INFORMATION TO USERS

This manuscript has been reproduced from the microfilm master. UMI films the text directly from the original or copy submitted. Thus, some thesis and dissertation copies are in typewriter face, while others may be from any type of computer printer.

The quality of this reproduction is dependent upon the quality of the copy submitted. Broken or indistinct print, colored or poor quality illustrations and photographs, print bleedthrough, substandard margins, and improper alignment can adversely affect reproduction.

In the unlikely event that the author did not send UMI a complete manuscript and there are missing pages, these will be noted. Also, if unauthorized copyright material had to be removed, a note will indicate the deletion.

Oversize materials (e.g., maps, drawings, charts) are reproduced by sectioning the original, beginning at the upper left-hand corner and continuing from left to right in equal sections with small overlaps.
WHAT TEACHERS THINK WHEN VIEWING VIDEO MODELLING OF EXEMPLARY PRACTICE

by

Cresencia G.W. Fong

A thesis submitted in the conformity with the requirements for the degree of Master of Arts
Department of Curriculum, Teaching and Learning (Computer Applications)
Ontario Institute for Studies in Education of the University of Toronto

© Copyright by Cresencia G.W. Fong 2002

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.
The author has granted a non-exclusive licence allowing the National Library of Canada to reproduce, loan, distribute or sell copies of this thesis in microform, paper or electronic formats.

The author retains ownership of the copyright in this thesis. Neither the thesis nor substantial extracts from it may be printed or otherwise reproduced without the author’s permission.

L’auteur a accordé une licence non exclusive permettant à la Bibliothèque nationale du Canada de reproduire, prêter, distribuer ou vendre des copies de cette thèse sous la forme de microfiche/film, de reproduction sur papier ou sur format électronique.

L’auteur conserve la propriété du droit d’auteur qui protège cette thèse. Ni la thèse ni des extraits substantiels de celle-ci ne doivent être imprimés ou autrement reproduits sans son autorisation.
WHAT TEACHERS THINK WHEN VIEWING VIDEO MODELLING OF EXEMPLARY PRACTICE

Master of Arts, 2002
Cresencia G.W. Fong
Department of Curriculum, Teaching and Learning (Computer Applications)
University of Toronto

ABSTRACT

This study explores the use of video vignettes as a tool for the professional development of teachers. It is postulated that teachers’ professional frames drive them to view vignettes through multiple “lenses”, and that teachers may not recognize exemplary practice when presented with it. A qualitative/quantitative hybrid design was used to collect data on the video elements that 11 pre-service and 11 experienced teachers attended to as they observed exemplary astronomy teaching vignettes. Data sources include pretest astronomy scores and think-aloud protocols. Quantitative analyses of the results suggest that teachers rarely recognized the exemplary practice presented to them as being ‘exemplary’. Furthermore, teaching experience significantly influences the type of lens through which a teacher will observe exemplary practice vignettes. There is also some evidence to suggest that instructing teachers to actively seek out exemplary practice aids them in attending to the underlying functions and purposes of the methodology presented.
ACKNOWLEDGEMENTS

First and foremost I would like to thank my family and especially my parents, Henry and Philomena Fong; for loving me, supporting me, and believing in me. Mom and Dad, you were my first teachers and I will forever be indebted to you. My accomplishments are your accomplishments!

Next I would like to thank my supervisor, Dr. Earl Woodruff. Your guidance has shaped this thesis project as well as my academic growth, and has inspired me to reach higher than was heretofore conceivable to me.

Thanks are also due to Dr. John Percy for supporting me and assisting me with astronomical issues, and to Dr. Jim Hewitt for being on my thesis committee.

I would also like to thank my research group—especially Nalini Chandra—for offering their input and advice, as well as for assisting me with my data analysis. Nalini, I am touched by your support, encouragement, and generosity of soul.

Finally, I would like to thank my friends—especially David—for their support and good cheer. Dave, your help and constant encouragement made my task immeasurably more manageable.
# Table of Contents

Abstract ............................................................................................................................... ii  
Acknowledgements ............................................................................................................ iii  
Dedication ........................................................................................................................ vii  
Chapter One: Introduction .................................................................................................. I  
Purpose of the Research................................................................................................... 3  
Chapter Two: Method ....................................................................................................... 14  
Participants...................................................................................................................... 14  
Procedures....................................................................................................................... 14  
Data Analysis .................................................................................................................. 17  
Inter-Rater Reliability ..................................................................................................... 19  
Chapter Three: Results .................................................................................................... 23  
The Effect of Teaching Experience .............................................................................. 23  
The Effect of Prior Subject-Matter Knowledge ............................................................ 28  
The Effect of Directed Viewing ..................................................................................... 31  
Chapter Four: Discussion ................................................................................................ 36  
Limitations of the Study................................................................................................. 39  
Implications for Future Research................................................................................... 41  
Summary .......................................................................................................................... 44  
References........................................................................................................................ 46  
Appendices  
Appendix A: Interview with the Exemplary Teacher ................................................... 51  
  First Video: Day and Night ......................................................................................... 51  

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.
Second Video: Moon Phases ................................................................. 55

Appendix B: Think-Aloud Protocol Schedule ..................................................... 68

Appendix C: Astronomy Knowledge Assessment ................................................. 71

Appendix D: Definition of Lens Categories (2nd ed.) ........................................... 85
  Content Lens (C) .................................................................................... 85
  Form Lens (F) ..................................................................................... 85
  Pedagogical Lens (P) .......................................................................... 88
  Surface-Level Media Lens (S) ................................................................. 90

Appendix E: Quick Reference of Lens Categories ............................................. 92
  Content Lens (C) .................................................................................. 92
  Form Lens (F) ................................................................................... 92
  Pedagogical Lens (P) ........................................................................... 92
  Surface-Level Media Lens (S) ............................................................... 93

List of Tables

Table 1: ANOVA & ANCOVA of Teaching Experience vs. Content Lens Proportion ................................................................. 25

Table 2: ANOVA & ANCOVA of Teaching Experience vs. Pedagogy Lens Proportion ................................................................. 27

Table 3: Teacher Performance on Astronomy Self-Assessment .......................... 28

Table 4: Teacher Performance on Pertinent Questions ...................................... 28

Table 5: Pearson Correlations of Test Performance vs. Lens Proportions ............ 30

Table 6: Pearson Correlations of Test Performance vs. Lens Raw Frequencies ...... 31

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.
List of Figures

Figure 1. Direction of effect for Content Lens proportion with respect to teaching experience and viewing instructions.......................... 32

Figure 2. Direction of effect for Form Lens proportion with respect to teaching experience and viewing instructions.......................... 33

Figure 3. Direction of effect for Pedagogy Lens proportion with respect to teaching experience and viewing instructions.......................... 34

Figure 4. Direction of effect for Surface-Level Media Lens proportion with respect to teaching experience and viewing instructions. ......................... 35
In memory of my grandfather, C.P. Lee, who was a man of vision

and

my uncle, L.C. Shek, who was a man of discipline.

Although you are both missed, your lives continue to teach great lessons.
CHAPTER ONE: INTRODUCTION

Teachers are being asked to teach for understanding (Darling-Hammond, 1997; Bereiter, 2002). For this to be done, it becomes imperative that teachers learn more about the subject-matter they teach, and how students learn these subjects (Garet, Porter, Desimone, Birman, & Yoon, 2001). Teachers need to possess sound knowledge of both subject-matter content and teaching pedagogy in order to achieve exemplary teaching (Shulman, 1986). Among its 167 recommendations to Ontario’s Ministry of Education and Training, The Royal Commission on Learning (1995) has called for education reforms resulting in heavier curriculum (Ontario Ministry of Education and Training, 1998) and increased accountability to the public (Education Quality and Accountability Office, 1996) which have placed additional burdens on teachers. Fred MacDonald (2002) has described the past decade’s changes in the Ontario educational landscape as an “assault on teachers and their work” (p. 2) and contends that this assault has been instrumental in bringing about an “identity crisis” (p. 10) among this province’s teachers. Being a profession that already thought of its work as “demanding and unpredictable rather than straightforward and routine” (Darling-Hammond, 1997, p. 71) prior to these recent changes, the issue of time in a teacher’s work life becomes ever more pressing:

They [teachers] experience it [time] as a major constraint on what they are able and expected to achieve in their schools. “No time”, “not enough time”, “need more time” - these are verbal gauntlets that teachers repeatedly throw in the path of enthusiastic innovators. (Hargreaves, 1994, p. 95)

Clearly, new models of Professional Development must be aware of, and sensitive to, time demands on teachers. Therefore, while recognizing the necessity for teachers to practice in ways they have never done so or experienced before, Linda Darling-
Hammond (1997) stresses a need for the restructuring teacher development programs. Lieberman and Miller (1999) note a positive trend in teacher professional development toward what they term “growth in practice”, where professional development becomes part of—not an addition to—school life, as it facilitates continuous growth in teachers.

Considering today’s ever demanding climate in education and its implications on teachers’ work lives, the internet becomes an increasingly favourable option for flexible delivery of teacher professional development. The Ontario Institute for Studies in Education of the University of Toronto (OISE/UT) Astronomy Project (http://www.oise.utoronto.ca/~ewoodruff/) is a working prototype of a website dedicated to self-directed teacher development in astronomy education by making resources and opportunity for discourse among teachers, educational researchers, and an expert astronomer available through its website. The project is co-lead by Dr. Earl Woodruff, a cognitive scientist and teacher educator at OISE/UT; and Dr. John Percy, a professor of astronomy at the University of Toronto.

In addition to addressing Lieberman and Miller’s assertion for “growth in practice”, the Astronomy Project as it is envisioned (Chandra, Woodruff, Kalchman, & Percy, 2001) will also address the 3 core features of effective professional development identified by Garet et al. (2001), namely: focusing on content, promoting active learning, and fostering coherence. Furthermore, this project will allow for sustained professional development, integration into daily school life, and collective participation; and will encourage professional communication among teachers—all of which, have been empirically confirmed by Garet et al. to be features of effective professional development supporting change in teacher practice.
Purpose of the Research

Problems of distance, cost, time, and shortage of presenters impeding the professional development of teachers are shrinking with the use of the internet as a tool for telecommunications (Russell & Sabatini, 2001; Herbert, 1999; Marx, Blumenfeld, Krajcik & Soloway, 1998) and the use of video technology (Smith, 1994). The SHARP project at Lancaster University combined these two technologies in a particularly new-wave approach to collaborative distance education for professional development in teaching where; digitized video representations of practice were created by, shared and discussed among an online community of practitioners in asynchronous multimedia conferences (Goodyear & Steeples, 1999).

Future plans for the OISE/UT Astronomy Project website include online access to digitized video vignettes of astronomy teaching (Chandra et al., 2001). Folk wisdom suggests that exposing teachers to video models of exemplary practice is a more powerful and efficient form of professional development than text alone. Indeed, there are a number of scholars who advocate exactly that approach (Smith & Diaz, 2002); particularly if these videos are supplemented with external support (McCurry, 2000; Tippins, Nichols, & Dana, 1999; Chaney-Cullen & Duffy, 1999; Copeland & Decker, 1996; Smith, 1994), or are incorporated within a case structure (Hewitt, Pedretti, Bencze, Vaillancourt, & Yoon, 2002; Marx, Blumenfeld, Krajcik & Soloway, 1998).

However ideal exposing teachers to video modelling of exemplary practice seems to be, some have found that teachers bring their own perspectives (Chaney-Cullen & Duffy, 1999) and belief sets (Tippins, Nichols, & Dana, 1999) when interpreting and processing such videos. In recognition of these findings and others who wonder if
teachers do in fact perceive and recognize exemplary practice when they are presented with it (Bereiter, in press), I question the utility of this approach.

