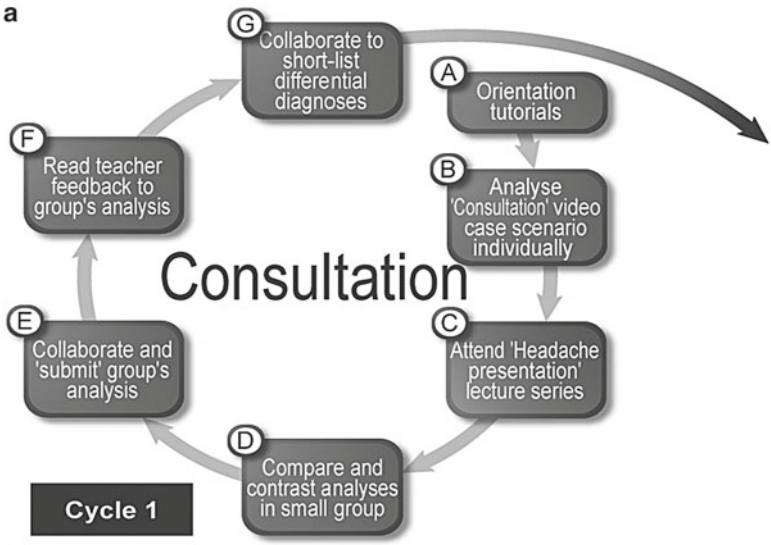
b

Descriptive key - curriculum model	
Consultation	Learning cycle 1 based on the 'Consultation' video
Examination	Learning cycle 2 based on the 'Examination' video
Arrows extending from and beyond each cycle	The first arrow indicates work from the first cycle required to advance into the second, and the second arrow represents post cycle activities, including application of new skills and knowledge into future learning and professional practice.The gradual darkening represents consolidation in learning processes.
Arrow underpinning model	Represents the overall focus of the model, that of viewing and analysing the video (in two parts) across the semester and viewing and practising clinical thinking processes. The gradual darkening represents consolidation in learning processes.

Fig. 10.1 (**a**) Representation of the chiropractic curriculum model (macro or course/subject-wide view). (**b**) Descriptive key to curriculum model

engage the clinical thinking process. They included 'Location', 'Onset', 'Trauma/Injury', 'Duration', 'Frequency', 'Character of pain', 'Intensity of pain', 'Course since onset', 'Pattern over a day', 'Relieving factors', 'Aggravating factors', 'Associated symptoms', 'Previous history', and 'Previous treatment'. These categories were to guide the students' thinking while they do not yet have chiropractic expertise and were correlated to categories being introduced in other subject areas. Further thinking on this is offered by the two chiropractic teachers, Vignette 2.

When students chose an area of video to analyse, they marked it, selected one of the categories, and entered notes. Each created marker stayed anchored to its segment of video. The notes entered were, in effect, clinical summaries in the form of



b

Cycle 1 - Descriptive key	
A	Attend one of the orientation tutorials for *MAT* training in the context of commencing the first learning activities
B	Independently analyse the 'Consultation' video-case scenario, explicitly selecting and aligning segments of the case to expert categories, supporting with notes
C	Attend the series of theory lectures on headache presentations throughout the semester
D	Compare and contrast own case analysis, categorisations and notes to peers in small group
E	Collaborate in small group (via flexible modes in or outside *MAT*) towards defined goal to select a peer's case analysis to represent the group
F	Read teacher's feedback to group via (1) formal responses to group representative's analysis, (2) ad hoc responses to online group discussions
G	Collaborate (via mode of group's choice) to arrive at a short list of differential diagnoses for the patient presentation

Fig. 10.2 (**a**) 'Learning Cycle 1' of the chiropractic curriculum model—'Consultation'. (**b**) Descriptive key to learning Cycle 1

'clinical notes'. This was done individually to enable sufficient reflection time, then opened to allow students to view the analyses across their small group and comment or collaborate on various points of analysis. The value of doing this activity was particularly related to professional record-taking practice, as noted by one of the teachers in Vignette 3.

Vignette 2: Marker Types: Teacher View

So our markers to the right there, Location, Onset, etc., were defined by us and the students had to mark the video according to where they thought those points occurred, where the practitioner was discussing information under those categories… At the same time, in another course, they were being taught how to take a patient history, a clinical patient history. So that was concurrent. So whilst the definitions [of the categories] weren't completely transferrable [between subjects], they were reasonably compatible. [T1, Isabella]

Each of those markers are very important aspects… for when you're taking a history for a headache sufferer. Because the classic type of history is referred to as an eight-point history. Now that encompasses some of that but you need to take a little bit more than that when you're actually taking a headache history… it's more than [eight] required; the extra information you need to assist you in formulating a… differential diagnosis for headache. [T2, Natalie]

Vignette 3: Professional Record Taking: Teacher View

in many respects what they were actually doing was writing clinical notes, so it was their first experience, they didn't realise it but they were actually going through a process which they'll do once they get into clinic of writing the findings based on the history they'll be taking… and as practitioners taking a history especially for headache is one of the most important steps in a case history to assist you in the diagnosis… case notes are also very important and they're often a thing that once you're out in practice people actually become quite poor at keeping. So it is sort of a way of introducing them to record keeping as well as learning to take clinical notes. [T2, Natalie]

To actively encourage the process of comparing and contrasting their analyses, the students were asked to nominate one person to represent the group with their findings. They collaboratively determined one representative for their group—engaging with each other's annotations and differentiating between levels of accuracy—using various forms of communication such as the blog tool or email linked from *MAT*. One single entry in a 'Conclusion' annotation panel in *MAT* formalised the group response and conveyed it to the educator. This is further explained in Vignette 4 by one of the students.

