

DECODING INFORMATION LITERACY WAYS OF THINKING IN STUDENT LEARNING: INFLUENCING PEDAGOGIC METHODS

S. Mohamed

Library Services

University of the Western Cape

Cape Town, South Africa

e-mail: shmohamed@uwc.ac.za / <https://orcid.org/0000-0002-1886-1429>

ABSTRACT

University students often experience hidden challenges in various courses across all levels of their academic careers. These difficulties often serve to deter student learning and academic progress which may end in high student failure rates. In some instances, this may be attributed to tacit assumptions that academic teachers make about their learners when preparing lesson plans, course content and learning assessments. It is often mistakenly assumed that students already possess the necessary information literacy ways of thinking to overcome bottlenecks within their respective disciplines.

To this end, the Teaching and Learning Librarian at the University of the Western Cape (UWC) Library, collaborated with an academic teacher to decode specific disciplinary difficulties and to subsequently enhance the required information literacy knowledge practices in student learning. Using a qualitative research approach, this study reports on how an Economics and Management Science (EMS) lecturer and the librarian used the Decoding the Disciplines Paradigm (DtD) to identify and deconstruct troublesome concepts in the Business and Finance module. The DtD model provides a clearly delineated, seven-step process for identifying and analysing disciplinary challenges and provides guidelines for designing instructional, motivational and assessment strategies that support deep learning.

Through the DtD Paradigm, the study identified specific information literacy proficiencies that should be developed or enhanced in student learning. Moreover, the article describes how, as one of the paradigm's steps, pedagogic methods were transformed to develop information literacy ways of thinking.

Keywords: Decoding the Disciplines Paradigm, Information Literacy, Information Literacy ways of thinking, Habits of Mind, ACRL Framework for Information Literacy for Higher Education, Business Finance, student learning

INTRODUCTION AND BACKGROUND TO THE STUDY

University students often experience hidden difficulties in various courses across all levels of their academic careers. These roadblocks (Basgier and Simpson 2019), threshold concepts (Meyer and Land 2005) or bottlenecks (Pace 2017) are described as metaphoric gateways or

portals that students need to traverse in order to comprehend difficult theories, ideas or concepts. For students to progress, they are required to move through a liminal space which is characterised by uncertainty, stagnation and intellectual discomfort.

Pace (2017, 1) adequately describes a typical classroom setting where learning is deterred by the disjuncture between the teacher's explanation of the content and the learner's interpretation of the said content:

“Somewhere in the world at this very moment there is a college class that is not working: an earnest instructor is deeply committed to sharing what makes his or her discipline so compelling ... but the instructor's words are not connecting. The students have no idea what they are actually supposed to do to master the material at hand – or worse, they are confidently following strategies that are completely inappropriate to the discipline.”

These “inappropriate strategies” may be attributed to students' lack of information literacy (IL) proficiencies that are profoundly needed for them to negotiate effective solutions to gain an in-depth understanding of the subject content.

IL enables students to become research-oriented, to hold critical approaches to knowledge, to be critical thinkers and seekers of diverse perspectives, to use these to position their own stance towards ideas and to be able to defend and share that in an ethical manner.

According to Lloyd (2010), IL is not a set of discrete skills but rather a socially constructed set of concepts, knowledge practices, and values which are experienced within a discipline. These practices include, but are not restricted to, developing an awareness of the importance of assessing information with a sceptical stance and with a self-awareness of one's own biases and worldview. IL ways of thinking also entail contributing to knowledge rather than consuming it; valuing intellectual curiosity, self-reflection and metacognition as well as exhibiting mental flexibility and creativity (Association of Colleges and Research Libraries 2016). These are some of the dispositions that are indicative of 21st century ways of thinking and are prerequisites to engaging effectively with information to solve troublesome course content.

In many instances, subject matter specialists mistakenly assume that students already possess these habits of mind to overcome bottlenecks within their respective disciplines. According to Costa and Kallick (2000, 1) a “Habit of Mind” (HoM) means displaying a particular inclination toward behaving intelligently when having to negotiate challenges. When expert thinkers are confronted with dichotomies in their disciplines, they tend to “draw forth certain patterns of behaviour which require a composite of many skills, attitudes, cues, and past experiences”. These are ways of doing and becoming which ought to be developed and enhanced in learners so that they are able to engage with the knowledge in their disciplines.

Academic teachers often make tacit assumptions about their learners' capabilities when

they prepare lesson plans, coursework and assessments. Notwithstanding the notion that ways of knowing, doing and becoming within disciplinary contexts are pivotal learning objectives, they are often overlooked in teaching. In addition, Lloyd (2010) further emphasises that educators should teach for the transfer of these IL competencies. Other researchers in the field of IL contend that universities should develop teaching and learning strategies that are appropriate for enhancing habits of mind within disciplinary contexts (Green, Hammer and Star 2009) and according to the ACRL Framework for Information Literacy for Higher Education (the Framework) – for fostering engagement with the core ideas about information and scholarship (ACRL 2016, 2). Hence, what is needed is an approach that will provide experts with a strategy that will bring their teaching methods in line with the IL learning needs of their students.

Although significant research has been conducted in the area of troublesome concepts and student learning, it is evident that questions remain about the best ways to identify these challenges so that teachers may address the pertinent IL needs of struggling students. This study proposes to use a model which may assist in identifying such IL capabilities that are lacking in students.

The study will explore the Decoding the Disciplines Paradigm, henceforth the DtD, which is a delineated, seven-step process for identifying and analysing disciplinary challenges and provides guidelines for designing instructional, motivational and assessment strategies that support deep learning.

AIMS AND OBJECTIVES OF THE STUDY

This study is part of a bigger project which aims to increase student learning through developing HoM that learners require for thinking and behaving as experts within disciplinary contexts. It reports on a pilot study which I, in my capacity as the Teaching and Learning Librarian, initiated with the School of Business and Finance in the EMS faculty and is essentially a work in progress.

The objective of this study is two-fold. The first objective is to identify expert information literacy HoM that could be developed in Business and Finance students to overcome instructional bottlenecks. The second objective is to present an educational approach for exploring how teaching methods may be transformed to develop expert information literacy HoM in the Business and Finance module. I attempt to achieve these objectives by answering the following research questions:

- 1) Which threshold concepts or bottlenecks are present within the liminal space between

expert and novice knowledge in the Business Finance module?

- 2) What are identifiable expert information literacy HoM that could be developed in the Business and Finance module to overcome the identified threshold concepts or bottlenecks?
- 3) How can pedagogic methods be transformed to develop expert information literacy HoM in the Business and Finance module?

The rest of the article is organised as follows: I provide a review of extant literature and case studies that describe how the DtD model has been used to alleviate students' challenges with course content. The literature analysis also outlines the efforts made to integrate conceptual understandings of information in student learning through the application of the ACRL Framework. Based on the literature review I propose an educational approach which aims at integrating IL ways of thinking in the decoding process and at transforming pedagogical methods.

CONCEPTUAL FRAMEWORK AND LITERATURE ANALYSIS

Transforming pedagogical methods to increase student learning

Typically, academic teachers have course outlines and module descriptors with chronological lists of due dates for completing topics and learning assessments for their modules. Based on this customary practice, a pervasive discourse permeates the literature which epitomises the student as a “consumer of services” (Land 2016, 11). Hence, authors recommend that course content should not be taught using prescriptive, linear methods as this might be counter-productive in the learning and teaching process. The contention is that such pedagogic techniques do not foster critical and autonomous thinking.