Implications of Frame Theory

We are constantly actively engaged in constructing meaning by negotiating the situations we encounter with our personal knowledge bank and collection of personal experiences (Schön, 1983). This constant negotiation and renegotiation—termed reflection-in-action by Donald Schön—involves the use of what Barnes (1992) has called a frame—assumptions and expectations influencing our knowledge of the world and our actions. Barnes (1992) states it clearly when he writes:

...the frames that we bring to any context allow us both to categorize what we see and to attempt to interpret what is going on there, including unexpected features and events. We also use the frame to supply, sometimes misleadingly, those aspects of the context that we did not consciously notice. (p. 16)

Indeed, Schön (1983) argues that when presented with an unfamiliar situation, a practitioner sees it simultaneously as “both similar to and different from the familiar one...The familiar situation functions as a precedent, or a metaphor, or—in Thomas Kuhn’s phrase—an exemplar for the unfamiliar one” (p. 138). Thus the “reflective practitioner” draws on their own repertoire of exemplars to frame new situations.

Applying Schön’s framework specifically to the teaching profession, Geddis (1996) asserts that the acts of problem setting and reframing constitute the essence of the reflective teacher’s practice. That we engage in—to use Schön’s term—“reflection-in-action” and the reframing of our experiences implies that micro-level frames, derived from individual experiences, are somewhat unstable (MacLachlan & Reid, 1994; citing Goffman, 1974). On a Macro-level however, teachers’ professional frames are not as
open to change because these frames are maintained by their colleagues (Barnes, 1992). Furthermore, the frames through which we interpret our experiences are often naturalized to the point of invisibility (MacLachlan & Reid, 1994). Interaction with people, events and constraints in a teacher’s work life influence the development of a teacher’s professional frames (Barnes, 1992). Barnes claims that these professional frames “represent the teacher’s interpretation of the roles and strategies available to him or her within the particular situation” (p.17).

What are the implications of frame theory on how teachers in this study interpreted video vignettes of exemplary astronomy teaching? In citing Deborah Tannen’s 1979 article, ‘What’s in a Frame: Surface Evidence for Underlying Expectations’, MacLachlan and Reid (1994) contend that:

...watching a film involves much more than the passive reception of sound and image. The viewer’s expectations and other framing devices associated with the film medium constantly mediate, as Tannen concludes in her article, ‘between a person and her/his perceptions, and between those perceptions and the telling about them’. (p.67)

Thus I view teachers in this study as using their tacit professional frames to constantly mediate and construct meaning from the video vignettes of exemplary practice. As they frame what they see, the teachers determine “the features to which they will attend, [and] the order they will attempt to impose on the situation” (Schön, 1983, p.165). To reflect the tacit quality of teachers’ professional frames, I prefer to describe the teachers of this study as viewing the video vignettes through “lenses”, rather than ‘framing’ the models of exemplary practice. Murray Smith’s (1994) findings concur with
MacLachlan and Reid’s (1994) contentions and support my postulation that teachers’ professional frames drive them to view vignettes of exemplary practice through a multiplicity of their own lenses:

Even though teachers may be sceptical of vignettes that do not match their classroom environment they frame problems with their practice. Further, they may look for solutions to their problems as they watch vignettes. It seems that the teachers are constructing their own meanings of the vignettes and these meanings are generated as they reflect upon their classroom practices. (p. 13)

Not only do I postulate that teachers view such vignettes through lenses, I argue that one cannot assume that the exemplary practice teachers observe through these lenses will be perceived as such. Carl Bereiter (in press) makes this point clear when he writes:

The most brilliant pedagogical idea of all time could arise in one classroom and remain unknown to the teacher next door. If it did become known, however, its brilliance would likely go unrecognized—even by the teacher who hit upon it.

(Bereiter, in press, chapter 11)

Bereiter’s observation suggests a number of research questions with regard to the use of videos demonstrating exemplary practice. Namely, what do teachers attend to when they are told they are watching video vignettes of exemplary practice in astronomy education? Or, what factors affect the type of lenses through which teachers view video vignettes of exemplary practice? And finally, are teachers more likely to achieve a deeper reading of the actions and events portrayed in video vignettes of exemplary practice when they are instructed to seek out exemplary practice, prior to viewing them?
A pilot study was conducted on three elementary teachers who had taught for 3, 10 and 18 years respectively. All three teachers were required to attend a one-on-one session with the researcher, where they completed an astronomy pretest and viewed video vignettes of exemplary astronomy teaching while thinking aloud. The same astronomy pretest and video vignettes have been used for this follow-up study. Data sources included astronomy pretest scores and think-aloud protocols. Results from the pilot study led me to postulate that teachers view video vignettes of exemplary practice through a combination of lenses: "Content", "Form", and "Pedagogy". Cursory examination of data from this follow-up study suggested the presence of a fourth lens, that of "Surface-Level Media". Inter-rater reliability was established using this data to determine if these lenses, described later in chapter two, are a viable and assessable construct for analyses.

Videos of Exemplary Astronomy Teaching

To begin to address the research questions, two videos demonstrating exemplary teaching in astronomy were created. One, demonstrating Day and Night (running time = 229 seconds), and the other addressing Moon Phases (running time = 318 seconds) were filmed, produced and digitized into Apple QuickTime™ movies by the researcher; using a mini digital-video camera and Apple's iMovie™ digital video editing and compression application.

The videos show a demonstrator performing a number of hands-on activities that teachers could do with their students, using standard and readily-accessible apparatus and materials. Day and Night contains two vignettes (103 seconds and 106 seconds long). In the first vignette of Day and Night, the demonstrator presents a global perspective—"God's view" or "third person"—to address what causes day and night. In the second
vignette, the demonstrator presents an individual—"first person"—perspective to address how the sun appears to rise in the east and set in the west.

There are three vignettes which constitute the *Moon Phases* video. In the first two vignettes (139 seconds and 60 seconds long) the demonstrator presents a global perspective to explain why we see different phases of the moon at different times in a month, and what causes a solar eclipse. In the third vignette (94 seconds long), the demonstrator presents an individual perspective to show why we see different moon phases in a month.

Together, all five of these vignettes demonstrate teaching techniques that are designed to help students better understand a portion of the curricular astronomy concepts specified in the "Earth and Space Systems" strand of Ontario's science expectations for grade 6 (Ontario Ministry of Education and Training, 1998). Work by Sadler (1992) indicates that many students do not understand these concepts, and Percy et al. have found that non-science majors enrolled in an undergraduate astronomy course have similar difficulties (Percy, Attard, Hamilton, Kalchman, Kerton, & McNaughton, 2000). In fact, pre-service teachers have been found to hold misconceptions about astronomy (Percy, 1999) and furthermore, their misconceptions are resilient to change even after participating in a number of workshops which addressed these misconceptions (Woodruff, Kalchman, Chandra, & Percy, 2000). My work (Fong, 2002) suggests that misconceptions about astronomy are not only pervasive among pre-service elementary teachers, but persists among experienced elementary teachers as well.

The vignettes used in this study were designed to help learners of all levels to overcome their problems of understanding. Three of the vignettes make use of 3-
dimensional models to represent the earth, sun and moon; which allow students to adopt a
global perspective, placing them somewhere in the universe as they observe the
movements of the earth and moon and try to understand the resulting patterns of change
observable from earth. However, the observations gleaned from a global perspective
require a fair leap to reconcile with observations gleaned from an individual perspective
that develops as a consequence of being an earthly inhabitant, and noticing the sun’s
regular movement across the sky as well as different shapes of the moon during different
times of the month (Chandra, 2001). Thus, the remaining two vignettes employ an
individual perspective to help minimize this mental leap. In these activities, students are
required to model the concepts of day/night cycles and moon phases by pretending their
bodies represent the earth. They must turn in appropriate directions with respect to the
sun or moon and demonstrate these phenomena as they would appear from the earth’s
point of view (Chandra, 2001).

Defining “Exemplary”

For the purposes of this study, ‘exemplary practice in astronomy’ is defined as
being a demonstration or activity that a professional astronomer would execute to address
a particular astronomical topic with the objective of helping learners come to a deep and
meaningful understanding of the topic. Therefore to further substantiate this study’s claim
that these five vignettes of hands-on astronomy activities are models of exemplary
practice, I asked Dr. John Percy of the University of Toronto, an expert in astronomy
education, to determine if the demonstrations presented could be considered exemplary.
He professed that these demonstrations are exemplary for two main reasons: (1) they are
all 3-dimensional demonstrations of 3-dimensional phenomena, and (2) they allow
learners to consider the phenomena through two different perspectives—the global as
well as the individual perspective. Studies have shown that thinking at different levels (Wilensky and Resnick, 1998) and from different frames of reference (Chandra, Woodruff, Fong, & Percy, 2002; Chandra, Woodruff, Kalchman, Percy, & Yoon, 2001) facilitate the advancement of learner understanding of patterns and phenomena in the world.

The demonstrator in the vignettes is Nalini Chandra, an elementary teacher and doctoral candidate, who specialized in conceptual change and astronomy education. Further consultation with this exemplary astronomy teacher brought to light some common misconceptions among young students of elementary astronomy (see Appendix A for a transcript of the interview). One misconception is the egocentric view that the earth remains stationary while the sun’s movement around the earth causes day and night. Another common misconception is that the sky looks the same for everyone, regardless of their location on earth. As for the phases of the moon, they are commonly misconceived as being the result of the earth’s shadow; and a further misconception about the moon is that people on different parts of the earth—Canada and Australia for example—will see a different type of moon on a given night. In her work, the demonstrator has found that children generally have a poor sense of direction and position with respect to objects in the sky, and this is linked to an inability to see the relationship between the global and individual perspectives of a given phenomenon. Since children have difficulty conceiving the possibility of different perceptions and perspectives of the same phenomena depending on one’s location either on earth or somewhere in the universe, they often are not able to visualize the same phenomena from
different perspectives. The demonstrator stresses that the ability to “move freely between these [individual and global] perspectives...is what makes an astronomer an astronomer”.

In addition to addressing all of the misconceptions the demonstrator has pointed out, a secondary goal for the methodology portrayed in the video vignettes was to immerse learners in the discourse of astronomy. In the vignettes, the demonstrator repeatedly uses such language as: “What you would see if you were in [one particular place], what you would see if you were in [another particular place], and what’s happening with respect to all these objects—the attraction between these objects if you were standing out there [looking at them] from a global point of view”. She contends that this gives learners a type of discourse with which to—“if I can quote Carl Bereiter [in press], ‘Move around within the subject’.... it gives them the tools they need to experiment with things”. By giving learners a linguistic tool as such, we are giving them a way to define and therefore explicate their conceptions (Scardamalia & Bereiter, 1999); making previous tacit perspectives explicit. Furthermore, giving a community of learners one common discourse to work within facilitates knowledge building within this community (Scardamalia & Bereiter, 1999).

An exemplary astronomy lesson must address student misconceptions directly. Since misconceptions about astronomy have been found to be pervasive among pre-service and experienced elementary teachers (Percy, 1999; Woodruff, Kalchman, Chandra, & Percy, 2000; Fong, 2002) it is fair to infer that teachers holding such misconceptions are not aware of student misconceptions of astronomy. The astronomy teaching presented in this study’s video vignettes were designed with student...
misconceptions in mind, and aimed to avoid or extinguish these misconceptions. This is what makes the demonstrations models of exemplary practice.

It is hypothesized that three factors impact the depth to which a teacher will view and process video vignettes of exemplary practice: teaching experience, prior subject-matter knowledge, and directed viewing.

The effect of teaching experience. Amount of teaching experience directly correlates with the depth to which teachers process a video vignette of exemplary practice. Teachers with more experience will be more likely recognize exemplary practice, and to view such practice through the Pedagogy Lens.

The effect of prior subject-matter knowledge. Teachers who possess more subject-matter content knowledge will be less likely to utilize the Content Lens, and more likely to view exemplary practice through the Form Lens and perhaps even the Pedagogy Lens. The deeper a teacher’s understanding of the subject-matter content is, the more likely they are to view video vignettes of exemplary practice through the Pedagogy Lens.

The effect of directed viewing. Prior to viewing video vignettes of exemplary practice, instructing teachers to actively seek out events and actions that are consistent with exemplary practice, will increase teachers’ rate of recognition of such practice as well as the likelihood that teachers will view the vignettes through the Pedagogy Lens.