After reviewing feedback from their teacher in *MAT*, via the 'Teacher Feedback' annotation panel, each group then collaborated to arrive at a short list of possible

Vignette 4: First Group Goal: Student View

the conclusion part was pretty simple actually, only one of us had to do it, like everybody would read through everybody else's stuff and then decide who had put the markers in the best places, who put enough information, the best sort of information, [and] it was easiest to come up with a working diagnosis. In my group I was the nominated person so we just had to go to one point and say I am the nominated person. Our teachers would then go through and… they'd use what I've done as a way of marking everybody's… [The team collaborated] via the blog in the main home page… and say 'okay, I think this person did this well, this person did that well. We all agree this person's the best, we'll get them to do it'… After that, the teacher would obviously go through and she'd read through what I'd written, where I'd put the markers, what was happening in the video at the point of that marker. And she'd say I'd agree, I wouldn't agree, perhaps you need to put a little bit more information here. This might not have been quite the right marker [category], you know that sort of thing. [S5, Chelsea]

differential diagnoses, listed in order of most to least likely. They then submitted their short lists to the teachers, using the 'Final Reflections' annotation panel. Importantly, this student-generated list became the marker types (categories of analysis) for the next video, 'Examination'. Essentially, the work that the student groups did in the first cycle of activities was critical for their continued clinical analysis of the second video.

10.4.3 Learning Cycle 2

The second learning cycle was less activity intensive and occurred over the second-half of semester when the students experienced competing assessment due dates. The students analysed the 'Examination' video, as the next phase in the clinical workup, where the practitioner conducts a physical examination on the same patient presenting with headache. The findings from the examination and patient history are then considered together to determine the 'working' diagnosis. The analysis of the video in this cycle was intended to be an individual task; here students could only see their own annotations in *MAT*. However, several of the small groups chose to continue collaborating using means such as the blog tool linked from *MAT* or other online or face-to-face means.

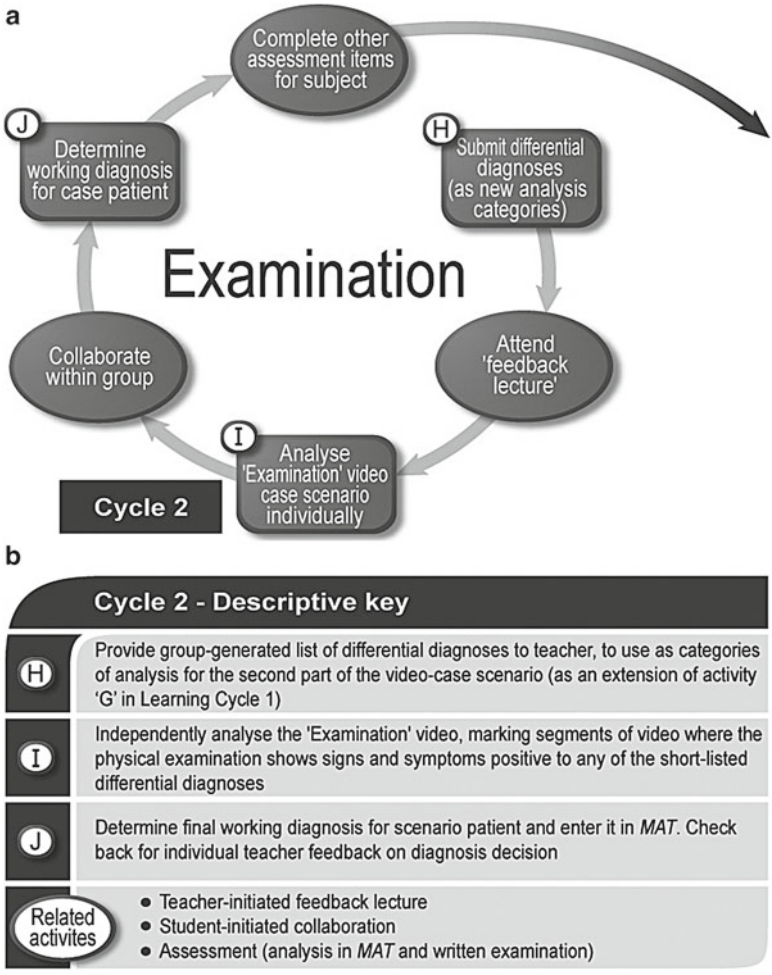


Fig. 10.3 (**a**) Learning Cycle 2 of the chiropractic curriculum model—'Examination'. (**b**) Descriptive key to learning Cycle 2

The students used their differential diagnoses as their analysis categories for the 'Examination' video. Teacher feedback and assessment for this cycle were on individual efforts, however, an additional and optional 'feedback lecture' was provided for the whole class.

Figure 10.3a provides a representation of 'Learning Cycle 2'. The shapes in the figure differentiate *MAT*-required activities (rectangle) interspersed with optional and/or related activities (oval). Figure 10.3b adds a descriptor key.

Vignette 5: Student Activities in Cycle 2: Student View

we went through to an 'Examination' video… basic physical examin[ation], which we had to watch and then… once we'd made our diagnoses of what we thought it was, we had to go through and mark each time something in the video correlated with what our diagnosis was… there's certain signs and symptoms… that go along with each of our diagnoses, and so anytime one of those came up we just marked it and the one [diagnosis] with the most markers won really… it all fitted together really well. [S4, Tori]

prior to going into the assessment you already worked out a few… differential diagnoses, before you decided on the working diagnosis anyway, so it was already down to two or three. Some people put in some erroneous differentials but I didn't think they stood up… the clinical sense came through ruling out other differentials which is the purpose of it anyway, you don't really want to have a self-fulfilling prophecy of, through your assessment, but you work out the test for all things, all the differentials and then it leads you towards the conclusion which may be different from what you'd thought could be the primary one. But in this case it was, I think it was straightforward. [S6, Luke]

10.4.4 A Closer Look at the Analysis Categories and Activities for 'Learning Cycle 2'

At the end of the first learning cycle, the students generated analysis categories for the 'Examination' video in the form of three to five possible/differential diagnoses, which the teachers added in *MAT* as specific group marker types. They varied a little across the 13 groups, 'cervicogenic headache', 'myofascial pain syndrome', 'migraine', 'tension-type headache', and 'TMJ joint dysfunction', compared to 'cervicogenic headache', 'myofascial pain syndrome headache', 'TMJ headache', and 'space-occupying lesion', for example.