In contrast to the linear and “consumerist” ways of teaching and learning, the DtD method of learning provides a fundamental alternative to Paulo Freire’s “banking model” which affirms the notion of students being passive consumers of information. In addition, Mohamed (2019) maintains that learners should rather be encouraged to actively shape their own lives through critical consciousness. The author further dispels the banking teaching method by suggesting that students be taught to adopt critical perspectives toward text, utterances and other modes of information (Mohamed 2019, 508). Hence, various authors such as Middendorf and Pace (2004), Miller-Young and Boman (2017), Yeo, Lafave, Westbrook, McAllister, Valdez and Eubank (2017) underline the importance of guiding learners to develop certain expert ways of critical thinking to assist them in the learning process.

Furthermore, Middendorf and Pace (2004, 1) emphasise that “generic formulas for encouraging higher order thinking skills” should not be used to teach learners how to analyse, synthesise and evaluate information. Instead, faculty should focus their research on “how people think and how students learn” to help them gain insight into their disciplines (Middendorf and Pace 2004, 2).

Fundamentally, Pace (2017) founded the DtD model which encourages peer-faculty dialogue on disciplinary practices and offers academic lecturers with opportunities to engage with student learning. The model suggests that teachers, operating as experts in their disciplines, hold tacit knowledge and implicit ways of thinking that are not necessarily accessible to novices in the discipline. This paradigm also allows for instructors to implement a variety of pedagogical methods which encompasses student-centred learning and active learning through a participatory and evidence-based approach. By using this model teachers are able to assist learners to focus on *how* to learn and think as opposed to *what* to learn and think.

Deconstructing student learning

Having been implemented in a variety of disciplines (Lee-Post 2019; Pinnow 2016; Rouse, Phillips, Mehaffey, McGowan and Felten 2017; Sturts and Mowatt 2012), the DtD model helps instructors to teach students disciplinary ways of thinking and comprises the following steps:

Step 1: *Identifying the bottleneck*: The lecturer identifies a place in the course where many students encounter spaces of liminality and obstacles to gaining insight and to mastering the material.

Step 2: *Defining the mental operations needed to get past the bottleneck*: According to Pace (2017), it is crucial to unlock the disciplinary unconsciousness of the expert practitioner. This is achieved by interviewing the expert to explore the steps that they would follow to accomplish the identified bottleneck. These steps form part of the professional’s innate and tacit habits of mind.

Step 3: *Modelling the tasks explicitly*. Students are given an opportunity to observe the instructor going through the steps that an expert would complete to master the task. The model provides teachers with opportunities to illustrate these ways of thinking to students.

Step 4: *Giving students practice and feedback*: Lecturers construct assignments, group activities and various learning exercises that allow students to practice specific skills that are defined in the second and third steps. Exercises may be integrated into the lesson plan whereby learners are assessed on whether they have comprehended each way of thinking (Pace 2017).

Step 5: *Motivating the students and dealing with potential emotional blockages*: Furthermore, if any notions of cognitive dissonance or emotional blockages in students are

detected, strategies need to be designed to encourage and motivate them.

Step 6: Assessing how well students are mastering the mental operations: The sixth step entails the design of formative and summative assessments to gauge whether the student can apply expert ways of thinking.

Step 7: Sharing what you have learned about your students' learning: The final step offers the lecturer an opportunity to share the results of this innovative process with a larger community.

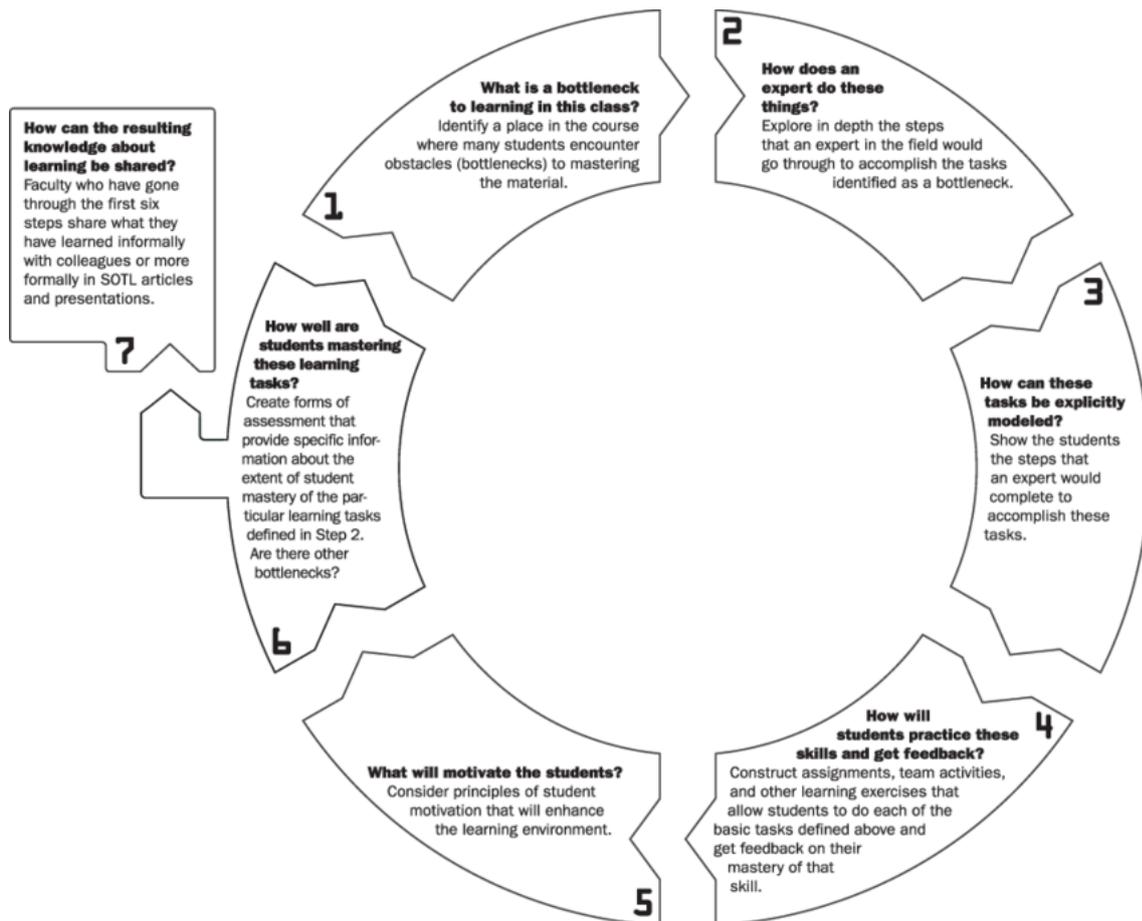


Figure 1: Decoding the Disciplines model (Middendorf and Pace 2004, 3)

It is worth noting that this is not a rigid nor prescriptive process but that it may be customised and aligned with the learners' needs. Teachers may select any stage to commence the decoding process. For instance, if using a backward design approach (Wiggins and McTighe 2005), it is quite possible to develop assessment strategies in Step 6, spend a whole semester on modelling expert ways of thinking to the class and opt to return to the remaining steps later in the curriculum.