In summary, folk wisdom would suggest that online digitized video vignettes of exemplary teaching have the potential to deliver sustained, powerful, efficient and flexible professional development for teachers over the internet; in light of impediments associated with workload, distance, cost, time, and shortage of presenters. However, it is postulated that teachers’ professional frames drive them to view vignettes of exemplary
practice through multiple lenses. Indeed, the pilot study suggested that teachers observe video vignettes of exemplary astronomy education through a combination of 3 lenses: Content, Form, and Pedagogy. The follow-up data indicated the presence of a fourth lens—Surface-Level Media. It is further postulated that teachers observing exemplary practice through these lenses will not perceive what they see as being ‘exemplary’. To explore these postulations, two videos containing five vignettes of exemplary astronomy teaching which addressed science topics specified in Ontario’s grade 6 science curriculum were produced. It is thought that these vignettes are models of exemplary practice for a number of reasons: (1) they are all 3-dimensional demonstrations of 3-dimensional phenomena, (2) they allow learners to consider the phenomena through two different perspectives, (3) they were created with student misconceptions in mind, and (4) they immerse learners in the discourse of astronomy. It is hypothesized that three factors impact the depth to which a teacher will view and process video vignettes of exemplary practice: teaching experience, prior subject-matter knowledge, and directed viewing.

In the following chapters, I describe my study design, and discuss the four lenses and their viability as constructs for analyses in chapter two. A summary of the quantitative results derived from statistical tests done on the qualitative data collected are presented in chapter three. An evaluation and interpretation of the research results and a discussion of their implications follows in the fourth and final chapter of this thesis.
CHAPTER TWO: METHOD

Participants

Participants in this study were 11 pre-service teachers and 11 experienced teachers who took part in this study on a voluntary basis. The pre-service teachers were enrolled at OISE/UT in the one-year, post-baccalaureate Primary-Junior (kindergarten-grade 6) division of teacher education. At the time of data collection, the pre-service teachers had completed two months of their program. The experienced teachers had taught anywhere from 6 to 33 years in elementary schools in Toronto, Canada. The mean number of years of teaching experience for this second group was 17 years.

Procedures

All participants were required to attend a one-on-one session with the researcher (see Appendix B for the think-aloud protocol schedule). At the beginning of the session, the participant was introduced to the OISE/UT Astronomy Project (http://www.oise.utoronto.ca/~ewoodruff/). The teacher then completed an online Self-Assessment test (see Appendix C), which is accessible at: http://www.oise.utoronto.ca/~ewoodruff/schedule/schedule.html.

This test is part of the OISE/UT Astronomy Project and consists of 30 astronomy questions, 10 of which speak to the topics addressed in the video vignettes (i.e. “Day and Night” and “Moon Phases”). The online Self-Assessment allows the test-taker to view their results immediately upon completion of the test. Every teacher’s score as well as the particular questions that the teacher answered incorrectly were made note of. This information was used to assess each teacher’s existing general knowledge and understanding of astronomy, as well as their knowledge and understanding of the particular topics addressed in the vignettes, prior to viewing the videos.

14

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.
Following the test, the participant was trained in think-aloud reporting (see Appendix B). This consisted of giving the teacher a deck of playing cards to sort four different ways, according to any rules of their choice, while thinking aloud. The teacher was then directed to give a concurrent verbal report as they viewed the two videos.

Since our objective was to determine what a teacher attends to as they are viewing a video vignette of exemplary practice, it was necessary to elicit verbal data from them as they watched the videos. A think-aloud report is one of two types of concurrent verbal report. In a concurrent verbal report, the cognitive processes, described as successive states of heeded information, are verbalized directly. Ericsson and Simon (1984) claim that cognitive processes are not modified by these reports. Heeded and verbalized information are determined by task-directed cognitive processes. Thus it would seem that concurrent verbal reports are the closest reflection of the cognitive processes when verbal data is called for.

As previously mentioned, our sample population consisted of 22 teachers. Eleven of these were pre-service teachers and the remaining 11 were experienced teachers. To investigate the effects of guided viewing, half of our 22 teachers were given direct instruction just prior to watching the videos. Before they were presented with the videos, each teacher was told that he or she was about to view two video vignettes which are models of exemplary teaching in astronomy. Furthermore, six pre-service teachers and five experienced teachers were then directly instructed to look for characteristics of exemplary practice, as well as pedagogically sound teaching principles in the vignettes. This was our “Directed Viewing” group. The remaining 11 teachers (5 pre-service and 6 experienced) were our “Open-Ended Viewing” group and were given no such
instructions prior to being presented with the videos. This was done to test our hypothesis that directly instructing a teacher to actively seek out characteristics of exemplary practice in astronomy education prior to viewing vignettes of exemplary practice, would significantly aid them in attending to and understanding the underlying functions and purposes of the methodology presented. For a synopsis of a think-aloud protocol session, please refer to Appendix B.

All think-aloud protocols were audio-taped, then transcribed and analyzed to determine aspects of the video vignettes that were attended to by the teachers. Each statement in every teacher’s protocol was then rated according to the lens categorizations described below, and assigned a single lens rating.

Each teacher’s protocol proportions were then analyzed for the different types of lenses utilized. Protocol proportions were considered rather than the raw frequencies of lens-type statements to control for ‘talkativeness’. It was found that the participants varied in the total number statements made throughout their individual protocols. This may very well be due to individual personality types, some people being inherently more talkative, others not so. Moreover, it is possible that some participants were more comfortable thinking aloud than others although all participants were trained to give think-aloud protocols prior to viewing the vignettes. Thus to control for ‘talkativeness’, I have used protocol proportions rather than statement raw frequencies in my quantitative analyses of the data.
Data Analysis

Lenses for Framing and Interpreting the Videos

This study questions if teachers recognize exemplary practice as such when they are presented with it. Furthermore, this study draws on frame theory and argues that teachers' professional frames drive them to view vignettes of exemplary practice through multiple lenses. The pilot study suggested that teachers observe video vignettes of exemplary astronomy teaching through a combination of three lenses: Content, Form, and Pedagogy. A fourth lens, the Surface-Level Media Lens, emerged upon examination of the follow-up data. A discussion of each of the four lenses follows.

Content Lens

When a teacher utilizes a Content Lens to view exemplary practice, they are essentially watching the vignette as a ‘student’ of the subject-matter being taught in the vignette, not as a teacher. Their purpose is to learn about the content that is being presented—not to learn how to teach the content. Thus, our participant views the video vignettes of exemplary practice for their own learning of astronomy, rather than as a teaching tool.

Think-aloud protocol statements which indicate that a teacher is viewing exemplary practice through a Content Lens demonstrate little or no analysis of the form, purpose or function of the astronomy demonstration; but have vague references to the accepted body of knowledge in astronomy. These types of statements may be queries directed at the researcher regarding astronomical topics which the teacher lacks knowledge about, or feels that they may have misconceptions about. They may be commenting on their own understanding of astronomy, or on their understanding of the actual lesson they see being demonstrated.
**Form Lens**

A teacher viewing exemplary practice through the Form Lens is watching the vignettes as a ‘teacher-technician’. They attend to literal events and their think-aloud protocol statements reflect a surface reading of the structure and form of the demonstrations presented. These teachers seem more concerned with the effective management of the learning activity than with the underlying purposes and functions of the exercise. Consideration of the foundations of student learning and deeper analysis of the underlying purpose or function of the astronomy demonstrations are not apparent.

Form Lens statements may evaluative in nature, but they merely evaluate the demonstration’s form. They may be a suggestion for improvement; but the alternative would merely affect the form, structure, or management of the demonstration. The teacher might be an expressing their general like or dislike of the methodology presented, but this is not substantiated with deeper analysis of the exemplary practice.

**Pedagogy Lens**

When video vignettes of exemplary practice are being viewed through a Pedagogy Lens, the teacher is observing the vignettes as a ‘master teacher’. The teacher is processing what they see at a deep level, focusing on the underlying purposes and functions of the demonstrations. It is apparent that the teacher is drawing on their knowledge of learning theory as well as their subject-matter knowledge as they process the vignettes. Furthermore, it is clear that the teacher is thinking beyond the execution of the activity presented, and makes suggestions for lesson extensions.

Statements arising from the use of the Pedagogy Lens during vignette-viewing, shows implicit attention to theories of science teaching and learning. These statements may stem from what Lee Shulman (1986) has termed “pedagogical content knowledge”,

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.
where the teacher not only possesses knowledge of the subject matter, but also knowledge of ways to enhance the teachability of that particular content domain. Any suggestions for modification or improvement to the demonstration would contribute to the function of the activity. Comments expressing a teacher’s like or dislike of the vignettes are substantiated by their knowledge of either one or a combination of educational pedagogy, subject-matter content, and pedagogical content knowledge.

In their efforts to increase the value of the video vignettes themselves as tools for the professional development of teachers, participants viewing these vignettes through the Pedagogy Lens may also draw upon their knowledge of the cognitive processes of learning, to make suggestions for change that would considerably alter the overall format of the videos.

**Surface-Level Media Lens**

A teacher who is viewing the video vignettes through the Surface-Level Media Lens is watching them as a ‘video producer’. Their comments and queries relate strictly to the presentation modality itself, the set, and the demonstrator’s appearance. Such statements are comments relating to background lighting, sound, camera angle, and camera focal points. These statements do not reflect on the overall format of the videos, the form of the demonstrations presented, nor do they reflect on the subject-matter of the lessons.

**Inter-Rater Reliability**

Two raters were given a four page manual which included a description of the types of statements which would correspond to each particular lens, as well as examples of such statements. In addition to the four lens categories, this manual included a fifth
“Miscellaneous—Not Categorized” category. After the raters studied this manual, they were each given 20% (172 statements) of the total number of statements which were randomly selected from the data, and were told to rate the statements according to the categories in this manual. This first round of rating yielded an unacceptable inter-rater reliability of 57%. Upon analysis of the ratings, it appeared that there were too many categories. Furthermore, there seemed to be some confusion among the raters with regards to the Pedagogy Lens (P) and the Form Lens (F) categories. Oftentimes, where one rater would rate a statement as being a ‘P’, the other would rate the same statement an ‘F’ and vice versa. The raters also mentioned that the four page manual was too “overwhelming”.

To address these issues, the “Miscellaneous—Not Categorized” category was deleted from the manual, thereby decreasing the number of categories to four. Every effort was made to refine and improve the defining criteria of ‘F’ lens statements and ‘P’ lens statements. A one page condensed version of the manual was developed, which did not include examples of statements. Two new raters were recruited and trained. Again, their training began with a self-study of the five page second edition categorization manual, which omitted the “Miscellaneous” category (see Appendix D). Unlike our first round of rating, the researcher then discussed each of the 4 lens categories with the raters independently, to clarify any misconceptions and to check for understanding of the categories. These discussions lasted one hour each. The raters were then given the abridged version of the manual (see Appendix E) to be used as a quick reference while rating the statements. After the raters had independently rated a randomly selected
sample of 20% (172 statements) of the total number of statements made by the study’s participants, it was found that 81% of their ratings were in agreement with each other.