The predominantly individual analysis of this cycle saw finalisation of the clinical thinking episode. The students watched the examination of the patient for evidence that confirmed any of the differential diagnoses they had short listed. See Vignette 5 for examples of student explanations.

The students arrived at a working diagnosis by evaluating which of their possible clinical options (differentials) had the most evidential support, and once they determined if their diagnosis was clinically valid, they then created a final marker on the video with a note stating what their working diagnosis was for the patient. A 'feedback lecture' was, however, provided early in this cycle, because as indicated by a student (Luke, S6, Vignette 4), some students 'put in some erroneous differentials' and the teachers wanted to ensure that the clinical thinking process was engaged as much as possible.

The ‘feedback lecture’ was designed in response to the short lists of differential diagnoses submitted by all 13 student groups. The collective list—once compiled for teacher analysis—showed a few surprising inclusions. This initiated an optional-to-attend lecture scheduled outside routine class time, which most students attended. The teacher discussed with the students the various differential diagnoses in a way that further modelled the clinical thinking process. It was intended to stimulate further thinking as the students finalised their working diagnosis. For teacher thinking on this lecture, see Vignette 6.

Vignette 6: Feedback Lecture: Teacher View

we actually gave them a feedback lecture… [I] had introduced them to headaches because these are second year students and they’re not used to clinical, anything clinical; they’ve been learning anatomy, pathology, physiology, the basic sciences. And my course is one of the first that introduces them to clinical thinking or clinical conditions… [I] was introducing them to headache while… they were using *MAT* too. But what happened after we finished… the first video, and I’ve thought it was really helpful, we had a great turn up of students, they really appreciated it. We actually… gave them feedback in a lecture rather than on the *MAT* but based on the findings we got from *MAT*, from what they had written, we were able to give them feedback… and we went through each of the marker types and said right, well what does this indicate, it indicates this, this and this… we were just trying to ensure that they were thinking along the right track before leading into this new ‘Examination’ [video] and I think because there were many steps involved it was pretty important that the students were kept engaged with it and had plenty of feedback… this was also after we had got their list of differentials from them so they still went through the process of working out their own differentials but we gave this… to assist them in their clinical thinking before they started to move into examination. [T2, Natalie]

10.5 Evaluation of the Chiropractic Curriculum Model

The evaluation of the chiropractic curriculum model sought to determine whether the main learning objective had been achieved in professional preparation for the students, particularly to engage clinical thinking in year 2 of the undergraduate programme. The analysis has been drawn from data mined in student IPIs (interviews) and postsurveys and cross-validated by teacher IPIs and artefact analysis. It begins with an overview harnessed from the postsurvey of effectiveness in work preparation plus what students nominated as key barriers and enablers to their

learning. It then unpacks three subareas (primarily from IPIs) of role modelling and challenge, reflecting on and understanding key learning and eventual professional practice readiness.

*10.5.1 Learning Effectiveness of the Model/*MAT

Collated postsurvey questions summarise student opinions of learning effectiveness of the chiropractic model in preparing students for the workplace. Figure 10.4 illustrates largely positive responses across questions on learning towards professional preparation, with higher level of agreeance to questions as they become more specific to the students' chosen profession. The graph shows accelerating positive responses from role modelling and interesting learning challenges (between 60 and 70 %) through to learning about health presentations and other activities relevant to their eventual clinical practice (between 70 and 90 %). A minority disagreed in these issues (3–17 %).

Two open questions in the postsurvey offered student views on both 'barriers to learning' and 'things about *MAT* least helpful to learning'. These have been themed, with examples of student responses quoted in Table 10.2. Out of 37 postsurvey respondents, 14 chose to respond to the former question and 13 to the

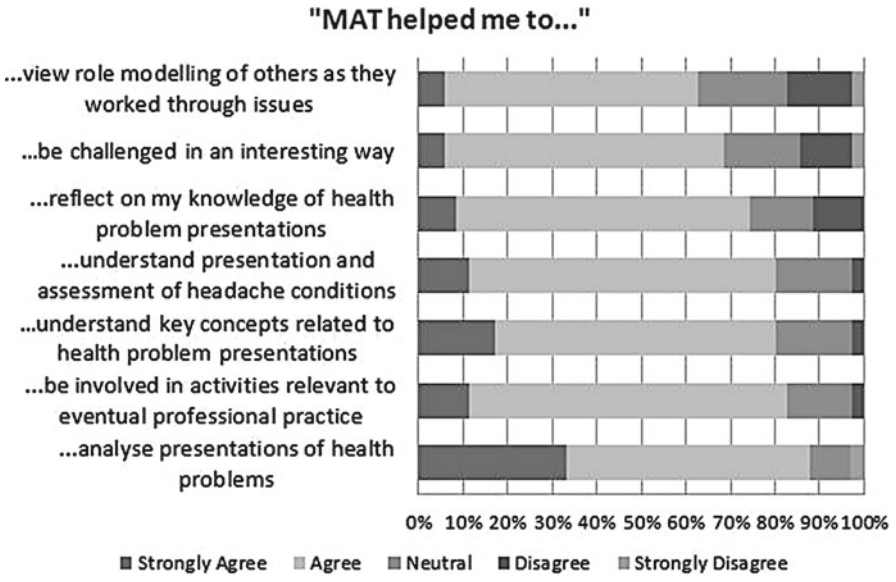


Fig. 10.4 Responses to postsurvey questions on *MAT*'s effectiveness in model

Table 10.2 Negative factors raised by students in a postsurvey open question

Dissatisfaction for	Example student quotes to represent range (some almost identical responses not repeated)
Technical issues	The site was occasionally very difficult to use
	Not the smoothest website, but once you knew how everything worked, it was alright, however slow
	Need an input time function
	Not knowing when other students had answered
	The amount of time the software took to use
	The technology was slower for me than it could have been
Teamwork	Working in a group of people I don't really know; would prefer to pick own group
	Not being able to choose our own group members
	Not all group members participated which made it hard to come up with decisions as a group
	Leaving 1 person to be 'chosen one'
Repetition or usefulness of tasks	Repetitive nature of tasks
	Video annotation was complex and not particularly useful
	It was fairly mundane; I'm not a big fan of computer work
Confusion	Instructions were not very good to follow
	Some of the instructions about the completion of tasks was sometimes confusing
	Differences between *MAT* and other courses was confusing
Only one video-case to analyse	Only one case