Unlocking the disciplinary unconscious of the expert

The interview process (Step 2) is considered to be the most intellectually demanding stage for the interviewee (Miller-Young and Bowman 2017). The objective of this step is to surface ingrained mental operations of the expert practitioner. Pace (2017) reiterates the significance of being able to identify connections between ways of thinking that emerge during the discussion as well as particular approaches to the bottleneck. This is achieved by focussing the interviewee's thinking process on questions such as "What would *you* do if you were asked to complete the task that blocks your student's learning?" (Pace 2017, 39).

In the Miller-Young and Bowman (2017) study, faculty members from diverse disciplines were interviewed and the transcriptions were qualitatively analysed for common themes. These themes were collapsed into three main overarching categories: *ways of thinking, ways of practicing and ways of being* (Miller-Young and Bowman 2017). These habits of mind are indicative of dispositions that are exhibited during engagement with information. In this particular example, one of the interviewees who is an engineering expert, mentioned that she would "break the problem down into simple parts and look at each simple part by itself, and then put it back together and solve the system of equations" (Miller-Young and Bowman 2017, 23). This habit involves both deconstruction and reconstruction of knowledge. The ability to rely on prior knowledge of theory and research and one's own experience to solve the bottleneck is another way of thinking that participants mentioned in their interviews.

One key practice that features in expert HoM, is the ability to withhold judgement before coming to a conclusion. It was explained that when calculating using equations [and formulae] in engineering, that one should not assume that, for instance, tension is equal to weight: "If you are not told something, or something isn't given in the question, don't assume" (Miller-Young and Bowman 2017, 27). Citing Wismath, Orr and Mackay (2015), Miller-Young and Bowman (2017, 32) maintain that problem-solving skills require "mental habits of patience and perseverance, a valuing of understanding over determining the correct answer ...".

In their study with athletic therapists, Yeo et al. (2017) present similar ways of thinking, practicing and being to those mentioned in the Miller-Young (2017) study. One important finding elicited during the interviews was the tendency to "draw out" the problem at hand. It was unanimously believed that one should visualise the disciplinary challenge through images and illustrations in order to gain deeper insight. This was common practice amongst anatomy lecturers.

These ways of thinking are aligned with some of the knowledge practices and dispositions that are entrenched in the ACRL Framework (2016). It may be inferred that there is a direct correlation between the mental operations of experts and their IL ways of thinking.

The case for information literacy habits of mind and practices in student learning

Information literacy ways of thinking and doing are categorised in 6 Frames (*Scholarship as Conversation*, *Research as Inquiry*, *Authority as Constructed and Contextual*, *Information Creation as a Process*, *Searching as Strategic Exploration* and *Information has Value*) or conceptual understandings of information in the ACRL Framework. These frames represent threshold concepts which are suggestive of 21st century information engagement. Where the Frames are applied in teaching and learning assessment, students are nurtured to think and behave as experts within their respective disciplines. Amongst other dispositions, they are taught to seek conflicting perspectives in the literature; understand that they are entering the middle of a metaphorical conversation where authors “converse” with one another through citation (*Scholarship as Conversation*); that research is an iterative process which depends on the formulation of questions and the use of different lines of enquiry (*Research as Inquiry*); that the degree of trust which one assigns to a source of information depends on the information need and is often constructed within disciplinary communities (*Authority as Constructed and Contextual*); that there are various formats of information which is packaged differently to be meaningful to a particular audience (*Information Creation as a Process*); that the search for information in the research process requires mental flexibility and persistence (*Searching as Strategic Exploration*) and that information itself has different dimensions of value (*Information has Value*). Each Frame consists of its own set of knowledge practices and dispositions that may be applied within all disciplinary contexts. The UWC Library uses this framework as a teaching philosophy to guide communication with faculty and as a resource for IL training.

Developed through collaboration with teaching faculty, Hassman and Hassman (2018) introduced brainstorming activities in the Rhetoric First Year Writing module. Their workshop was built around multiple “crowd source” rounds where students provide feedback to their peers and brainstorm additional research questions related to their topics. The activity lends itself to one of the Framework’s knowledge practices which teaches learners to deconstruct or “deal with research by breaking complex questions into simple ones ...” (ACRL 2016, 7). Similarly, Gordon (2011) argues that for students who learn mathematics, the inquiry process should be made explicit so that mathematical HoM could be developed and enhanced. In his discussion, he emphasises the importance of breaking down or simplifying intricate questions, encouraging student reflective practices and “taking things apart” (Gordon 2011, 462) and demonstrating desirable HoM in the teaching process.

Other studies report on the development of information practices such as self-directed learning and reflective practices where the iterativeness of the research process was

demonstrated through concept mapping (Jarson 2018). This was effected through the creation of visual representations on chart paper to depict the use of convergent and divergent thinking in group work.

The Framework has also been used extensively to nurture the ethical and legal use and citation of images (Baron et al. 2017); differentiating between paraphrasing, summarizing and quoting (Arthur, Archer and Burton 2017); and evaluating and identifying relevant information from search results (Skinner and Williford 2018). The abovementioned expert dispositions are examples of information practices that practitioners use to engage with knowledge in various disciplinary contexts.

Commonalities between the DtD model and the Framework for Information Literacy for Higher Education

In her presentation *Decoding the ACRL framework for information literacy: Applying the “Decoding the Discipline” model for instructional planning workshop*, Baer (2015) highlighted the commonalities and differences between the two models.

The “bottlenecks” in the DtD paradigm and the Framework’s “threshold concepts” both refer to places where the learner experiences difficulty in the liminal space. The transformative, irreversible, integrative, bounded and troublesome nature of threshold concepts (Meyer and Land 2005) is also found in the DtD model where it is surfaced in the expert’s interview. Pace (2017) adequately describes this transformation as a space which is “irreversible”. Once students have mastered the threshold concept, they will never again be able to think in the ways in which they did before this transformation.

These mental operations are concretised through modelling processes and the integration of class activities as described in Rouse et al. (2017), Miller-Young and Boman (2017), Sturts and Mowatt (2012), and Pinnow (2016). The very nature of the liminal state is transformative. As Evans and Kevern (2015) postulate, without the appropriate teaching approaches and assessment strategies, the learner fails to discover the “transformative potential” of this liminality (Evans and Kevern 2015, 4). Citing Mezirow (1997), Maiese (2019) expounds on the pedagogy of transformative learning as one which emphasises “critical reflective thought, group deliberation and group problem-solving” (Maiese 2019, 13).

Similarly, the ACRL Frames serve to demystify the discomfort which is associated with the liminal state. The application of its knowledge practices in student learning creates a transformative learning experience, bounded within the discipline and integrated within disciplinary content.

The Framework is also underpinned by threshold concept theory and its concepts are

considered to be relevant across disciplines. Similarly, the DtD model focuses on discipline-specific tasks and ways of thinking. However, I do believe that both models are complementary approaches which may bring into effect the necessary transformational conceptual understandings of information via appropriate disciplinary tasks.

Paucity in the literature

Although the Framework (ACRL 2016) has been used extensively in IL training, I have not found any empirical studies to suggest that it may be applied in teaching disciplinary content to alleviate instructional bottlenecks. By the same token, academic teachers have used the DtD model for instructional planning to identify bottlenecks, transform student perceptions of these places of difficulty, and adjust teaching methods accordingly. However, there is paucity in the literature regarding the use of the model to integrate information literacy HoM in student learning.