There were three interesting trends among the 19% (33 statements) of disagreed-upon ratings. The first and most obvious trend shows itself in 45% of the raters’ disagreements (15 statements); where they categorized the statements as either “Form” or “Pedagogy”, but disagreed between the two categories. That is, rater ‘A’ categorized 11 of these 15 statements as being Pedagogy Lens statements, while rater ‘B’ categorized the same 11 statements as being Form Lens statements. Rater ‘A’ categorized the remaining 4 of these 15 statements as being Form Lens statements, while rater ‘B’ categorized the same four statements as being Pedagogy Lens statements. A second trend is seen in 24% of disagreements (eight statements), where the raters disagreed between the Form Lens and the Surface-level Media Lens categories. Rater ‘A’ categorized six of these eight statements as being Form Lens statements while rater ‘B’ categorized the same statements as being of the Surface-Level Media Lens. The remaining two statements were categorized by rater ‘A’ as being Surface-Level Media Lens statements and categorized by rater ‘B’ as being Form Lens statements. The third trend is apparent in another 24% of the disagreements (8 statements); where the raters were evenly divided on the distinction between Form Lens statements and Content Lens statements. Therefore, post analysis reveals a trend in 94% of the raters’ disagreements (31 out of 33 statements), all involving Form Lens statements. Although an inter-rater reliability of 81% had been achieved on 172 statements, it seems the definition of the Form Lens remains slightly translucent even after revisions and refinements—particularly in the distinction between the Form Lens and the Pedagogy Lens.
Generally, inter-rater reliability of 80% or better is considered acceptable for a widely-used instrument (Carmines & Zeller, 1979). For qualitative data, some even consider inter-rater reliability of at least 70%, or a Cohen’s Kappa of K> 0.70 to be satisfactory (Schmeekle, 2001). Bearing this in mind, I feel that our achieved level of 81% inter-rater reliability on this study’s lens categorizations is acceptable. I therefore conclude that these lenses are a viable and assessable construct for analyses.
CHAPTER THREE: RESULTS

Through quantitative analyses of this study's qualitative data, the effects of three factors on lens-type utilization were investigated: the effect of teaching experience, the effect of prior subject-matter knowledge, and the effect of directed viewing. It is important to note here, that all teachers viewed the video vignettes through a combination of the four lenses. No teacher viewed the vignettes through any one particular lens 100% of his or her viewing time. Of interest to this study is the degree to which teachers employed each lens, and the factors that affect this. The following is a report on the results of these statistical investigations.

The Effect of Teaching Experience

Univariate analyses of variance (ANOVA) were initially conducted to explore the relationship between teaching experience and lens-type utilization. In subsequent consideration of this study's small sample size (N = 22 teachers), Mann-Whitney non-parametric tests were performed to explore the same relationship. Both types of tests yielded similar indications of significance and directions of effect in all cases. Four cases were analysed: teaching experience and protocol proportion of Content Lens statements, teaching experience and protocol proportion of Form Lens statements, teaching experience and protocol proportion of Pedagogy Lens statements, and lastly, teaching experience and protocol proportion of Surface-Level Media Lens statements.

Teaching Experience and Content Lens

From the Mann-Whitney non-parametric test of the effect of teaching experience on the think-aloud protocol proportion of content lens statements, I used a z-score approximation to the Mann-Whitney test and attained a Z-value of -2.344. The P-value is 0.019. Thus it can be concluded that there exists a significant relationship between
teaching experience and protocol proportion of Content Lens statements. With respect to the proportion of a protocol containing Content Lens statements, pre-service teachers have a higher median than experienced teachers, based on the sum of ranks. Hence, the direction of effect shows that pre-service teachers made significantly more Content Lens statements than experienced teachers.

Did the pre-service teachers make more Content Lens statements because they had less prior subject-matter knowledge? Did the experienced teachers make less such statements simply because they were not concerned with the subject-matter presented? To investigate these questions, an analysis of covariance (ANCOVA) was done to explore the partial effect of teaching experience on the protocol proportion of Content Lens statements, after controlling for teacher performance on the astronomy self-assessment. The ANCOVA results were then compared with results from an ANOVA test between teaching experience and protocol proportion of Content Lens statements. Table 1 is a summary of these results.
Table 1

ANOVA results of Teaching Experience and Protocol Proportion of Content Lens Statements and ANCOVA results of the same variables after covarying Teacher Performance on the Astronomy Self-assessment

<table>
<thead>
<tr>
<th></th>
<th>ANOVA</th>
<th>ANCOVA</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>F</strong></td>
<td>4.55 (1,20)</td>
<td>5.44 (1,19)</td>
</tr>
<tr>
<td><strong>P-value</strong></td>
<td>0.045</td>
<td>0.031</td>
</tr>
<tr>
<td><strong>Partial R²</strong></td>
<td>0.186</td>
<td>0.223</td>
</tr>
</tbody>
</table>

Mean Protocol Proportion of Content Lens Statements

(Pre-service Teachers)

ANOVA: 32.008%
ANCOVA: 32.757%

Mean Protocol Proportion of Content Lens Statements

(Experienced Teachers)

ANOVA: 13.702%
ANCOVA: 12.953%

Since the P-value is lower and the $R^2$ is higher in the ANCOVA as compared to the ANOVA, it can therefore be concluded that the effect of teaching experience is stronger in the ANCOVA test than in the ANOVA test.

**Teaching Experience and Form Lens**

A z-score approximation to the Mann-Whitney test was used, and a Z-value of -0.986 was attained. Since the P-value is 0.324, there is no significant relationship between teaching experience and protocol proportion of Form Lens statements.

With respect to the protocol proportion of Form Lens statements, it can be concluded that pre-service teachers have a higher median than experienced teachers,
based on the sum of ranks. Although the pre-service teachers made more Form Lens statements than the experienced teachers, they did not make significantly more.

**Teaching Experience and Pedagogy Lens**

A Z-value of -2.134 was attained by using a z-score approximation to the Mann-Whitney test. Since the P-value is 0.033, it can be concluded that there is a significant effect between teaching experience and the proportion of a protocol containing Pedagogy Lens statements. Based on the sum of ranks, I know that experienced teachers have a higher median than pre-service teachers with respect to the proportion of a teacher’s protocol containing Pedagogy Lens statements. Hence the direction of effect indicates that experienced teachers made significantly more Pedagogy Lens statements than their pre-service counterparts.

Did the teachers who made fewer statements in total, actually make a large proportion of Pedagogy Lens statements in their protocols? This question prompted me to do an ANCOVA to explore the partial effect of teaching experience on the protocol proportion of Pedagogy Lens statements, after controlling for the total number of statements in a protocol. These results were then compared to our ANOVA test between teaching experience and protocol proportion of Pedagogy Lens statements. Table 2 is a summary of these results.
Table 2

ANOVA results of Teaching Experience and Protocol Proportion of Pedagogy Lens Statements and ANCOVA results of the same variables after covarying Total Number of Statements

<table>
<thead>
<tr>
<th></th>
<th>ANOVA</th>
<th>ANCOVA</th>
</tr>
</thead>
<tbody>
<tr>
<td>F</td>
<td>4.906 (1,20)</td>
<td>5.468 (1,19)</td>
</tr>
<tr>
<td>P-value</td>
<td>0.039</td>
<td>0.030</td>
</tr>
<tr>
<td>Partial R²</td>
<td>0.197</td>
<td>0.223</td>
</tr>
<tr>
<td>Mean Protocol Proportion of Pedagogy Lens Statements (Pre-service Teachers)</td>
<td>20.841%</td>
<td>20.372%</td>
</tr>
<tr>
<td>Mean Protocol Proportion of Pedagogy Lens Statements (Experienced Teachers)</td>
<td>40.314%</td>
<td>40.784%</td>
</tr>
</tbody>
</table>

Since the P-value is lower and the $R^2$ is higher in the ANCOVA as compared to the ANOVA, I can therefore conclude that the effect of teaching experience is stronger in the ANCOVA test than in the ANOVA test.

**Teaching Experience and Surface-Level Media Lens**

A z-score approximation was used to the Mann-Whitney test to attain a Z-value of -0.592. Since the P-value is 0.554, I can conclude that there is no significant relationship between teaching experience and the proportion of a teacher’s think-aloud protocol containing Surface-Level Media Lens statements.

With respect to protocol proportion of Surface-Level Media Lens statements, experienced teachers have a slightly higher median than pre-service teachers, based on the sum of ranks. However, this direction of effect is too insignificant to be remarkable.
Teaching Mean Score Standard Number of
Experience (%) Deviation Teachers

Experienced 47.27 14.18 11
Pre-service 50.18 7.57 11
All Teachers 48.73 11.19 22

Univariate analysis of variance indicated no significant differences in test performance between experienced and pre-service teachers.

Of the 30 questions, only 10 pertained to the topics addressed in the videos (see Appendix C for a listing of the 10 pertinent questions). Table 4 summarizes teacher performance on these 10 questions:

Table 4
Teacher Performance on Questions Pertaining to Topics in the Videos

Teaching Mean Score Standard Number of
Experience (%) Deviation Teachers

Experienced 55.45 19.68 11
Pre-service 50.00 18.97 11
All Teachers 52.73 19.07 22
As with overall performance on the self-assessment, univariate analysis of variance indicated no significant differences between experienced and pre-service teachers' performance on the 10 questions in the self-assessment that pertained to the topics addressed in the videos. It would seem that teaching experience does not affect teacher performance on the astronomy self-assessment, and does not predict the amount of prior subject-matter knowledge a teacher possesses.

To investigate the possibility that prior subject-matter knowledge influences the type of lens through which a teacher will view vignettes of exemplary practice, I did 16 Pearson correlation tests, with consideration given to teachers' overall performance on the 30 questions in the astronomy self-assessment, and their performance on the 10 questions in the self-assessment that pertained to the material presented in the videos. Both these independent variables were then correlated with each of the four lens variables. The lens variables were the protocol proportions of each of the four lens types, as well as the statement raw frequencies of the four lens types.

Pearson correlation tests yielded no significant relationship between a teacher's overall performance on the self-assessment and the proportion of their think-aloud protocol containing statements of any particular lens type. Similarly, I found no significant relationship between a teacher's performance on questions in the self-assessment which pertain to the material presented in the videos, and the proportion of their protocol containing statements of any particular lens type. I found the same results when I considered the raw frequencies of statement types in a protocol, rather than the proportion of a protocol containing statements of a particular lens type.
However, there was one exception out of the possible 16 cases: a significant relationship between overall performance on the self-assessment and the raw frequency of Pedagogy Lens statements. Tables 5 and 6 summarize the results of my quantitative analyses of the effect of prior subject matter knowledge on the lens type teachers used to view video vignettes of exemplary practice.

Table 5

Results of Pearson correlation tests between test performance and proportion of different lens statements in a think-aloud protocol

<table>
<thead>
<tr>
<th>Self-Assessment Performance of 22 Teachers</th>
<th>Proportion of a Think-Aloud Protocol</th>
<th>Content</th>
<th>Form</th>
<th>Pedagogy</th>
<th>Surface-Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>All Questions</td>
<td>Pearson Correlation</td>
<td>-0.203</td>
<td>-0.199</td>
<td>0.265</td>
<td>0.117</td>
</tr>
<tr>
<td></td>
<td>P-Value</td>
<td>0.365</td>
<td>0.375</td>
<td>0.234</td>
<td>0.605</td>
</tr>
<tr>
<td>Pertinent Questions</td>
<td>Pearson Correlation</td>
<td>-0.115</td>
<td>-0.209</td>
<td>0.354</td>
<td>-0.163</td>
</tr>
<tr>
<td></td>
<td>P-Value</td>
<td>0.612</td>
<td>0.350</td>
<td>0.106</td>
<td>0.468</td>
</tr>
</tbody>
</table>

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.
Table 6

Results of Pearson correlation tests between test performance and raw frequencies of different lens statements in a think-aloud protocol

<table>
<thead>
<tr>
<th>Raw Frequencies of Statements in a Think-Aloud Protocol</th>
</tr>
</thead>
<tbody>
<tr>
<td>Performance of 22 Teachers</td>
</tr>
<tr>
<td>Self-Assessment</td>
</tr>
<tr>
<td>Content Lens Correlation</td>
</tr>
<tr>
<td>Form Lens Correlation</td>
</tr>
<tr>
<td>Pedagogy Lens Correlation</td>
</tr>
<tr>
<td>Surface-Level Media Lens Correlation</td>
</tr>
<tr>
<td>All Questions</td>
</tr>
<tr>
<td>Pearson Correlation</td>
</tr>
<tr>
<td>0.114</td>
</tr>
<tr>
<td>All Questions</td>
</tr>
<tr>
<td>P-Value</td>
</tr>
<tr>
<td>0.613</td>
</tr>
<tr>
<td>Pertinent Questions</td>
</tr>
<tr>
<td>Pearson Correlation</td>
</tr>
<tr>
<td>0.040</td>
</tr>
<tr>
<td>Pertinent Questions</td>
</tr>
<tr>
<td>P-Value</td>
</tr>
<tr>
<td>0.860</td>
</tr>
</tbody>
</table>

*Correlation is significant at the 0.05 level (2-tailed).