latter; some entered multiple issues. No single theme tended to overwhelm; however, the most prominent issues beyond technical were related to teamwork, repetition of tasks, confusion with instructions (or more generally), and having access to only one video-case to analyse. Several explicitly stated they had no issues.

Eighteen students responded to the question on 'what about *MAT* was most helpful to learning', and again, some gave multiple factors. Overall, three response themes emerged: appreciation of real-life examples, being able to anchor descriptions and discussions to segments of the video-case, and being able to link theory to practice. These themes with student quotes are provided in Table 10.3. Two outlier quotes included 'The entire program' and 'I had to'; the latter perhaps referring to extrinsic motivation of assessment requirements.

Table 10.3 Positive learning factors raised by students in a postsurvey open question

Appreciation for	Student quotes
Real-life examples	Watching a real chiropractor
	Real situation
	Viewing another chiro in practice
	Seeing how an actual chiropractor dealt with a patient
Anchoring notes/discussions to segments of video-case	The markers enabled me to actually locate findings and use them to create a diagnosis
	Watch and re watch it, feedback, student interaction
	The fact *MAT* I would place markers where there were clinical findings and review and edit those markers with comments as well. How others would comment on it also
	[Noted appreciation for a subset of the annotation activity:]
	Online collaboration
	Individual work
	Other students comments
	Review and editing
Linking theory to practice	Application of knowledge acquired in lectures
	Having to go over what we had learned and use it in a 'real world' situation
	Linked to theory
	Seeing a role play of clinical situation and how what we are learning is applied
	Viewing what we've learnt in clinical practice

10.5.2 Role Modelling and Challenge

The chiropractic model centred on the learning challenge of engagement with expert modelling represented in video. Majority student agreement and minority disagreement to being challenged in an interesting way (Fig. 10.4) were elucidated by interviewees noting the activities were straightforward, with some saying too easy, and acknowledgement that this was due (at least in part) to the just-in-time style of applying what they were concurrently learning to the analysis of the patient scenario in *MAT*. There was some recognition that while activities seemed easy, they did help link theory to practice. One student with an established health professional background who found it tedious rather than challenging also saw several benefits of using *MAT* compared to traditional learning and assessment methods. For further illustration read student views in Vignette 7.

Vignette 7: Ease of Activities/Tedious: Student View

it can be tedious at times, especially when you've got 'okay do this in this 2 days, do that in that 2 days'… it definitely helped with the learning of the headache types because you did have to know them while you were looking at them, because you couldn't just watch a movie, 'oh that was interesting, what did I just learn?' you had to know what you were doing, because you had to write down markers… if we had of been given it and said 'okay you don't know anything about it but you've got to kind of make it up yourself', that would have been more of a challenge. Because then we would have to go out and find all the information first off because we were, at the same time we were doing MAT, we were still learning about the headache types so we were having a lecture, we'd been given a task in that so everything's sort of fresh in the mind and not set in yet. So it was kind of moulded as we went along. [S5, Chelsea]

I found some of it a little bit tedious… seemed a little bit slow in some ways, but then you need it to go slow because you need to go through it and do all the marking and everything… I think you learn more from this, I already know more from this, just looking at differential stuff, than you do from doing an assignment I think… I mean I was looking up stuff as well, and looking at differential diagnoses… and looking those up and then cross-referencing those kind[s] of things at the same time. But because it gives you a different format to learn in and it gives you a visual format, and audible format, and you interact with it and you can compare with your peers in the same thing as well, it's much easier, much better assignment because you can talk about stuff… it has benefits, on multiple, multiple points compared to assignments. [S6, Luke]

The teachers interviewed were satisfied with student engagement levels, noting that *MAT* rendered the video-case interactive in a way that the students had to work with 'the clinical thinking in as the industry modelling… to pull it apart, mark it, think about it' ([T1, Isabella]). However, one teacher noted a reduced level of engagement towards the end of the semester, predicting its cause as competing study commitments in a heavy end-of-second-year study load. This was confirmed by the artefact analysis, which showed a small minority were not active in *MAT* in the second cycle of learning towards the end of the year, that is, 70 students were active compared to 75 in the first cycle.

Having an expert chiropractor presenting industry modelling in the video was appreciated by the students, with few qualifications, of which might explain the minority disagreement to the role-modelling postsurvey question (Fig. 10.4). Excerpts of student interviews included positive phrases such as:

- ‘He’s [chiropractor in video] really good… He’s not just messing around and saying lines off a piece of paper, he knows what’s going on and it makes it more real’. [S7, Shohini]
- ‘You got into the practice atmosphere, so you could actually see the way it works, the way you should word your questions… He did a few physical examinations on her and… you see which order they come in and you find the red flags, so you know exactly what to be looking for’. [S8, Hasibe]
- ‘His line of questioning for elimination of more serious risk factors and those kind of things helps, and doing it in a calm and relaxed way without alerting the person to that he was… inquiring as to more sensitive possibilities was quite good’. [S6, Luke]
- Also see student postsurvey comments under ‘Real-life examples’ in Table 10.3.