Although studies about the DtD and its application in teaching and learning focus on expert ways of thinking, none have discussed how such cognitive processes of academic teachers should be used to develop information literacy HoM.

The recommended approach

Based on extensive research of both models, I recommend that the DtD paradigm be used to develop expert information literacy HoM in student learning. The methods section of this article shows how I identified expert information practices by using the Framework. In addition, I demonstrate how the DtD model and the Framework are both used to transform pedagogical practices in the Business Finance module.

In a study by Altan, Lane and Dottin (2017), the authors clustered related HoM with intelligent behaviours using Costa and Kallick's (2000) 16 Habits of Mind model. The intelligent behaviours were used as common denominators which were mapped against educational theories to construct a conceptual framework for teaching dispositions. I used a similar mapping technique in the current study. Hence, by comparing expert mental operations to IL ways of thinking, I was able to use the DtD and Framework in a mutually inclusive and beneficial way to increase student learning.

METHODOLOGY

Research design

This project is a model building study and a work in progress that uses a qualitative research

design. The methodology aims at refining the DtD model by integrating an additional step to the interview process and subsequently to the DtD model. This integration is based on inductive modes of reasoning (Mouton 2001) which illustrates the similarities between the DtD and the Framework.

A semi-structured interview was used to determine the ingrained mental operations (HoM) of the subject matter specialist (lecturer). While I began the interview with a set of standardized questions, interactive discussions unfolded which were guided by new information that was obtained from the specialist.

A self-administered questionnaire was given to students to determine the instructional bottlenecks that they are experiencing. A questionnaire was also given to students to evaluate their perceptions of the new teaching approach.

Sample and sampling techniques

The study used a non-probability convenient sampling method for both lecturer and students. The School of Business and Finance was chosen because I had been collaborating with some lecturers for three years to integrate critical literacies in their modules. Hence, it was convenient for me to introduce this model to the lecturer as a relationship of trust had already been nurtured. In addition, the lecturer was willing and innovative in his approach to learning and teaching.

The Business and Finance module had 40 students who were registered as part-time undergraduate students. To determine the bottleneck, I administered a questionnaire to the students during the first session. Twenty-two ($n=22$) participants voluntarily completed the questionnaire. Two weeks later I, together with the lecturer, attended and participated in the second session and administered an evaluation questionnaire after the session to the participants to gauge their perceptions of the lesson. Eighteen ($n=18$) students were present in this session and completed the questionnaire.

Data collection and research instruments

I collected data according to the 7-step sequence of the DtD model. As it is a work in progress, the data reflects the activities represented in the first four steps of the process as outlined below:

Step 1: Identifying the bottleneck

To identify the main instructional bottlenecks that students experience, I designed a questionnaire for students (Appendix 1). There were seven open ended questions and two closed questions. The questionnaire was administered to the undergraduate part-time Business Finance students who attend class on Monday evenings. The questions were drafted to determine the

main challenges that these students experience in this module for example: “Identify a challenge related to the content that you are experiencing in this module? Note: please refer to difficulties with the content only”; “Elaborate fully on the challenge(s) mentioned in question A. (More detail about the concept or method that you do not understand)”; “Does this challenge/difficulty prevent you from understanding the rest of the content? If yes, why do you say so?”; “What attempts do you make to understand the content?”

Step 2: Interviewing the lecturer

This step in the data collection process was aimed at surfacing the ingrained knowledge of the lecturer and his tacit ways of approaching the challenges identified in Step 1.

Data was collected through a semi-structured interview with the Business Finance module lecturer. Using an interview guide, the questions varied and although spontaneous, focused on the same topics. This allowed the interview to be more natural and conversational.

The interview lasted approximately an hour and a half. It took place in the library and was audio-recorded and transcribed with the permission of the lecturer. The interview guide consisted of 10 open-ended questions which can be viewed in Appendix 2. I transcribed the interview to extract expert HoM that pertain to the bottleneck identified in Step 1.

As illustrated in Table 1, I listed the lecturer’s information practices and ways of thinking and scrutinised each answer for particular keywords and phrases that describe IL knowledge practices or dispositions. I then mapped these keywords and phrases across the Framework’s threshold concepts and found similar dispositions across a number of Frames.

In this manner, information practices that ought to be enhanced in student learning were strategically identified.

Step 3: Designing a teaching approach

For the remaining 2 weeks, I proceeded to liaise with the lecturer to design a different teaching approach and lesson plan (Appendix 3) that would make his mental operations more explicit. This approach was then modelled to the students in class two weeks later during the second session. Eighteen (n=18) students were present in this session.

Together, we designed a group activity for the class to give students the opportunity to practice the lecturer’s explanation. This activity was based on the ways of thinking that were extracted from the interview with the lecturer in Step 2.

Step 4

In addition, I designed an assessment for the students which was completed in class. The

assessment was aimed at developing the ability to formulate questions pertaining to the bottleneck.

Step 5

As a final step, I gave the students an evaluation questionnaire (Appendix 4) to complete at the end of the session. The questionnaire comprised closed and open-ended questions. Eighteen students (n=18) were present in this second session and participated in the activities, assessment and evaluation questionnaire.

FINDINGS AND DISCUSSION

The findings are discussed according to the logical sequence of the DtD model. As mentioned earlier, data was collected from questionnaires and a semi-structured interview.

Step 1: Identifying the bottleneck

Research Question 1: Which threshold concepts or bottlenecks are present within the liminal space between professional and novice knowledge in the Business Finance module?

Twenty-two students (n=22) participated and completed the questionnaire. The main challenge identified from the questionnaire indicates that students struggle with interpreting and applying business formulae, in particular, the perception of time value of money. The following responses permeate the totality of the feedback:

“I don’t know how to use the formula to solve the problem” (BF22).

“I have a problem understanding the keys PV and FV (where PV represents the *present value* and FV represents the *future value*)” (BF 4).

“I don’t know why we have to use a formula. I can’t understand how and for what purpose it can be used” (BF13).

These expressions of uncertainty and stagnation are characteristic of cognitive bottlenecks. Despite the lecturer’s efforts to repeat examples and exercises pertaining to this formula, students continued to struggle with applying it to authentic problem scenarios.

Step 2: Interview and analysis

During the interview the Business Finance lecturer reiterated the fact that his students struggled with understanding business formulae and their ability to engage with its components. I spent 1 hour 50 minutes probing the lecturer’s mental frame and approach to this specific problem. Pace (2017) emphasises that it is imperative to steer the interviewee back to the objective of the

interview by constantly reminding him of *his approach* to the challenge and not how he teaches the formula to his learners: “How do you simplify a complex problem for yourself? What do you understand by the word “formula”? Do you ever think about the origin of a formula? How do you visualise the formula in a scenario?”

Research Question 2: What are identifiable expert information literacy HoM that could be developed in the Business and Finance module to overcome the identified threshold concepts or bottlenecks?

The lecturer’s responses revealed his innate HoM which include recognising formulae as data or information that is packaged differently. He maintained that he visualises this information first to understand the purpose of the formula: “I read the facts and I visualise the formula and its purpose”.

In transcribing of the interview, I matched this disposition with the Frame *Information Creation as a Process* (Table 1), in particular, the knowledge practice to *recognise that [authentic] information may be perceived differently based on the format in which it is packaged*.