**The Effect of Directed Viewing**

Recall that six pre-service and five experienced teachers were given direct instructions to look for pedagogically sound teaching principles and aspects of exemplary practice in astronomy education, prior to be presented with the videos. This was the “Directed Viewing” group. The remaining 11 teachers (5 pre-service, 6 experienced) were given no such instructions, and constituted the “Open-Ended Viewing” group.

I conducted two-way ANOVAs to probe: (1) the interaction between directed viewing and teaching experience, and (2) the relationship between protocol proportion of each of the four lens-type statements and directed viewing. In all tests, teaching experience and directed viewing were fixed factors.
Directed Viewing and Content Lens

When considering the interaction F-test from the two-by-two analysis of variance with respect to interaction between view type and protocol proportion of Content lens statements, I find the effect of view type does not depend upon teaching experience \([F(1,18) = 0.002; \text{ns}; R^2 = 0]\). Conversely, the effect of teaching experience does not depend upon view type. Therefore, there is no significant interaction between view type and teaching experience. From examination of the directed viewing F-test, it is evident that there is no significant relationship between view type and protocol proportion of Content lens statements \([F(1,18) = 0.741; \text{ns}; R^2 = 0.04]\). Figure 1 is a profile plot illustrating the direction of effect in light of teaching experience and viewing instructions.

Estimated Marginal Means of Content Lens Protocol Proportions

![Graph showing estimated marginal means of Content Lens protocol proportions](image)

*Figure 1.* Direction of effect for Content Lens proportion with respect to teaching experience and viewing instructions.

Directed Viewing and Form Lens

The interaction F-test in the two-way ANOVA of directed viewing and protocol proportion of Form Lens statements shows the effect of directed viewing does not depend
upon teaching experience \( [F (1,18) = 0.077; \text{ns}; R^2 = 0.004] \). Conversely, the effect of teaching experience does not depend upon directed viewing. Hence, there is no significant interaction between view type and teaching experience. The directed viewing F-test shows no significant relationship between directed viewing and protocol proportion of Form lens statements \( [F (1,18) = 0.827; \text{ns}; R^2 = 0.044] \). Figure 2 is a profile plot illustrating the direction of effect in light of teaching experience and viewing instructions.

**Figure 2.** Direction of effect for Form Lens proportion with respect to teaching experience and viewing instructions.

**Directed Viewing and Pedagogy Lens**

As expected, from the two-by-two analysis of variance with respect to interaction between view type and proportion of a protocol containing Pedagogy lens statements, I find that the effect of directed viewing does not depend upon teaching experience \( [F (1,18) = 0.046; \text{ns}; R^2 = 0.003] \). Conversely, the effect of teaching experience does not depend upon view type. Therefore, there is no significant interaction between directed viewing and teaching experience. From the same ANOVA, with respect to directed
viewing and proportion of a protocol containing Pedagogy Lens statements, I find a significant relationship between view type and proportion of a protocol containing Pedagogy Lens statements \([F(1, 18) = 4.157; \text{P-value} = 0.056; R^2 = 0.188]\). Figure 3 is a profile plot illustrating the direction of effect in light of teaching experience and viewing instructions.

![Profile Plot](image)

**Figure 3.** Direction of effect for Pedagogy Lens proportion with respect to teaching experience and viewing instructions.

**Directed Viewing and Surface-Level Media Lens**

Again as expected, the interaction F-test from this two-way ANOVA between view type and Surface-Level Media lens proportion, reveals that the effect of directed viewing does not depend upon teaching experience \([F(1, 18) = 0.308; \text{ns}; R^2 = 0.017]\). The converse is also true. I conclude that there is no significant interaction between directed viewing and teaching experience. Turning to the directed viewing F-test of the same two-way ANOVA, I find no significant relationship between view type and the proportion of Surface-Level Media Lens statements found in a teacher's protocol when...
considering the numerical result from my data analyses \( F(1,18) = 0.268; \ ns; R^2 = 0.015 \). However, the profile plot of estimated marginal means of Surface-Level Media Lens statements suggests significant findings. This discrepancy may perhaps be a result of the low power of influence that is characteristic of the small sample size \( (N=22) \) used in this study. Figure 4 is a profile plot illustrating the direction of effect in light of teaching experience and viewing instructions.

![Estimated Marginal Means of Surface-Level Media Lens Proportions](image)

**Figure 4.** Direction of effect for Surface-Level Media Lens proportion with respect to teaching experience and viewing instructions.
CHAPTER FOUR: DISCUSSION

The goal of this research was to investigate if teachers perceive and recognize exemplary practice when they are presented with it, and the factors that contribute to this. Teachers’ think-aloud protocols were examined to determine what they attended to as they observed video vignettes of exemplary astronomy teaching. Schön (1983) claims that the features to which a practitioner attends as well as the order to which they impose on a situation occurs as they frame the problem of the situation. From this, it is logical to infer that determining what teachers attended to will indicate how they framed the videos they observed. The findings suggest that teachers do not necessarily attune to the exemplary practice, and that teachers bring to bear a number of tacit frames—‘lenses’—when they observe video vignettes modelling such methodology. They are: Content, Form, Pedagogy, and Surface-Level Media.

I had hypothesized that more teaching experience, more prior subject-matter knowledge, and directed viewing; would all contribute to the likelihood that a teacher would achieve a deep reading of the actions and events they observed. However, the data show that of the three variables, only teaching experience had a significant impact for three out of the four lenses. Prior subject-matter content knowledge has no effect, and directed viewing has only a modest effect on one out of the four lenses—utilization of the Pedagogy Lens.

Teaching experience has an impact on all lenses except for the Surface-Level Media Lens. This exception comes as no surprise as this particular lens requires no knowledge of teaching or the subject-matter content to be utilized. Pre-service teachers bring the Form Lens to bear on observation of exemplary practice moderately more than experienced teachers. The most divergent lens usages between the two groups of
teachers are the Content Lens and the Pedagogy Lens. That is, pre-service teachers watched the vignettes to gain subject-matter content knowledge more so than experienced teachers, while experienced teachers achieved a deeper, more pedagogical reading of the vignettes more often than pre-service teachers.

Initial data analysis prompted further questions. Upon consideration of the less talkative teachers, I wondered if a large proportion of what they did say were Pedagogy Lens statements. If so, this would have statistical consequences to my data analyses because I focused on lens-type proportions of protocols, rather than lens-type raw frequencies to control for "talkativeness". However, post analysis with total raw frequencies of statements as a covariate revealed that the effect of teaching experience on Pedagogy Lens proportions actually strengthened. I conclude that talkativeness does not affect the likelihood of a teacher bringing to bear a Pedagogy Lens upon viewing vignettes of exemplary practice.

Initial data analysis also spurred more curiosity about the relationship between teaching experience and Content Lens utilization. Recall that the mean performance of all teachers on the online astronomy self-assessment was 48.73%, and that pre-service teachers did not do significantly better or worse than their experienced counterparts. This indicates that the sample uniformly did not have much content knowledge to begin with. With this in mind, one would assume that both groups would then spend a greater proportion of their time watching the video vignettes through the Content Lens, in order to gain subject-matter knowledge that was obviously lacking. Although the pre-service teachers did so to some degree, this was generally not the case for the experienced teachers. Post analysis with prior knowledge as a covariate shows that the effect of
teaching experience on the utilization of the Content Lens becomes even stronger. Thus, the ANCOVA does not support the idea that prior subject-matter content knowledge has an effect on the relationship between teaching experience and utilization of the Content Lens.

What are some possible reasons for the disparity between pre-service and experienced teachers' attention to subject-matter content while observing the vignettes? Conceivably, pre-service teachers have difficulty recognizing characteristics of teaching methodology, and when they do, they rarely recognize the deeper underlying purposes of the teaching methods they observe. This perhaps results in their higher tendency to view vignettes of exemplary practice as students of the subject-matter content being presented. Bearing in mind that the data were collected just after the pre-service teachers had completed their second month of a ten month teacher preparation program, another possibility is that the pre-service teachers had not yet fully developed a self-identity of "Teacher", but rather still saw themselves as "Student". Thus they viewed video vignettes of exemplary teaching not as Teachers, but as Students with the accustomed goal of attaining subject-matter content knowledge. However, if given a directive prior to viewing, pre-service teachers will make more Pedagogy Lens statements than if they are not given such a directive. Experienced teachers may not be overly concerned with subject-matter content knowledge. Perhaps they have learned to rely solely on the teaching skills they have developed over the years, and have come to the conclusion that they are effective teachers in spite of neglecting their own subject-matter knowledge of the domains they teach. These are possible explanations for the drastic disparity in pre-
service and experienced teachers' usage of the Content Lens. Further research is needed to explore this issue.

As previously stated, results show that prior subject-matter knowledge does not affect the type of lens through which a teacher will view video vignettes of exemplary teaching. There was, however, one exception out of a possible 16 cases: a significant relationship between overall performance on the astronomy self-assessment ("quiz score") and the raw frequency of Pedagogy Lens statements in a protocol. A possible interpretation of this finding can be attributed to chance occurrence. If rejection is hypothetically set at 5%, it follows that one significant correlation out of 20 cases would be attributed to chance alone. One significant correlation found out of a possible 16 cases in this study's analyses of prior subject-matter knowledge effects is statistically close to 1/20. Hence this single exception may just be a chance occurrence, so the following is somewhat speculative. However, if this single exceptional case is not a chance occurrence, the reader must note that the 22 teachers in this study had limited subject-matter knowledge to begin with, as evidenced by their performance on the astronomy self-assessment (mean overall self-assessment score: 48.73%, mean score on questions pertinent to the vignettes: 52.73%). Thus if there exists an effect between prior subject-matter knowledge and lens type utilization, it may not be detectable in this particular study due to the sample population's limited knowledge of astronomy.

Limitations of the Study

A number of limitations relate to this study's sample. The small sample size translates to low statistical power. This may have been a major explanation for the discrepancy between numerical results from the data analysis of the effect of directed
viewing on Surface-Level Media Lens utilization; which indicate no significant findings, and the corresponding profile plot (Figure 4) which indicates significance.

However, I still found consistent results from parametric and non-parametric tests given the low statistical power of this study; demonstrating that teaching experience impacts the utilization of the Content, Form, and Pedagogy lenses. This suggests that a follow-up study using a larger sample size, thereby increasing statistical power, would certainly amplify this particular finding.

A second limitation stemming from the sample population relates to the amount of teacher education the pre-service teachers had undergone. At the time of data collection for this study, these teacher candidates had completed 2 months of their 10 month program. It would be interesting to see if pre-service teachers observe exemplary practice significantly differently at the completion of their teacher preparation program.

The third limitation due to the sample is that there wasn’t enough variability in prior subject-matter knowledge among our teachers. They all had very limited knowledge of astronomy. Future research must include teachers possessing deep understanding of the subject-matter content in their sample.