Qualifications to appreciation for modelling included not quite the equivalence of being in a clinic, and half (four out of eight students interviewed) stated they would like more video-cases for comparison and/or extension of their learning. Reasoning for more cases included exposure to more patients and sets of symptoms, comparisons of how different chiropractors approach tasks and how to approach different situations, or even the very practical suggestion of learning the process with one scenario, then applying it to further scenarios to better prepare for fourth year practical work. Of those who noted that a video-case was not the same as being in an actual clinic (three out of eight), all conceded it was the next best thing, especially wherever it was difficult to get timely access to a clinic.

One of the teachers noted a limit to role modelling by video-cases in that the direction of the clinical process is set, and there is limited room for the students to go off on a differing direction with their analysis—although there were variants in the potential diagnoses short listed by the students.

10.5.3 Reflecting on and Understanding Key Learning

There were indicators from the interviews that the video-case analysis approach to learning helped the students to reflect on and gain key concepts and understanding, as related to presentation and assessment of headache conditions. For example, they liked being able to see the overlapping of marker types on the video to confirm complexities, yet filter through these various categorisations to help make conclusions. This aligns with the mostly positive postsurvey data on reflection/understanding questions (Fig. 10.4) and the learning enabler theme of anchoring discussions to segments of video-case (Table 10.3). Albeit, this is potentially a factor better realised at a later date, such as fourth year when they are more clinically active.

Some students offered caution on the method of reflection and analysis. They suggested keeping an open mind and think about the process even if it seems relatively easy, allowing flexibility in *MAT* use to cater for busy students’ preferred style and pace of study and taking care that the students understand the reason why the analysis categories are chosen and why they might vary between headache and

Vignette 8: Cognition: Teacher and Student View

[the model] actually challenges their knowledge base and integrates a number of their learning areas and then puts it into the clinical thinking machine, so that they get to use that… So they're like the brains behind the operation. They have to be the person analysing what's going on and thinking about each part. [T1, Isabella]

MAT's actually quite interactive… by having these marker types, it actually forces them to sit there and watch and listen to the video. And to think about 'well what's happening in this?' rather than just sitting there passively watching the video, they're actually working with it… actually thinking about what they've seen and what does it mean. So that to me is essential for what I'm doing in the class so that they understand that it's what they're learning and what does it mean for them. So it's an opportunity to actually go through that process with them and also it's sort of a way of enforcing how they should be learning their material too. [T2, Natalie]

I understand what they're [teachers] trying to do… rather than going listing down 'cervicogenic headaches, these are the signs and list the symptoms for it'. So actually going 'Alright, this patient's saying this' and trying to link that with your lists, rather than just… rote learning everything. [S2, Alistair]

other patient scenarios. The teachers saw benefits of building their students' knowledge base in the model. For excerpts of the teachers' views on student cognition, plus a student view on how he saw the teachers' approach, see Vignette 8.

10.5.4 Eventual Professional Practice Readiness

Postsurvey questions with nearest relevance to application in eventual professional practice received strong support from the students (Fig. 10.4). Additionally, students nominated the theme of linking theory to practice as a learning enabler (Table 10.3). From the interviews, prominent themes emerging related to clinical thinking application in authentic learning situations and relevant to eventual chiropractic practice were:

- Professional clinical note taking derived from applying a clinical thinking process (particularly first learning cycle)
- Arriving at appropriate diagnosis (particularly second learning cycle)

The interviewed students discussed the various requirements to annotate the video-case, often in ways that included terminology of the thinking practitioner plus referring to applying theory to practice. Some examples of this from the first learning cycle are offered (Vignette 9; previous Vignette 4).

Vignette 9: Clinical Note Taking: Student View

She [nominated peer representing group] had the most description I think, and the most succinct answers… you see here it's quite dot pointed, which is how you would do it in practice. You wouldn't be writing full sentences out and everything. It was just quite professional… [For example,] under 'trauma', this student has written, 'Had a car accident 2 years ago. Quite close to the time of onset. Was hit from the right-hand side and caused a whiplash injury to the neck from right to left. Had moderate to severe neck pain for about a week after the accident. Did not hit head. The headaches didn't start until about 2 months after the accident'… I think it's a really important tool in terms of patient—not interaction because you can't really—but clinical note-taking and things like that, and associating a real patient with a condition. Rather than just learning about a condition you can actually, say, draw from that and then add that into a patient file and differentiate what they could possibly have… Rather than just jumping in with a patient straight from the go. I think it's important to learn how to do this and then get feedback on whether we're doing it correctly. [S1, Lani]

Vignette 10: Clinical Thinking Process: Student View

we kept referring back to the lecture notes. I found that not just what was clinically wrong with her but as a patient, not just as a person, this particular patient, because of her age and her sex and all the symptoms that we've got … there was a stronger case for a cervicogenic rather than myofascial pain syndrome. [S7, Shohini]

The students tended to appreciate how the process applied in the model ultimately made clinical sense on arriving at their final or working diagnosis. Being able to look at the coloured categories across the timeline of the video-case to literally see their 'thinking' against their short-listed differential diagnoses evidenced the process. Even some who guessed the diagnosis earlier appreciated the quality of the process. See Vignette 10 for a student's view.

The teachers confirmed the clinical note-taking process as an iterative product of the students' clinical thinking. One teacher demonstrated in *MAT* a student annotation to a segment of the video-case and confirmed that the 'summary of the main clinical findings at that point' would appropriately represent clinical notes that a practitioner would either write or enter into a computer.