Similarly, I mapped each way of thinking across the knowledge practices and dispositions of the Framework. These can be found in Table 1:

Table 1: Mapping the lecturer’s ways of thinking with knowledge practices and dispositions of the Framework

Mental operation identified in interview	Information Literacy way of thinking/Habit of Mind
“I read the facts and I visualise the formula and its purpose”	Recognise that [authentic] information may be perceived differently based on the format in which it is packaged. <i>Frame – Information Creation as a Process</i>
“Thinking about what I already know about formulae and then look at the set of facts and try to list the keys in order”	Organize information in meaningful ways. <i>Frame – Research as Inquiry</i>
“I ask myself questions and try different ways to solve the problem”	Value intellectual curiosity in developing questions and learning new investigative methods. <i>Frame – Research as Inquiry</i>
“I practice by applying the formula to different scenarios and keep persevering”	Value persistence, adaptability and flexibility. <i>Frame: Research as Inquiry</i>

The data was analysed by mapping the responses against key concepts (conceptual understandings) and keywords from the Framework. The lecturer explained that his approach to analysing a new business formula entails “visualising the meaning of the scenario and its purpose when looking at a formula” and “thinking of the different components of a formula and its purpose as a form of information”. These habits of mind are directly aligned with the knowledge practices and dispositions of the Frame *Information Creation as a Process*.

In addition to teaching learners an understanding that the purpose, message and delivery of information are intentional acts of creation (ACRL 2016, 6), this concept also conveys the message that information appears in any format. Information is transferred as text, objects, performance as well as images and symbols. This is a key disposition that learners should develop and resonates with expert ways of thinking in that it is important to be able to interpret information in any format. Lee-Post (2019) reiterates this notion by stating that students regard solving business problems “as nothing more than putting numbers in a model” or as in this study, a *formula*. They display very little interest in how the [formula] “was derived, how to interpret the answer ... and how to extend the [formula] to represent more complex situations” (Lee-Post 2019, 404).

The lecturer also explained that he would ask himself “questions and try different strategies to solve the problem”, “thinking about what I already know about formulae – before attempting to solve the problem” and “practice by applying the formula to different scenarios and staying positive by persevering” (See Table 1). I found synergy between these ways of thinking and the Frame *Research as Inquiry*, which refers to an understanding that research is iterative and depends upon asking complex or new questions to develop additional questions” (ACRL 2016, 9) or insight into the discipline.

Similarly, Riegler (2016) contends that literacy in mathematics cannot be viewed in isolation from the subject matter. Having been interviewed by Pace himself, Riegler, who teaches mathematics at a university, claims that his own reading processes of mathematical equations were made transparent. Hence, he became more sensitive to students’ struggles with literacies in this regard. The Business Finance lecturer expressed similar notions in my interview with him where he states that “all students should go through maths literacy skills” to be able to understand formulae, because “the minute students see a formula, it becomes very complicated for them” (lecturer).

The close comparison between the lecturer’s dispositions and those listed under each Frame leads to a realisation that expert practitioners develop information practices and information literacy HoM as they become immersed within their disciplines.

Step 3: Designing a teaching approach

Research Question 3: How can pedagogic methods be transformed to develop expert information literacy HoM in the Business and Finance module?

The lecturer and I met several times to discuss and plan a new teaching method which could mirror his ways of thinking and in turn, develop the students’ understanding of the IL concepts. I then proceeded to draft a lesson plan (Appendix 3) which incorporates the steps in

the decoding process. In order to establish a link between the Frames and teaching method, the following approach was designed: “Visualising the problem” and “thinking of the different components of a formula and its purpose as a form of information”.

Based on my advice, the lecturer designed a timeline to explain the formula (See Figure 2): TVM or Time Value of Money.

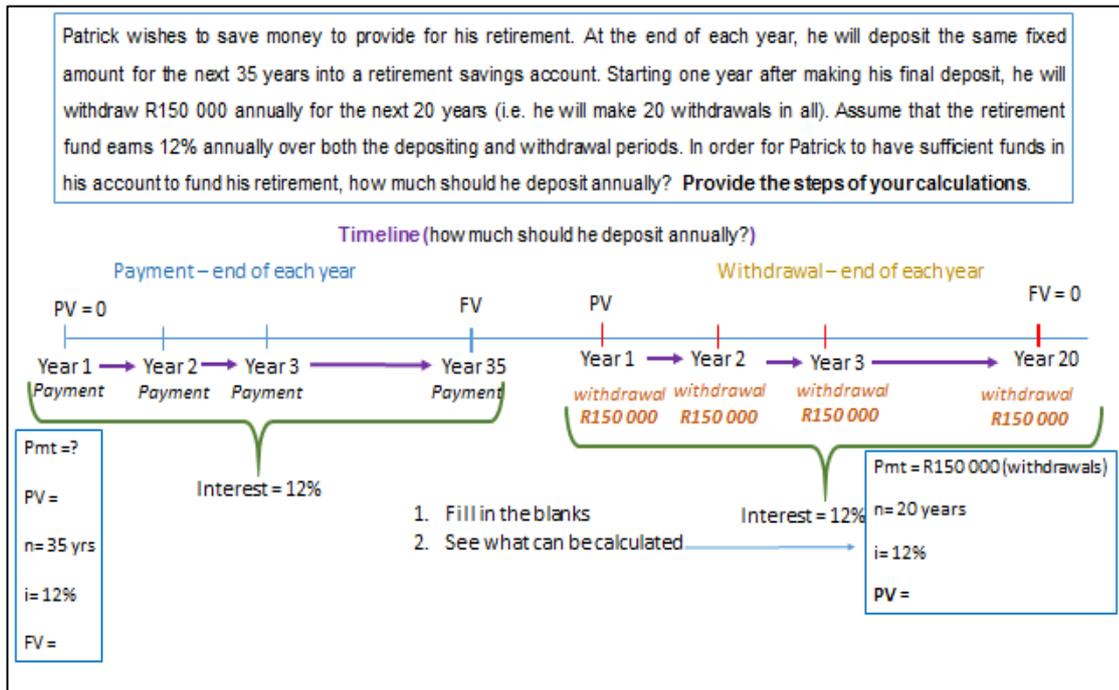


Figure 2: A time line for the TVM formula

During the interview the lecturer emphasised the importance of demonstrating the use and analysis of a formula in the same way that “you would try to understand it” (lecturer). Using an infographic which I designed to complement the formula (See Figure 3), the lecturer explained the meaning of TVM using the analogy, thus modelling his own way of thinking.

According to Pace (2017), modelling can be the most enjoyable and creative part of the decoding process. It is imperative that the lecturer links the analogy that he uses to the actual content. This enables the student to “see the cogs turning” (Pace 2017, 57) as the instructor uses the infographic to explain the formula. They should understand that this is a process that they themselves should repeat when having to solve a business problem of this nature.

Both images were used on the overhead projector. The lecturer used the representations as a means to elicit further questions and discussions with the students. This form of instruction resulted in a very interactive class with more “responsiveness than usual” (Lecturer).