Since the video vignettes in this study addressed only one subject domain—astronomy—this study’s findings may not be generalizable to teacher observations of exemplary practice in other subject domains. Perhaps if the video vignettes were of a subject that is more intuitive to teach, I may get more protocol statements indicating that the exemplary practice was viewed as intended—through the Pedagogy Lens.
Implications for Future Research

Consistent with MacLachlan and Reid’s (1994) thoughts on film viewers’ process of constructing meaning, teachers in this study drew on their existing repertoire of exemplars to frame video vignettes of exemplary astronomy teaching. These tacit frames the teachers brought to their viewing experience have, for the most part, shown that models of exemplary practice used in this study were not perceived the way they were intended to be. That experienced teachers in the present study were more likely to view the vignettes through the Pedagogy Lens than preservice teachers, may be an indication that they have developed more pedagogical content knowledge over the years, allowing them to unconsciously draw on this bank as they framed what they saw. However, the low astronomy pretest scores indicate that whatever pedagogical content knowledge these experienced teachers possessed, their knowledge of pedagogically sound teaching principles far outweighed their knowledge of the subject-matter content. Conversely, since preservice teachers have not yet developed much pedagogical content knowledge; it may follow that they do not have as rich a repertoire of such knowledge which would allow them to frame the vignettes via the Pedagogy Lens. This would indicate that when teachers are presented with notions or situations that fall outside of their existing tacit frames, they fail to understand models of exemplary practice as they are intended to be. Indeed, the following statement from Schön (1983) would certainly support this argument:

When practitioners are unaware of their frames for roles or problems, they do not experience the need to choose among them. They do not attend to the ways in
which they *construct* the reality in which they function; for them, it is simply the given reality. (p. 310)

He goes on to assert that it is only when one becomes aware of one's own frames that we may also become aware of the possibility of framing our reality in alternate ways. The implications of Schön's work on this study, leads me to suggest that teachers must be made explicitly aware of their tacit professional frames. Only then can there be conceptual change in teachers, as well as an increased likelihood that they will view video vignettes of exemplary practice through the Pedagogy Lens and indeed recognize the exemplary practice as such. This is consistent with this study's statistically significant finding (P-value = 0.056) that, directing a teacher to look for aspects of exemplary practice prior to presenting them with the videos will result in a higher proportion of Pedagogy Lens statements in his or her think-aloud protocol.

One way to make teachers aware of their professional frames prior to watching video vignettes of exemplary astronomy teaching would be to show them this study's manual of lens categorizations (Appendix D), emphasising that they are to view the vignettes through the Pedagogy Lens. This would not only foster awareness of other possible frames, but also provide a clear description and exemplar statements of the Pedagogy Lens. A second possibility would be to preface each vignette with a discussion on student misconceptions in astronomy and how that particular demonstration would address those misconceptions. As previously stated, an exemplary lesson should address student misconceptions. However, if a teacher is not aware of what the student misconceptions are, they are not likely to recognize the exemplary practice presented to them. I believe that the latter route would be more effective in fostering conceptual
change in teachers, and helping them to recognize exemplary practice when it is presented to them. Further research is needed to verify this.
SUMMARY

Folk wisdom would suggest that online digitized video vignettes of exemplary teaching have the potential to deliver sustained, powerful, efficient and flexible professional development for teachers over the internet; in light of impediments associated with workload, distance, cost, time, and shortage of presenters. This study explored the use of video vignettes as a tool for the professional development of teachers. It was postulated that teachers' professional frames drive them to view vignettes through multiple lenses, and that teachers may not recognize the exemplary practice when presented with it. In this study, a qualitative/quantitative hybrid design was used to collect data on the video elements that 11 pre-service and 11 experienced teachers attended to as they observed exemplary astronomy teaching vignettes. Data sources included pretest astronomy scores and think-aloud protocols. Quantitative results derived from statistical analyses of the qualitative data suggest that teaching experience significantly influences the type of lens through which a teacher will observe vignettes of exemplary practice. There is also some evidence to suggest that, prior to viewing a vignette, instructing a teacher to actively seek out characteristics of exemplary practice aids them in attending to the underlying functions and purposes of the methodology presented.

The research findings confirm the original two postulations. Teachers in this study drew on their existing repertoire of exemplars to frame video vignettes of exemplary astronomy teaching, causing them to observe the vignettes through multiple lenses. When teachers are presented with notions or situations that fall outside of their existing tacit frames, they fail to understand models of exemplary practice as they are
intended to be. That is, the teachers rarely recognize the exemplary practice presented to them as being 'exemplary'.

I suggest that teachers must be made explicitly aware of their tacit professional frames. This is in recognition of two rationale: (1) Schön’s (1983) contention that it is only when we become aware of our own frames that we may also become aware of the possibility of framing our reality in alternate ways, and (2) this study’s statistically significant finding (P-value = 0.056) that directing a teacher to look for aspects of exemplary practice prior to presenting them with the videos will result in a higher proportion of Pedagogy Lens statements in his or her think-aloud protocol. Only by making teachers explicitly aware of their own tacit professional frames can there be conceptual change in teachers, as well as an increased likelihood that they will view video vignettes of exemplary practice through the Pedagogy Lens and indeed recognize the exemplary practice as such. Unlike an exemplary astronomy teacher, the tacit professional frames of other teachers seeking support in astronomy education methodologies will not likely include knowledge of student misconceptions in astronomy. Since an exemplary lesson must necessarily address student misconceptions, I further suggest that video vignettes modelling exemplary practice be prefaced with a discussion on how that particular demonstration addresses specific student misconceptions.

The findings of this study indicate that further research is needed to explore ways to make teachers aware of their tacit professional frames and how this new awareness affects the extent to which teachers recognize exemplary practice when presented with video modelling of it.
REFERENCES


Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.


APPENDIX A: INTERVIEW WITH THE EXEMPLARY TEACHER

The following is a transcript of an interview conducted by the researcher, Cresencia Fong (CF); on the exemplary teacher (ET) portrayed in the videos used in this study. This demonstrator is an elementary teacher and an OISE/UT doctoral candidate who specialized in conceptual change and astronomy education. The interview occurred on Thursday, May 16, 2002. The demonstrator was asked to view the videos and to concurrently comment on the exemplary practice presented in the vignettes.

First Video: Day and Night

Vignette 1: What causes day and night? (Global Perspective)

ET: First of all, I think this is sort of the typical way of teaching, but I think that what is different about this is that I purposely started talking about the different countries, which I think kids have some kind of ideas about different countries, different time zones—because they’ve done a lot of traveling—so relating that back to them and this whole idea about astronomical phenomena, I think is really good, as far as them getting to think about where those ideas are coming from. So when you start talking about different countries on the other side of the world, like Australia, it starts to draw out some of those preconceptions or preconceived ideas that they’ve already been expose to through watching the Olympics for example at midnight, and things like that. It starts to draw out those things. I think that helps when you start to talk about those things.

ET: I don’t think, from my experience, it’s so funny—but even though you’re showing them this idea that it’s the earth turning, they still don’t get it just with this. Kids tend to believe that they, or the earth rather, is stationary, and it is the sun’s movement around the earth that causes day and night. But I think they do understand the idea of the
difference between day and night, and it has to be in a very, very dark room, like it is there [in the video]. So I think that’s good. And the whole idea of showing a stationary sun and the global perspective is what makes this your typical way of teaching. In my experience, I have found that a common misconception among kids is that the sky looks the same for everyone, regardless of their location on earth. So the fact that I keep moving back and forth between different places [countries]—sort of instils that everybody doesn’t see the same thing at the same time, that, depending on where you are, things in the sky are going to look different. So that’s probably what’s best about showing this [global] perspective.

ET: So it definitely drives home that point—about what causes day and night. It tries to get away from the idea that the sun is moving, by having the stationary sun in the model. That’s why I think this is a good piece.

**Vignette 2: Rising in the East, Setting in the West (Individual Perspective)**

ET: What I think is exemplary about this lesson is that it will start to get the students involved and actually what I’ve seen happen is there’s so much, when you think it’s probably going to be easy to show it actually brings out a lot of confusion and I think that’s what’s particularly exemplary about this. It’s not just a demonstration that you can show. This person [demonstrator] might as well be a globe. But when you start to put the kids in that position—becoming the earth—and then they have the East and West signs in their hands, you start talking about what I think is really important in astronomy and that’s direction and position. In my work, I have found that kids generally have a poor sense of direction and position with respect to objects in the sky. To address this,
we have the earth as a position, and we've got these things that are directions which we take for granted—the sun rising in the east and setting in the west—how does that happen? They really struggle when asked to consider the question: “How does the sun appear to rise in the east and set in the west?” In order to understand this, they need to consider the phenomenon from the global as well as the individual perspectives, and to jump back and forth between the two perspectives. Such cognitive acrobatics usually does not come naturally to kids. So by getting them to hold East and West signs in their hands and try to orient their bodies to make the sun rise in the east and set in the west, I think it gives them a very individualistic perception of what’s happening to that sun. They have to start to coordinate both what they just saw—the outside [global] perspective—and what they’re doing with their own bodies. So it becomes a very temporal experience. But for them to truly understand it, they have to see the relationship between the local perspective and the global perspective. A big problem is that kids don’t see this relationship. I think the only way students can be aware of [whether or not] they’re understanding it, is if they use this stuff and they really try and think about it in the sense that, “Okay we just saw that the earth is the only thing that’s turning, and how is it [the sun] moving?” Because I think that’s what’s missing from the last lesson—that they see it from that perspective, but that means nothing to them as far as standing on earth and seeing the sun move. So this just gives them another thing, but I’ve found that it becomes really confusing in itself because they’re so used to looking at a globe and people on a globe [and they wonder] how that sun’s moving, that the confusion that will arise around this will raise a lot of discussion. And it will probably—what happened with—this is where I decided to start on the whole idea of putting a globe [on their
bodies] so they can understand that there’s certain parts of the world—so you put North
America on their front, Australia on their back—so they really become the globe. I think
this [demonstration] leads into that whole idea about where things are on the globe. And
it’s certainly, if they go further, it can lead into a further discussion about the earth being
round and why do people on certain parts of the earth see it differently. So as a starting
lesson, to draw out confusion and preconceptions, [that’s why] I think this [activity] is
really, really good. Aside from just showing other different perspectives, it starts to get
them to think about motion, direction, perception—all those things which I think are all
part of astronomy. And that’s the basis of why we have so much confusion in astronomy.

CF: Do you mean ‘perception’ or ‘perspectives’?

ET: Perspectives. Perception. Perceptual in the sense that what they saw there [Vignette
2] is different from what they saw there, in the previous lesson—and it’s different from
what they’re going to be experiencing in this one [Vignette 2] and the first one [Vignette
1]. So—perception and perspectives—all those things—kids are often not aware that
different perceptions and perspectives of the same phenomena could arise, depending on
one’s location. And because they are not aware of this, they often aren’t able to visualize
any given phenomena from different perspectives. I think astronomy, when you start to
get down to the nitty gritty, is basically about how effectively you can visualize these
things. And it’s not until you get really expert in it—being able to move freely between
these perspectives, I think is what makes an astronomer an astronomer, as opposed to a
lay person that could just say, “Well the earth turns and that’s why we have sun.” So
what these [demonstrations] start to do, is they start to get kids thinking about those things, talking about perceptions and perspectives. Once they begin to discuss these issues, the idea of perspectives comes to the forefront and the kids become consciously aware of something that had only been tacit before. As their awareness increases, their ability to conceive of, or visualize celestial events from different perspectives increases. For example, in one of my classes, I had a great discussion about what east, west, north and south is. It came up out of this [Vignette 2]. And that whole discussion helped us to get past this idea that north is not always up. When you look at the globe, north is not always up. If you’re in the South Pole, there could be an ‘up’ there too. So it’s that whole thing, and ‘east’ and ‘west’ are relative terms. Both things really set the stage for how we were going to discuss other concepts, or how we were going to continue to discuss those things. So definitely that’s what is exemplary about this is that, it draws different types of discourse.

*Second Video: Moon Phases*

**Vignette 3: Modelling Moon Phases (Global Perspective)**

ET: So this is really good in the sense that I’m [the demonstrator is] talking about what *someone* would see if they’re standing on earth. That’s a really god thing because what happens I think, in most lessons or textbooks, is they start to present students with all these different types of perspectives without giving the discourse with it. If you were to open up some of the recent textbooks, they’ll show what a person would see from earth, around the phases of the moon where they are with respect to the earth. I’ll show you the picture if I have an astronomy book. If a student is just reading that, it’s really difficult to jump from one perspective to another perspective. So this whole reinforcing of what you would see if you were standing here [on the earth], as opposed to what you would see if
you were standing out in space, gets them thinking about, “Okay I have to change my perspective in order to understand that.” Most of them probably won’t, but at least it will get them to begin to think about—it’s a good orienting tool—is to try and picture what you would see. Typically, I think ‘Piagetian’-wise, they should be able to make that leap, but I think it’s hard for most of them. You have start putting in that thing about, “What you would see if you were standing here,” and then look at—what I think happens is many kids look at these demonstrations from an outside perspective and they just see a half moon instead of a new moon, because there’s light shining here, and this side is dark, so they’ll just sat, “That must be a half moon,” but the idea about what you see if you’re standing here, on the light side of the earth. And that’s when you have a new moon, when it’s in the daytime. See that’s another thing that can be brought up, because they always say, “Well why is that we have—you can sometimes see the moon in the daytime and the night time?” I think this kind of set-up is perfect for that, once you start talking about “what you would see if”.