Vignette 11: Clinical Thinking Process: Teacher View

[This model] engaged the clinical thinking process in a way that it isn't normally done in pre-clinical years. So whether they were aware of that or not, I don't know but I guess, I imagine that some of them got that. They … [implemented] a process of theoretical information, think about the tests that they were doing in other areas and then go through that clinical process and arrive at a conclusion. So that's clinical thinking, so this will stay with them I hope, I think. So they've had a simulated experience and interacted with it years pre-clinically. So normally what happens is that those students go to the teaching clinic and then they get to apply this mass of information, you know in about Year Four of the program. This is Year Two. [T1, Isabella]

The teachers, as practitioners and academics, noted that the decision-making in *MAT* made clinical sense, while acknowledging that the students were not yet ready for thinking at expert levels. This model had laid the groundwork, engaging the clinical thinking processes up to 2 years earlier than had previously been the situation. This was recognised as an important step in student learning towards professional practice readiness. See Vignette 11 for a teacher's view on the clinical thinking process.

10.6 Issues and Implications Arising

A two-cycle curriculum model was designed based around real-world clinical video-cases that students interacted with in the new multimedia format of *MAT*. The rich data set of the study illustrated the model and provided evaluative findings.

An earlier work-in-progress report on *MAT* integrations across four higher education curricula, including this chiropractic cohort, showed that 'Higher satisfaction responses by students were presented in *MAT* cases that had some or all of: (1) teacher presentation and upload of videos in *MAT* (compared to student… upload…); (2) teacher feedback; (3) learner-learner interaction to achieve meaningful goals; (4) formal assessment requirement' (Colasante & Lang, 2012, p.462). The chiropractic model showed indications of comparably stronger student satisfaction likely because it encompassed all four of these factors, each of which emerged in the data of this chapter.

The first factor, whether teachers or students created and/or uploaded the videos, was due partly to technical angst experienced by other cohorts during video upload. The chiropractic students appreciated the professionally produced videos, particularly due to the expert chiropractic modelling of clinical thinking, and how it was the next best option to actual clinical experience. The second factor, teacher

feedback, was embedded in the chiropractic model at progressive steps to scaffold learning, in deliberate manageable workloads for the moderate to large class (75 active students). Additionally, a previously unplanned 'feedback lecture' was provided to further scaffold and model clinical thinking processes.

The third factor, peer collaboration, was required to achieve two progressive goals in the first learning cycle (nominating peer analysis for group representation and short-listing differential diagnoses) and was engaged by students during the second cycle, even though collaboration was not required to achieve the final goal (to determine working diagnosis). The activities in *MAT* interrelated to study throughout the course (subject) and contributed to assessment—the fourth factor—via group work in the first learning cycle of the model and individual conclusions at the end of the second cycle. This work also aided preparation for the final written examination, which together comprised the course assessment requirements.

The chiropractic model presented aligns to several e-learning curricula design recommendations from a JISC e-learning programme report (McGill, 2011) that include (summarised) the following:

- Allocate development and preparation time for curriculum change.
- Change curriculum design to integrate technology (don't just 'add' technology).
- Integrate active approaches to learning using technology that supports real-world experiences and collaboration.
- Include developmental feedback and peer dialogue.

The report also notes that good projects have 'clear and well articulated reasons for trying out… different technological approaches' (p.25). The rationale for chiropractic curriculum change involved a genuine learning need to promote clinical thinking earlier in the programme, intrinsic teacher interest in meeting the theoretical and technological learning needs of a modern student cohort, and the availability of technology to assist, in the form of *MAT*. However, while rationale was clear in design, the findings of the study suggest clearer articulation to the student cohort was required. For example, additional steps for headache analyses are compared to other (eight point) clinical presentations, realism of selecting own team members in authentic scenarios, and methodical steps required in the clinical workplace. Taking this last point further to acknowledge the simulated technological interface, the view of activities as tedious—even though students understood underpinning value—could be tackled by explicating the need for a balance between what happens in the real world and what is achievable towards this by using *MAT*, for example, to keep pace as a class as setting changes in *MAT* affected whole class (e.g. opening from individual to group analysis). Foregrounding of the end goals may assist, although the students' perceptions around the stepwise progression instructions may align to theory that '[t]hinking doesn't happen in a lockstep, sequential manner, systematically progressing them from one level to the next' and should be more complex and messy (Ritchhart, Church, & Morrison, 2011, p.8); formative chiropractic clinical thinking is underpinned by a methodical approach. The videocase provided the complex content to interact dynamically with, and the systematic

approach formed the basis of how a chiropractic expert may logically handle the case, albeit a little altered by the technological interface of *MAT*. If later controls in *MAT* become more granular, then guidance could mature to a more holistic approach and allow groups to set their own pace. Such *MAT* improvements are not impossible, as already the student-initiated idea of 'need an input time function' (Table 10.2) has been addressed; video segments can now be selected by entering time range (or by original 'stretching' of marker wings by mouse).

Findings potentially relevant to other collaborative artefact-centred/case-based models include:

- Using a two-cycle integrative model
- Offering multiple scenarios/cases
- Incorporating a responsive feedback mechanism

10.6.1 Two-Cycle Integrative Model

The chiropractic curriculum model was structured over two distinct but interconnected learning cycles. To promote learning from multimedia, Mayer and Chandler (2001) found that 'part-then-whole' or 'part-then-part' learning architectures were favourable over 'whole-then-whole' and that interactivity only improved learning if it was consistent with how students learn, for example, 'in a way that minimised cognitive load and allowed for the two-staged construction of a mental model' (Mayer & Chandler, 2001, p.396).

Additionally, Mayer and Chandler (2001) acknowledge the role of pretraining to help students understand behaviour in each stage of the multimedia. The chiropractic model offered tutorial sessions to orient students and commence the first activities with both pedagogical and technical support on hand, then a concurrent lecture series on headaches to use as resources for the work in *MAT*.

10.6.2 Multiple Scenarios/Cases

The chiropractic students valued the modelling of the expert practitioner in the video-case; however, half of the students interviewed recommended more than one scenario to encounter a variety of experiences. Reimer et al. (2006) found positive correlation between the number of cases and student achievements.