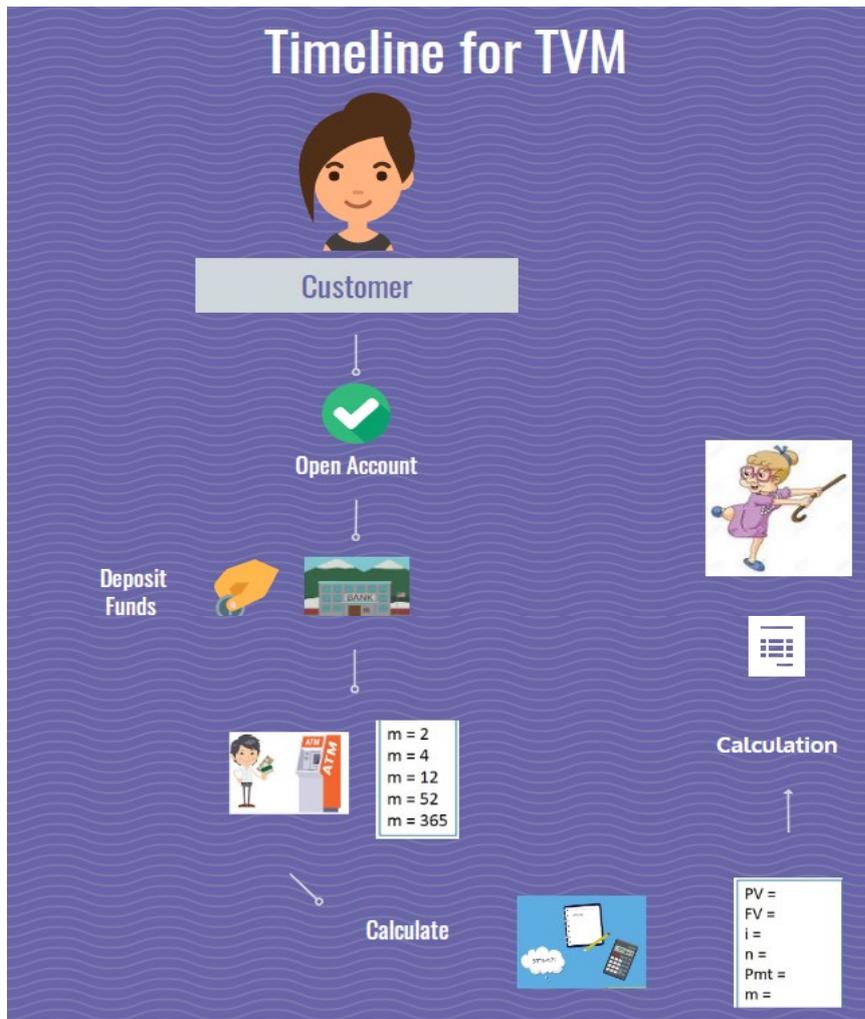


Figure 3: An infographic of the TVM timeline

The results elicited from the evaluation questionnaire show that all ($n=18$) participants agreed that the infographic helped them to understand the components of the formula. Similarly, all the participants affirmed that the infographic clarified the purpose of the formula in the business scenario. Only four (14%) participants failed to recognise the formula as a format which represents a set of facts or a given scenario. These perceptions are illustrated in Table 2.

Table 2: Evaluating the infographic and formulae ($N=18$)

Questions	Agree	Disagree
The image that the lecturer used to explain the proposed scenario helped me to understand the components of the formula	18	
The image that the lecturer used to explain the proposed business scenario helped me to understand the purpose of the formula.	18	
I recognise formulae as ways to represent a set of facts or a given scenario	14	4

An activity to check for understanding

As emphasised in his interview, the lecturer states that students should know “why a particular

formula is used and its purpose” (lecturer). He presented the students with a different set of facts and asked them to work in pairs to design their own timelines. I handed them chart paper and kokis which they used to draw the timelines. See Figure 4 where the image from one of the students indicates a schematic analysis of the formula.

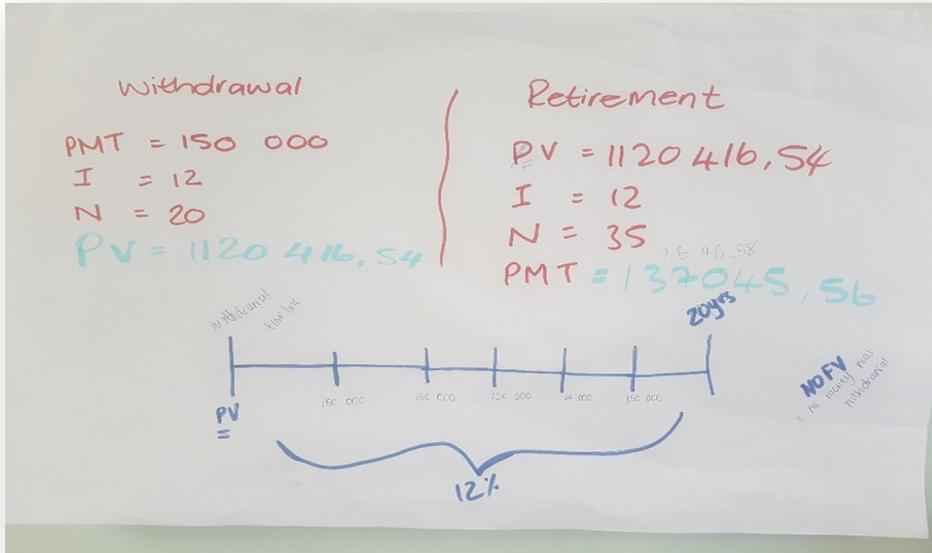


Figure 4: A timeline drawn by students

Each pair shared their timelines with the class and explained how they analysed the problem. It was evident from the open-ended questions that all 18 participants agreed that this activity gave them insight into the various ways to unpack and analyse the set of facts (See Table 3). They also found it useful to apply the formula to the set of facts. Seventeen (n=17) students said that they can relate the infographic to a similar set of facts. This positive result may be because group work reinforces critical thinking and reflection (Maiese 2019).

Table 3: The group activity (N=18)

Question	Agree	Disagree
The group activity gave me insight into the various ways to unpack and analyse the set of facts	18	
The group activity helped me to apply the formula to the set of facts	18	
I was able to relate the explanations in the infographic to a similar set of facts in the practical exercise	17	1

The lesson on the timeline and infographic was positively received by students (See Figure 5) as indicated by the following responses “I could view formula from a different perspective” (BF2); “The exercise removed uncertainty as to how to apply the formula” (BF4); “I could break down the components of the formula into meaningful parts” (BF7).