CF: But in a new moon, they wouldn’t see any moon.

ET: That’s right, that’s right. So at night—this would be a new moon, so there’d be no moon [to see]. But in the daytime—see sometimes in the daytime, you can see a quarter moon. I forget which one it is, and there are different positions around what time you see a moon. Like sometimes [we see] the moon is in the early evening, and then sets. If it’s here, then it’s a different—it sets in the later evening, or the early morning. Or if it rises in the early morning, it sets early noon. It all goes back to that whole idea of “what
you’re seeing when it’s in a particular position”. So I think once—so why would people see these different phases? It’s the moon that’s going around—this is stamping out probably one of the biggest misconceptions that the earth’s shadow causes phases of the moon. Which is really good, in the sense that I’m [the demonstrator is] talking about the orbit, and I think I [in the video] talk—she [the demonstrator] talks about the difference between ‘phases’ and ‘eclipses’ too. So let’s go on.

ET: So that’s the whole thing about position of the moon.

ET: You see that whole thing about how she’s moving her head to sort of pretend that she’s the person standing on earth? I think that’s something that kids can model after, and they’ll do that. And I think that’s the purpose of the next lesson [Vignette 5] in particular, with the Styrofoam ball—that you have to see it from the perspective of someone on earth—the ‘local’ or ‘individual’ perspective, as well, they’re probably from—this lesson—when I’m [the demonstrator is] standing up here demonstrating it—it gives them that whole other global perspective; that it’s the moon that’s moving. The sun is still hitting the moon all different places, it’s not the earth that’s blocking it out and that’s an eclipse. That’s what’s different.

ET: So that whole idea about “what we would see…”, “the sun is shining on…”—that whole type of talk, that type of discourse—is the type that you want kids to start to get accustomed to talking about. So what’s good about what I’m [the demonstrator is] doing here, is that I’m trying to immerse them into the discourse of astronomy, which is, “What
you would see if you were in one particular place, what you would see if you were in another particular place, and what’s happening with respect to all these objects—the attraction between these objects if you were standing out [looking at them] in [from] a global point of view”. So [here] I’m immersing them into that discourse, whereas a textbook—just presenting them different perspectives doesn’t do that as well. And the whole idea of how she [I the demonstrator] is turning her head, to pretend that she’s a person standing on earth, and looking at it [the moon or the sun]—I think that would really help—and showing that this part is lit, this part is not. It really leads into some great discussions about, “Well, why do we only see a full moon in the night time, and which moon is it that we see in the daytime? Why don’t we see a moon sometimes?” So that leads into a lot of these things. So you can use this whole outside perspective to draw on that.

ET: So what’s really good about this, is that you think about this, just sort of like the new moon phase—the moon is actually—like if you’re standing on earth here, that’ll get kids to think about, “Well, it’s daytime here, and here’s the sun, so if I’m standing here on the other side of the earth where it’s evening, then they’ll still not see a moon.” And then I think what can be added to this whole thing, is the Starry Night™ software. This is where it’s really good to start adding in other types of software because they’ve already had this instruction—about what we would see—and then that actually enhances what they do see. In the software, it shows them a new moon, and you can actually see the outline of it, so you know that there’s something there if you looked in the sky, it’s just
that we can’t see it because it’s daytime and the light is not reflecting away [from the moon], so we can see it’s reflecting on the other side.

CF: So because the demonstration shows that, from a global perspective you then would supplement this would *Starry Night™* to get the individual perspective?

ET: Yes. Just so they can really see it, sort of drive home the idea of what the new moon is, and it will also show them the moon moving. So it just sort of serves as an anchor, so that to bring those other local perspectives to it. So that’s why I think these—and plus the way I’m [the demonstrator is] talking about, “This is what you would see, this is what you would see,” that’s really good too. And then they can start experimenting with all these things that provides that base that they can go back to, and start thinking about that whole idea of, “What would a person that’s having daytime see?” You can see that on *Starry Night™*, and they would see the outline of a moon. So then at the same time, they can flip back and look at someone at night, “Do they even see that outline, or are they in a position that they can see it?” So it starts talking about the whole idea about position and where the sun and where the moon is, etcetera.

ET: And again, this part—what we see from earth—we can talk about, it will lead into discussions about—probably the best discussion that comes out of this type of lesson is, “If it’s a half moon for us [in Canada], will it be a half moon for them [in Australia]?” There are misconceptions that the type of moon that we see is going to be different then the type of moon that they see. I’ve seen that misconception a lot. And so this type of
lesson can serve as anchor for discussing that, in working with those ideas. So you can add in another temporal component, and I don’t think I [the demonstrator] do that here, but it definitely can come out. I think it’s one of the questions that come out of this lesson. And she [I the demonstrator] can start showing that the earth turns, but the moon doesn’t move that much within one day.

**Vignette 4: What causes a solar eclipse? (Global Perspective)**

ET: So after you do the moon phases, this is a perfect time—it usually comes up in the discussions, “Then what’s a solar eclipse?” It helps with that one misconception that moon phases are caused by shadows of the earth—this helps to address that type of misconception—that the only time you’re going to have the moon casting a shadow on the earth or the earth casting a shadow on the moon is when you have a solar or lunar eclipse. So she’s [I the demonstrator am] able to talk about the orbit being totally in line with the earth—that it helps to address the idea about the shadows and talking about eclipses, because I think that’s probably really difficult for them to understand. The whole idea about the orbit changing, because I think even in some textbooks, it almost looks like it’s just a perfectly circular orbit, and I think that’s leading to some misconception. So talking about the phases, and then bringing in the eclipses, addressing that idea about orbital paths of the moon and shadows—that’s really good, addressing that misconception and fostering that kind of discourse.

ET: So that’s perfect. She [I the demonstrator] starts talking about that whole idea that, “If it is a perfect orbit, then we should have an eclipse once a month because there’s a
shadow [ET draws a circle in the air], there’s a shadow again [ET draws a circle in the air], there’s a shadow again.” So that’s really good.

Vignette 5: Becoming the Earth to Explore Moon Phases (Individual Perspective)

ET: Okay, so I like how this lesson again, is building on the first one [demonstration] about phases of the moon, talking about the idea about, “What I would see,” so now she [I the demonstrator] is the earth. So remember she [I the demonstrator] what she was talking about before, “What they would see,” so now it’s a different perspective and because they don’t have to imagine what someone one earth would see. So essentially the person—the earth—is seeing a part of the moon. And I have seen students start to use this way of talking about what the sun would see, and what the earth would see. And it really helps when they can get immersed in that type of talk, because it helps them to just break down all these perceptual barriers that’s so common in astronomy—moving from the ‘global’ perspective to an ‘other’ perspective to a ‘self’ perspective—there are so many different ways you could look at it. What happens too, is that we get kids looking at the same thing but seeing different things. So it has to sort of get them to start converging on one way of seeing something, so that they can start to talk about the more relevant things. If they’re fighting about whether it’s this way or that way or it’s this way or that way—once they can move past that, then you could start to talk about the more conceptually relevant things. These types of lessons are really helpful in that. There are so many different perspectives that a single individual can bring to them, that they really suffer in that sense.
ET: Even though this is not accurate in the sense that she [I the demonstrator] is not turning as well, so she’s—she is the earth and she’s—it’s not modelling perfectly the whole physical coordination of movements. She [I the demonstrator] should also be turning so they can see that one part of the earth also sees—do you know what I’m saying?

CF: You mean she should be orbiting the sun?

ET: Right. She should be orbiting the sun, but say we were just talking about one month of moon phases, she [I the demonstrator] should also be turning every 24 hours, right?

CF: Isn’t she [the demonstrator] turning though, on her chair?

ET: She [I the demonstrator] is turning on her chair, but I think she’s only turning to show each week. She’s not turning to show each day. That’s a minor problem. What I think is really good about this, is if you could just tell kids, you know ideally, she [the demonstrator] should be turning—or you have another student hold the moon so that she can still be the earth, and say, “Okay, North America now, is seeing a half moon this side, and then it’s night time for us”. You could start to integrate day and night stuff. But what I think is really good about this [demonstration], is what it starts to do—it hammers down those different phases, week to week, what you would see. So they get good practice going, “New moon, first quarter, half moon, third quarter, new moon, first quarter”—so it starts to get them into that—the positioning aspect of it. So then once you
get them to practice the position, I've found that if you were to say, "Okay, what would a full moon be?" And it's just a matter of looking at where the sun is, where the earth is, and then the moon. And they [students] do that. You can see them even working in their tests, they become—they'll see a diagram on the test, and they'll use that whole position lesson to try and picture where things are. Like I said earlier, a big source of confusion for students in astronomy is the issue of the position and direction of objects in the sky and how their relative motions affect what we see.

CF: So you'll see their arms waving around in the air?

ET: Yes. You see their arms moving, and it's wonderful that way, in a sense that, they can look at a diagram now, and actually become one of the pieces in the diagram. Whereas if you don't give them these things, then they're just looking at a diagram, and we don't know what's going on then. There are so many different takes. Some students are very field-independent. They're really good at putting themselves into a diagram. But then there's other students that can't. So this type of lesson again, it serves as that type of anchor that will allow them to immerse themselves into the diagram. And that's exactly what this does. As far as—again—"Here's the sun, if you're earth, where would a full moon be?" They know then, a full moon has to be on the other side of the earth. "Where would a new moon be?" It has to be in between the sun and the earth. So that whole idea about where it's positioned, where are these things with respect to each other? And again the things that diagrams in textbooks do is it only shows a very flat world on paper view, which is someone else's conceptualization of it. It's not 3 dimensional and
it's not representative of how things are moving in space. Spatially, I think this is really good. Temporally, in the sense that they don't see what's happening on a night to night basis—

CF: You mean the earth and the moon not rotating at correct rates?

ET: So temporally, that's a disadvantage, but I think if you address the spatial part and then the temporal part in different lessons, then there's less cognitive load. So this is what this [demonstration] does. Once they [students] can get this down, and do it -they do get it down - even very low students that I've worked with can start to use it really mechanically. Almost anybody can get that idea down. It's sort of, I mean almost like in math. When you're working with timestables, in the old way of teaching math, when you're working with timestables, they have to have a sense of $1 \times 1$, $2 \times 2$ - if you can't do your timestables, you can't do anything else with that. It's sort of in that sense, but a bit different, in that you're not trying to get them to memorize it. You're actually trying to get them to feel it - feel where they are - whereas if you just get kids to memorize timestables in math, they're not really getting the feel of it.

CF: They don't really get the meaning of it.

ET: Right. So that's when manipulatives come into play. But I think this [demonstration] goes beyond just manipulating it, in the sense that how she [the demonstrator] manipulated it—you know—at the front of the room—
CF: Using the 3 models?

ET: Yes, you know the 3rd person perspective, the global perspective. This actually puts them right into it. And then it’s that whole challenge of bringing those 2 ideas together, which I think is where you start to see—

CF: “Bringing the 2 ideas”—meaning spatial and temporal ideas?

ET: No, bringing the whole—what they [students] saw her [demonstrator] doing at the front of the class [using the 3 models]—the global and the local perspectives. So I think that’s when you start to see real understanding coming through—if the student can move between the global and the local [perspectives]—I think that would be a fair leap.

ET: And again this is really good because she’s working with the same discourse she established using the global perspectives, “What I would see from earth, what I would see...” That’s basically what elementary astronomy is about—it’s about what we see—and explaining things we see. So talking about what we see in the sky and trying to explain it would just testify against the pictures. That can be limiting, whereas this helps to show them what you would see from so many types of perspectives.