Muller, Sharma, and Reimann (2008) offer that others' schema presented in social interactions—arguably the chiropractor with the patient in the video—can help the novice form a mental template that models the expert example. They also note the role of individual engagement with a case followed by collaborative work, when they argue that 'observing should precede engaging in dialogue to set groundwork for ideas to come and limit faulty effort (Bandura, 1986; Vygotsky, 1978)' (Muller et al., 2008, p.294).

Additional cases could also provide 'alternative conceptions' where students experience deeper learning when discussing and challenging misconceptions presented in video (Muller et al., 2008). In the chiropractic model, alternate conceptions were limited to where short-listed differential diagnoses were incorrect. However, misconceptions could be incorporated into video-cases later in the chiropractic programme, such as common errors that occur in clinical history taking, permitting the students to fine-tune their clinical thinking skills.

10.6.3 Responsive Feedback Mechanism

The 'feedback lecture' was initially unplanned and therefore did not feature explicitly in the research evaluation instruments. However, it was important in the overall teacher feedback mechanisms of the model which helped scaffold the students' clinical thinking processes. To scaffold learning in computer-supported collaborative environments, teacher steps of 'diagnosis' (or identification), 'intervention', and 'evaluation' might be useful (van de Pol et al., 2010, in van Leeuwen, Janssen, Erkens, & Brekelmans, 2012). The chiropractic teachers identified students' midpoint short-listed differential diagnoses as showing a minority of improbable options. Teacher identification was indeed aided by the nature of explicit online communications compared to group/class discussions (van Leeuwen et al., 2012).

Potential misdiagnosis by the students was always possible as they were novices in clinical thinking. The teacher-chosen 'intervention' was to hold an additional, voluntary lecture to provide targeted feedback. However, this was not surface feedback, or one of only 'feedback, explanations, instruction, modelling, hints, and[/or] questions' (van der Pol et al., 2010, in van Leeuwen et al., 2012, p.306), but rather a combination that aimed to tease out clinical thinking in the students by facilitating them through the process using the student-determined range of differential diagnoses. The timing of this intervention occurred as students commenced their engagement with the second learning cycle of the model; therefore, the teachers could monitor their progression to determine effectiveness of the intervention.

Evaluation of the feedback lecture's role towards effectiveness of the model could be designed into future research.

10.7 Future Developments and Directions

Since this study, the model has been used in a subsequent second-year chiropractic undergraduate class as well as an adaptation for postgraduate chiropractic students. Evaluation of these further integrations is underway. Additionally, more patient scenario video-cases have been produced, expanding to a suite of videos, or 'headache series'.

The widening of video-case-based learning across the chiropractic programme is aligned with the findings of a recent study. Loghmani et al. (2011) reported that the most common recommendation by students for future use of a case-based learning model was more consistent implementation across the curriculum.

Future directions include implementation of the curriculum model, and adaptations of, into other health-care study programmes. In particular, models for integrating interactive media-based clinical interactions may well provide an increasingly relevant and sustainable vehicle for students to gain elements of their clinical experience. This could have great value in a climate where it is increasingly difficult, logistically and economically, to secure medical and allied health education clinical placements. In addition, there is considerable potential scope for adaptation as tools of continual professional development for qualified health practitioners. There are also options to develop further video-cases which are not exemplars of clinical practice but variants of practice. These directions would provide an opportunity to further stimulate and facilitate problem-solving, critical thinking, and clinical decision-making skills, which are positive attributes of case-based learning often cited by students (Loghmani et al., 2011) and form skill sets useful for health practitioners of the future.

Acknowledgements The authors would like to acknowledge RMIT University project sponsors, the Learning and Teaching Investment Fund (LTIF 2011), and the College of Science, Engineering and Health: Academic Development Group. The authors would also like to acknowledge G. Marchiori for his graphical contributions to this paper.

References

Black, K. A. (1993). What to do when you stop lecturing: Become a guide and a resource. *Journal of Chemical Education, 70*(2), 140–144.

Carroll, N. L., Markauskaite, L., & Calvo, R. A. (2007). E-portfolios for developing transferable skills in a freshman engineering course. *IEEE Transactions on Education, 50*(4), 360–366.

Colasante, M. (2010). Future-focused learning via online anchored discussion, connecting learners with digital artefacts, other learners, and teachers. In C. H. Steel, M. J. Keppell, P. Gerbic, & S. Housego (Eds.), *Curriculum, technology & transformation for an unknown future* (pp. 211–221). Proceedings ascilite Sydney 2010.

Colasante, M. (2011). Using video annotation to reflect on and evaluate physical education preservice teaching practice. *Australasian Journal of Educational Technology*, *27*(1), 66–88. http://www.ascilite.org.au/ajet/ajet27/colasante.html

Colasante, M., & Lang, J. (2012). Can a media annotation tool enhance online engagement with learning? A multi-case work-in-progress report. In *Proceedings of the 4th International Conference of Computer Supported Education* (Vol. 2, pp. 455–464). Porto. Ed. José Cordeiro, Markus Helfert and Maria João Martins, 16–18 April 2012.

Dalziel, J. (2012). Using learning design for innovative eTeaching. *Presentation for ALTC National Teaching Fellowship*. Swinburne University, Melbourne, 30 May 2012.

de la Harpe, B., & Radloff, A. (2006). Lessons learnt from three projects to design learning environments that support 'generic' skill development. *Journal of Learning Design*, *1*(2), 21–34. http://www.jld.qut.edu.au/

Gray, M., & Aspland, T. (2011). Midwifery practice in the university context: Perspectives of postgraduate students on the effectiveness of case-based learning in preparation for the workplace. *Teaching and Learning in Nursing, 6*, 38–45. doi:10.1016/j.teln.2010.07.003.

Hansen, J., & Krackov, S. (1994). The use of small group case-based exercises in human gross anatomy: A method for introducing active learning in a traditional course format. *Clinical Anatomy, 7*, 357–366.