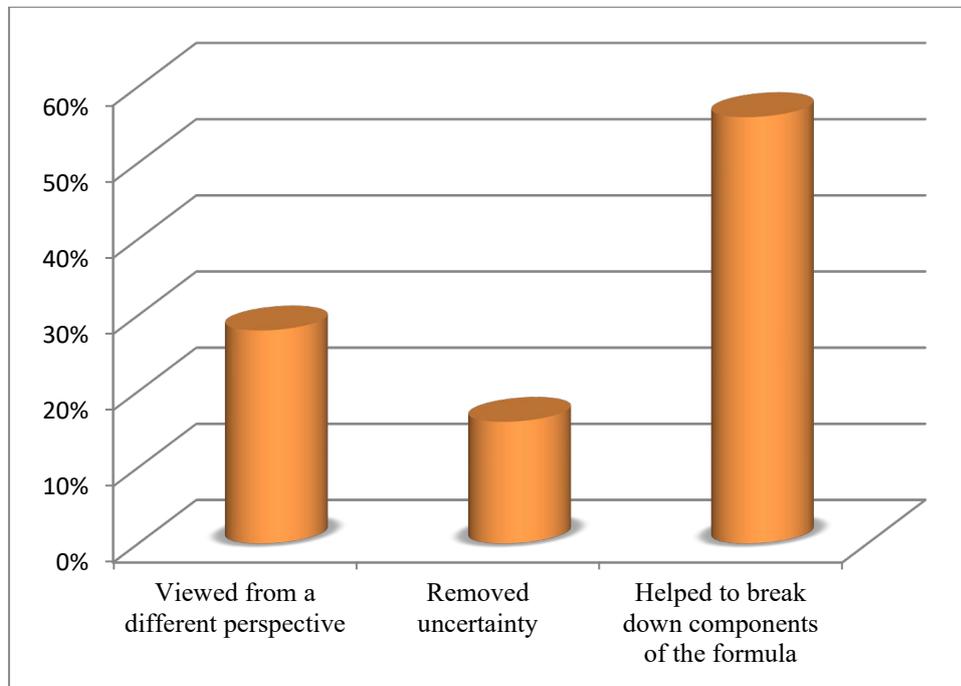


Figure 5: Students' responses to timeline exercise

Step 4: Assessment: Phrasing questions to understand a difficult concept

I designed an assessment to test students' ability to formulate questions to arrive at a possible answer (See Table 4). The lecturer had mentioned in the interview that the various keys or components of the formula TVM have proven to be troublesome to the students. His approach is to ask questions pertaining to the component itself to understand how it fits into the equation. Students were given the form and asked to complete it by drafting meaningful questions for each business concept. This develops critical thinking and is aligned with the Frame *Research as Inquiry*.

Table 4: Assessing the ability to phrase questions

Business Concept	Question: What type of questions will you ask to gain a better understanding of each of these concepts?
E.g. Time Value of money	E.g. How does "time" affect the value of money?
Future value	
Present value	
Simple interest	
Compound interest	
Cash Flow	

By being able to formulate questions about difficult concepts or phenomena the learner is nurtured to acquire the expert's perspective on inquiry (ACRL 2016). The following questions represent some of their responses to the exercise, for instance, the concept "compound interest":

- “Is there a keyword that one looks for to spot compound interest?” (BF13).
 “What are real-life examples that could explain compound interest?” (BF13).
 “How does compound interest impact on other keys of the formula?” (BF14).
 “Is this interest easier to calculate or work with?” (BF11).

These questions illustrate elements of critical thought and analysis of the business concepts.

Figure 6 shows the feedback from the evaluation questionnaire. When asked whether they benefitted from this exercise, 28 per cent (n=5) of the participants said that they needed assistance with formulating questions. Fifty per cent (n=9) of the participants agreed that phrasing questions helped them to analyse the concepts. Twenty two percent (n= 4) of the participants said that they can analyse and break down difficult concepts into a simpler explanation.

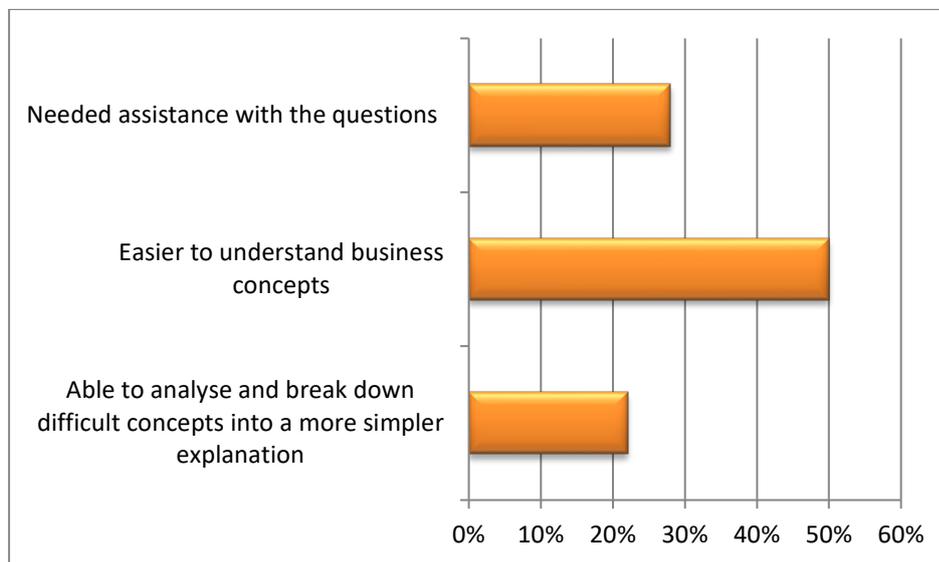


Figure 6: Student feedback on phrasing questions

LIMITATIONS OF THE STUDY

I had interviewed only one lecturer in the faculty as part of a pilot study. The restricted number of willing interviewees makes it difficult to conclude whether expert dispositions may be applied and developed in all disciplines.

Furthermore, this phenomenon was explored with a small sample of students (N=18) which is 45 per cent of the total number of 40 study subjects in the Business Finance module. This may have skewed results. It may be inferred from these limitations that the data obtained through this method provided limited insight into students' experiences with regards to some of the assessments.

IMPLICATIONS OF THE STUDY FOR HIGHER EDUCATION AND ITS IMPACT ON TEACHING AND LEARNING

The nature of information literacy education at Higher Education Institutions is generally characterised by mechanical styles of teaching where academic librarians train their students to develop a set of skills that are needed to find relevant information. This usually includes navigating databases and library search engines as well as being taught to use reference management tools. As expounded above, these linear, prescriptive methods of teaching information literacy skills do not address, nor enhance, the much-needed attributes that learners require to engage with information in their disciplines.

This study has dispelled the standard perception of information literacy and allows the reader to view it through a different, nuanced lens. Not only could the ACRL Frames or threshold concepts be used to inform curriculum design and enhance student learning within various disciplines, but they could also be used to develop expert ways of thinking. The disjuncture between expert and novice information practices is addressed in the findings of this study. The study proves that, by acquiring conceptual understandings of information, the struggling student can adopt a holistic view of the “problem” in the course content and may approach it in a manner that is aligned with expert practices.

Hence, the findings of this study also show that lesson plans and teaching methods should include the expert’s tacit ways of thinking and approaches to the content. This nuanced approach to teaching and learning may have a profound impact on higher education as it aims to assist learners with disciplinary challenges by empowering them to think and behave as experts in their fields. Furthermore, the recommended teaching style cuts across all faculties as the ACRL Framework can be applied in many disciplines, thereby extending the boundaries between the Library and faculty.

It may be therefore be inferred that the study serves to abandon previously accepted notions of information literacy as a library-centric phenomenon for one which allows for a more inclusive relationship between academic teachers and librarians. Not only does my frequent collaboration with lecturers facilitate the integration of critical literacies in tertiary education – it also expands the general perception of the library and librarian as key resources within the context of teaching and learning. The integration of literacies into teaching and learning has implications for educators, learners and for academic librarians. Through a dialogic approach, I was able to uncover student challenges in the Business Finance module and assist with uncovering expert ways of thinking that could be used to help students overcome their challenges.