Holt, K. R., & Beck, R. W. (2005). Chiropractic patients presenting to the New Zealand College of Chiropractic teaching clinic: A short description of patients and patient complaints. *Chiropractic Journal of Australia, 35*, 122–124.

Kimpton, A. J., Polus, B. P., & Walsh, M. J. (2011). Demographics, clinical characteristics and response to care of patients attending chiropractic teaching clinics. In *Chiropractic and Osteopathic College of Australasia National Conference*. Melbourne, 8–9 October 2011.

Loghmani, M. T., Bayliss, A. J., Strunk, V., & Altenburger, P. (2011). An integrative, longitudinal case-based learning model as a curriculum strategy to enhance teaching and learning. *Journal of Physical Therapy Education*, *25*, 42–50. http://search.proquest.com.ezproxy.lib.rmit.edu.au/docview/863250520?accountid=13552

Marshall, C., & Rossman, G. (2006). *Designing qualitative research* (4th ed.). Thousand Oaks, CA: Sage.

Mayer, R. E., & Chandler, P. A. (2001). When learning is just a click away. Does simple user interaction foster deeper understanding of multimedia messages? *Journal of Educational Psychology, 93*(2), 390–397.

McGill, L. (2011). Curriculum innovation: pragmatic approaches to transforming learning and teaching through technologies. *Transforming curriculum delivery through technology programme synthesis report*. JISC e-Learning Programme.

Muller, D., Eklund, J., & Sharma, M. (2006). *The future of multimedia learning: Essential issues for research*. Retrieved on May 15, 2012, from http://www.aare.edu.au/05pap/mul05178.pdf

Muller, D. A., Sharma, M. D., & Reimann, P. (2008). Raising cognitive load with linear multimedia to promote conceptual change. *Science Education, 92*(2), 278–296.

Niyendo, J. (1990). A comparison of low back pain profiles of chiropractic teaching clinic patients with patients attending private clinicians. *Journal of Manipulative and Physiological Therapeutics, 13*(8), 437–447.

Niyendo, J. A., & Haldeman, S. (1986). A critical study of the student interns' practice activities in a chiropractic college teaching clinic. *Journal of Manipulative and Physiological Therapeutics, 9*(3), 197–207.

Niyendo, J., Phillip, R. B., Meeker, W. C., Konsler, G., Jansen, R., & Menon, M. (1989). A comparison of patients and patient complaints at six chiropractic college teaching clinics. *Journal of Manipulative and Physiological Therapeutics, 12*(2), 79–85.

Reimer, S., Hörnlein, A., Tony, H. P., Kraemer, D., Oberück, S., Betz, C., et al. (2006). Assessment of a case-based training system (d3web.Train) in rheumatology. *Rheumatology International, 26*, 942–948.

Rich, P. J., & Trip, T. (2011). Ten essential questions educators should ask when using video annotation tools. *TechTrends, 55*(6), 16–24.

Ritchhart, R., Church, M., & Morrison, K. (2011). *Making thinking visible: How to promote engagement, understanding, and independence for all learners*. San Francisco: Jossey-Bass.

Sandefur, R., Febbo, T. A., & Rupert, R. L. (2005). Assessment of knowledge of primary care activities in a sample of medical and chiropractic students. *Journal of Manipulative and Physiological Therapeutics, 28*, 336–344.

Shokar, G. S., Bulik, R. J., & Baldwin, C. D. (2005). Student perspectives on the integration of interactive web-based cases into a family medicine clerkship. *Teaching and Learning in Medicine, 17*, 74–79. doi:10.1207/s15328015tlm1701_13.

Simonsohn, A., & Fischer, M. (2004). Evaluation of case-based computerized learning program (CASUS) for medical students during their clinical. *Deutsche Medizinische Wochenschrift, 129*, 552–556.

Stolovitch, H., & Keeps, E. (1991). Selecting and writing case studies for improving human performance. *Performance Improvement Quarterly, 4*(1), 43–55.

Sutyak, J., Lebeau, R., & O'Donnell, A. (1998). Unstructured cases in case-based learning benefit students with primary care career preferences. *The American Journal of Surgery, 175*, 503–507.

Talmage, D. M. (2001). Teaching with cases to enhance the clinical and problem-solving skills and integration skills of fourth-term chiropractic students. *Journal of Chiropractic Education, 15*(2), 53–60.

The Pennsylvania State University. (2012). Introduction to classroom flipping. *Teaching and learning with technology, a unit of its@PennState*. The Pennsylvania State University. Retrieved on May 16, 2012, from http://tlt.its.psu.edu/flip

van Leeuwen, A., Janssen, J., Erkens, G., & Brekelmans, M. (2012). Teacher's scaffolding behavior in CSCL; A Case Study. In *Proceedings of the 4th International Conference on Computer Supported Education* (Vol. 2, pp. 304–312). Porto. Ed. José Cordeiro, Markus Helfert and Maria João Martins, 16–18 April 2012.

Weimer, M. (2002). *Learner-centered teaching: Five key changes to practice*. San Francisco: Jossey-Bass.

Williams, B. (2006). Qualitative analysis of undergraduate paramedic students' perceptions of using case-based learning in an online learning environment. *Journal of Emergency Primary Health Care*, *4,* Article Number 990191.

Williams, B. (2009). Do undergraduate paramedic students embrace case-based learning using a blended teaching approach? A 3-year review. *Australasian Journal of Educational Technology*, *25*, 421–439. http://www.ascilite.org.au/ajet/ajet25/williams.pdf

Wyatt, L. H., Perle, S. M., Murphy, D. R., & Hyde, T. E. (2005). The necessary future of chiropractic education: A North American perspective. *Chiropractic & Osteopathy*, *13*(10), doi:10.11.1186/1746-1340-13-10

Yoo, M. S., Park, J. H., & Lee, S. R. (2010). The effects of case-based learning using video on clinical decision making and learning motivation in undergraduate nursing students. *Journal of Korean Academy of Nursing, 40*, 863–871.