The study aims to enhance the cognitive skills and academic knowledge that students need to succeed in the 21st Century. The mastery of these skills enables students to think flexibly and creatively, transferring and applying their learning from one context to new situations. In the Business Finance class, this is evident in the students' ability to phrase questions that will help them to understand difficult concepts. Moreover, their transformed perceptions of business formulae attest to the fact that the implementation of appropriate pedagogical approaches that are aligned with the learner's information literacy needs should be foregrounded in transformative teaching.

The proposed method also borders on critical pedagogy which aims to decolonise colonial or traditional ways of teaching. It disempowers colonial teaching methods by empowering the student to develop expert HoM and by narrowing the gap between the teacher and student.

CONCLUSION

This small study explored the possibility of bringing critical literacies and HoM into the DtD model by integrating an additional step in the decoding process. Having transcribed the interview with the lecturer, I compared his ways of thinking to the knowledge practices and dispositions of the ACRL Framework to determine whether there is any synergy between disciplinary expertise and information literacy HoM. This is recommended as a vital step that could assist in addressing bottlenecks in the teaching and learning process.

The study confirms that the expert practitioner of the Business Finance module holds tacit knowledge which may be identified as expert information literacy HoM. These ways of thinking are indicative of 21st century literacies and knowledge practices that ought to be enhanced in student learning. The disjuncture that often exists between the novice student and lecturer may be attributed to the learner's lack of IL proficiencies that could be applied in disciplinary contexts.

The study identified specific bottlenecks that were found in the liminal state. For learners to cross these thresholds they must adopt certain patterns of behaviour that are aligned with conceptual understandings of information. These practices will enable them to work with the knowledge in their discipline. The study has proven that expert thinking and behaviour are directly aligned with IL practices.

Furthermore, librarians could use the Framework to position expert IL ways of thinking in student learning. The study has proven that IL dispositions are aligned with expert HoM and are immersed in the ingrained knowledge and practices of the practitioner. Moreover, educators could transform their teaching practices to cultivate information literacy HoM in student learning.

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APPENDIX 1: Identifying the Bottleneck

Question 1: What do you enjoy most about this module?

Question 2: Please complete the table below:

Question A	Question B	Question C	Question D
Identify a challenge related to the content that you are experiencing in this module? Note: please refer to difficulties with the CONTENT only.	Elaborate fully on the challenge(s) mentioned in question A. (More detail about the concept or method that you do not understand).	Does this challenge/difficulty prevent you from understanding the rest of the content? If yes, why do you say so?	What attempts do you make to understand the content?

Question 3:

Do you seek assistance from the lecturer related to your challenge(s)?

 YES

 NO

Question 4:

What do you think the lecturer could do to assist you with overcoming the difficulty?

Question 5:

Do you seek assistance from the tutor related to your challenge(s)?

 YES

 NO

Question 6:

What do you think the tutor could do to assist you with overcoming the difficulty?

Question 7:

Do you consult any material on the challenging concept/method/phenomenon other than that which is prescribed for you? If so, what type of material do you search for and how do you obtain this material?

Researcher: Shehaamah Mohamed
Senior Librarian: Learning & Teaching
UWC Library
shmohamed@uwc.ac.za

APPENDIX 2**Interview Questions for the lecturer**

- 1) What do you understand by the word “formula”?
- 2) Do you ever think about the origin of a formula?
- 3) How do you visualise the formula in a scenario?
- 4) How do you simplify a complex problem for yourself?
- 5) Can you define this problem more clearly?
- 6) What would you do if you were asked to complete the task that blocks your students' learning?
Put yourself in the perspective of someone who is in the course who has had all this background material, who sits down to read the text. And what does he or she do? What does that tell you?
What information are you getting from that?
- 7) How do you know which element of the problem to focus on first?
- 8) What are you looking for at this point in your research?
- 9) Are you visualizing anything as you do that? Why is doing that important?
- 10) How does the response to this action affect what you do next?
- 11) How do you know what to ignore at this point?
- 12) Are you comparing what you see here to something else?
- 13) How do you know which method to apply at this point?
- 14) How do you know when you have hit a dead end?

APPENDIX 3

Lesson Plan – School of Business and Finance
Module: Business Finance (MDP580) (which incorporates the steps of the *Decoding the Disciplines Paradigm*)
Duration: 17:30–19:30 (2 hours)

The modified learning outcomes are based on the expert ways of thinking that were elicited in the interview with the Librarian

TOPIC: Time Value of Money

Workshop/presentation outcomes: Students should be able to:

1. recognise that information may be perceived differently based on the format in which it is packaged
2. visualise the information that is conveyed in the formula
3. formulate questions to break complex problems into simple ones and to make causal connections and relationships

Time	Presentation Phases/ Content	Presenter Actions/Methodology	Participant/student Actions
	<p>Step 3: Modelling new teaching method Learning outcomes 1 and 2</p> <div style="border: 1px solid black; padding: 5px; margin: 10px 0;"> <p>The lecturer and librarian design a teaching method and activity for the class</p> </div> <p>Step 4: Assessment Learning outcome 3: Aim is to develop critical thinking skills for unpacking difficult business concepts</p> <p>Students formulate questions that may aid them in understanding concepts related to formulae eg, TVM</p>	<p>Use an Infographic to teach the aspects of a formula Apply a time-line to illustrate how a formula may be broken into different parts Lecturer uses different scenarios to apply the formulae, each time increasing the difficulty of the scenario</p> <p>Lecturer checks for understanding</p> <div style="border: 1px solid black; padding: 5px; margin: 10px 0;"> <p>Students are given an opportunity to practice and receive feedback by doing an assessment.</p> </div>	<p>Students will observe and answer specific questions posed by the lecturer. Session becomes interactive.</p> <p>Controlled Activity: Students work in pairs to create their own timelines with chart paper and kokis and apply it to a different set of facts</p> <p>Students to present their findings to the class</p> <p>An assessment is completed in class</p>

APPENDIX 4

**BUSINESS FINANCE MDP 580 (EMS)
EVALUATION QUESTIONNAIRE**

Initial & Surname: (optional)

Student No: (optional)

Please answer the questions below:

1. Visualising the facts. Please TICK your choice

1.1. The image (infographic) that the lecturer used to explain the proposed business scenario helped me to understand the components of the formula

 AGREE DISAGREE

1.2 The image (infographic) that the lecturer used to explain the proposed business scenario helped me to understand the purpose of the formula

 AGREE DISAGREE

1.3 I recognise formulae as ways to represent a set of facts or a given scenario

 AGREE DISAGREE

2. Practical Exercise

2.1 The group activity gave me insight to the various ways to unpack and analyse the set of facts

 AGREE DISAGREE

2.2 The group activity helped me to apply the formula to a set of facts

 AGREE DISAGREE

2.3 I was able to relate the explanations in the infographic to a similar set of facts in the practical exercise

 AGREE DISAGREE

3. Written Exercise

3.1. Did you find the written exercise (table) helpful? (Tasks 2).

 YES NO

3.2. If yes, how did formulating questions about concepts assist you?

.....
.....

3.3 If No, please explain why.

.....
.....

4. Which part of the lesson was most beneficial to you? Explain

.....
.....

5. Which part of the lesson did you least enjoy? Explain

.....
.....

6. Do you have any suggestions or comments about how your understanding of business formula and concepts can be improved?

.....
.....