ET: This is really good, because they can see that if you are standing on earth, the moon has changed its position from a half moon—from being juxtaposed here with the sun as opposed to being across from the earth and the sun. And they can see that, “Wow, it is a
big bright full moon—not an eclipse. It’s just up higher because of the orbital path.”

And that again, addresses what she [the demonstrator] did in the eclipse vignette. So it’s bringing that back. Now what would be really neat is if this [the moon] goes down [in line with the sun then with the earth]. Then there would be a shadow. But then it would probably be too big of a shadow.

ET: So that whole—especially the new moon—they can feel the light shining on their face, they’re still being the earth. But they don’t see the moon. The moon is not shining on them. So they know that that moon is not being blocked out because light is still reaching their face. This further addresses the misconception that phases of the moon are caused by shadows of the earth. So again talking about that whole orbital path—I think that really helps them with that, like at least in a test situation and talking about shadows. If they have some kind of conception of what a shadow is. Whereas what these lessons are really good at doing is talking about shadows, which I think is something that it brings up that idea, “Then what’s a shadow?” And you could get into great discussion about, “Well, is there a shadow in space?” They have a local idea of what a shadow is—the light hitting you, and it’s on the ground. It’s really hard for them to get across this idea about—in space you can have the sun hitting this tiny object that will cast a shadow millions of miles away onto the earth. So that’s good enough. That’s bringing out those topics of shadows, of light.

ET: So when you start to introduce that type of vocabulary then it can lead into—it gives, I think it gives students a language that they can use to move around in the subject.
So once you start to introduce them to that—the discourse of astronomy—it’s all about, “What you see if, what you see if it’s here, what you see if it’s there, and this is what’s happening. And from a global perspective this is what’s happening. From what you see if you’re on earth this is what’s happening. This is what’s happening if you’re on the moon.” All that gives them a type of a discourse to move around—if I can quote Carl Bereiter (in press)—“Move around within the subject”. I can get you the page where he says that. I can’t remember how he described it. I have it in my thesis. But it gives them the tools they need to experiment with things and move around in the subject. So you don’t need to teach them everything about everything. Once they have these few ways of looking at things, or experimenting with things, or talking about seeing from here seeing things from there—then we’ve got computer simulations. We’ve got models and things like that, that they can now start to use to refine their understanding.
APPENDIX B: THINK-ALOUD PROTOCOL SCHEDULE

1. The researcher will briefly tell the teacher of the OISE/UT Astronomy Project. The teacher will then be introduced to the astronomy project website at http://www.oise.utoronto.ca/~ewoodruff, and will complete the astronomy quiz at http://www.oise.utoronto.ca/~ewoodruff/schedule/schedule.html

2. The researcher will briefly tell the teacher about her thesis project, and the role of this research within the OISE/UT Astronomy Project. Namely, that future plans for the OISE/UT Astronomy Project website include online access to digitized video vignettes of astronomy teaching, but it remains to be determined how teachers interpret and process such videos when they are presented as models of exemplary practice. The researcher will explain that, in the interest of learning about teachers’ cognitive processes as they view these videos, we will have to rely on teachers to think aloud as they view the vignettes.

The researcher will explain to the teacher what a “think-aloud protocol” (concurrent verbal report) is:

“A think-aloud report is one of two types of concurrent verbal report. In a concurrent verbal report, the cognitive processes are verbalized directly. ‘Cognitive processes’ are the successive states of heeded information. Later, I will be showing you 2 video vignettes of exemplary teaching in astronomy. You will need to say exactly what you are thinking and wondering at each moment, as you view these videos.”
3. For the purposes of letting the teacher practice thinking aloud, the teacher will then be given a deck of playing cards:

"To give you a chance to practice thinking aloud, I'd like you to sort these playing cards according to any sorting rule of your choice. Please do this while thinking aloud." The researcher may ask, "What are you thinking now?" to prompt the teacher to think aloud when necessary.

4. The teacher will then be shown 2 video vignettes: "Day and Night" and "Moon Phases". Just before the videos are shown, the researcher will explain:

"You are about to view 2 video vignettes which are models of exemplary teaching in astronomy. The first vignette, titled 'Day and Night' is 4 minutes and 19 seconds long. The second vignette, titled 'Moon Phases' is 4 minutes and 23 seconds long. They are on CD-ROM, in QuickTime movie format. You need to think aloud as you view these vignettes. If you wish, you may move the slide rule at the bottom of the QuickTime window to rewind and re-view segments of the videos as necessary. You may also pause the video when you speak. We say this is exemplary teaching; because the demonstrations you are about to view are what Dr. John Percy, a professional astronomer, has used with teachers to address a particular astronomical topic with the objective of helping their students come to a deep and meaningful understanding of the topic."

5. (If the participant is placed in the "Directed Viewing" group—as opposed to the "Open-ended Viewing" group):
“As you watch the vignettes, focus on any characteristics of exemplary practice, or pedagogically sound instruction practices that you see.”

6. The researcher begins the video, and begins to record the session on audiotape. At the end of each of the 2 videos, the researcher will ask the teacher if there is any part of the video that the teacher would like to view again.

7. The researcher will ask the teacher if there are any questions or comments about what they have seen today, or about the OISE/UT Astronomy Project. The researcher will address these, and thank the teacher for their participation and their time.

The researcher will ensure:

- That the teacher realizes that he/she is not under scrutiny; but that we want to learn what teachers attend to, when they are told they are observing exemplary practice.
- That the teacher should at all times comment liberally on his/her actions, intentions and thoughts.
- That the teacher is at ease. This involves explaining that the researcher may give only a bare minimum of help to the user, and apologizing in advance for this.
APPENDIX C: ASTRONOMY KNOWLEDGE ASSESSMENT

* Note that only questions 1, 2, 3, 7, 10, 11, 12, 13, 14 and 15 probed for understanding of topics pertaining to the content presented in the video vignettes used in this study.

1. **What causes day and night?**
   - The Earth spins on its axis.
   - The Earth moves around the Sun.
   - Clouds block out the Sun's light.
   - The Earth moves into and out of the Sun's shadow.
   - The Sun goes around the Earth.

2. **Why did the moon change shape?**
   - Something passed in front of it.
   - It moved out of the Earth's shadow.
   - It moved out of the Sun's shadow.
3. Of the following choices, which looks most like the Earth's path around the Sun?

- Answer A
- Answer B
- Answer C
- Answer D
- Answer E
The diagram above represents a model of the sun, Mars and one of Mars' moons, Deimos. Please look at the model and determine which object looks most like Deimos to the person in the model who is observing from the pole of Mars.

5. An orange that represents the Sun is placed at the front of a classroom in Toronto. If the next nearest star to the Sun is represented by another orange, where should it be placed?

- The back of the classroom.
- The other end of the school.
6. Which is the most accurate model of the Moon in relative size and distance from the Earth? (The unshaded object in each diagram is the Earth)

A) ![Diagram A]
B) ![Diagram B]
C) ![Diagram C]
D) ![Diagram D]
E) ![Diagram E]

- Answer A
- Answer B
- Answer C
- Answer D
- Answer E

7. How often is the Sun directly overhead at noon in Toronto?

- Every day.
- Only in the summer.
- Only for the week of the summer solstice.
- Only for one day each year.
- Never
8. The main reason for it being hotter in the summer than in the winter is:

- The Earth's distance from the Sun changes.
- The Sun is higher in the sky.
- The distance between the northern hemisphere and the Sun changes.
- Ocean currents carry warm water north.
- An increase in 'greenhouse' gases.

9. Which answer shows a pattern from the closest object to the Earth to the farthest from the Earth?

- Space Shuttle in orbit --- Stars --- Pluto
- Pluto --- Space Shuttle in orbit --- Stars
- Stars --- Space Shuttle in orbit --- Pluto
- Stars --- Pluto --- Space Shuttle in orbit
- Space Shuttle in orbit --- Pluto --- Stars

10. Which choice represents the best estimate of the time it takes for the Moon to go around the Earth?

- Hour
- Day
- Week
- Month
- Year
11. Which choice represents the best estimate of the time it takes for the Earth to turn on its axis?
   - Hour
   - Day
   - Week
   - Month
   - Year

12. Which choice represents the best estimate of the time it takes for the Earth to around the Sun?
   - Hour
   - Day
   - Week
   - Month
   - Year

13. Which choice represents the best estimate of the time it takes for the Moon to around the Sun?
   - Hour
   - Day
   - Week
   - Month
   - Year

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.
14. Which choice represents the best estimate of the time it takes for the Moon to turn on its axis?
   o Hour
   o Day
   o Week
   o Month
   o The Moon does not turn on its axis.

15. Approximately what time could it be if you saw a thin crescent Moon on the western horizon?
   o Sunrise
   o Sunset
   o Noon
   o Midnight
   o Anytime of day or night

16. Stars A and B appear equally bright in the night sky. However, star A actually gives off more light than star B. Which of the following is true about star A?
   o It is the same distance from us as is star B.
   o It is farther away from us than star B.
   o It is closer to us than is star B.
   o It is the same temperature as is star B.
17. Most astronomers consider astrology to be:
   - A science
   - A good way to determine personality traits
   - Helpful in predicting world events
   - More than one of the above
   - None of the above

18. During July at the North Pole, the Sun would:
   - Be overhead at noon
   - Never set
   - Be visible for 12 hours each day
   - Set in the Northwest
   - None of the above

19. Which date below has the most hours of daylight in Toronto?
   - June 15
   - July 15
   - August 15
   - September 15
   - All dates are the same
20. A driver came out of a shopping mall one night and looked at his car. His car is painted pure blue and the lights illuminating the parking lot are pure yellow.

What color did his car appear to be?

- White
- Green
- Yellow
- Blue
- Black

21. When green glass is placed between the flashlight and the white movie screen, a green spot appears on the screen. If green glass and red glass are placed between the flashlight and the movie screen (as shown on the right below), what will happen to the spot?

- It will be green.
- It will be yellow.
22. **You are in a completely dark room. There are no lights and no windows.**

Which group of objects do you believe you might be able to see?

- Bicycle reflectors
- Silver coins, aluminum foil
- White paper, white socks
- More than one of these groups
- None of the above

23. Which of the following would make you weigh half as much as you do right now?

- Take away half of the Earth's atmosphere.
- Double the distance between the Earth and the Sun.
- Decrease the Earth's rate of spin so that 1 day equals 48 hours instead of 24 hours.
- More than one of these groups
- None of the above

24. **Two identical light bulbs are placed behind a book. If light bulb A is on and light bulb B is off, the book casts a shadow in the box below.**
If both light bulbs are now turned on, which of the diagrams below best represents the shape of the shadow that will cast by the book?

- Answer A
- Answer B
- Answer C
- Answer D
- Answer E

25. Astronauts in the Shuttle appear to be 'weightless'. Which of the following statements best describes or explains the phenomenon of 'weightlessness'?

- There is no gravity in space.
There is no atmosphere in space.

The gravity of the Space Shuttle is not sufficient to hold the astronauts on the floor.

Both the astronauts and the Space Shuttle are 'falling' toward the Earth at the same rate.

There is no magnetic field in space.

26. The Earth moves in an almost-circular orbit around the Sun because:

- That is the 'natural' path of an object in space
- Of the combination of its sideways motion, and the Sun's gravitational force
- The Sun moves in an almost-circular path around the Earth
- Of the Sun's magnetic field
- None of the above

27. The Moon is moving around the Earth as shown in Figure 1.

If the force of gravity were to suddenly disappear, which of the following arrows would best represent the path of the moon?
28. Which of the following statements is not true?

- Stars are distant suns.
- Some stars are closer than Pluto.
- Stars emit light, but planets reflect light.
- Stars do not orbit the Sun.
- 'Shooting stars' are not stars.

29. Which of the following statements is true?
- The Moon keeps the same face towards the Earth, so it does not rotate.
- The Moon is sometimes visible in daytime.
- There is no gravity on the Moon.
- The back side of the Moon is always dark.
- The distance to the Moon is ten times the distance across Canada.

30. **The Sun and the Moon appear to be the same size in the sky, but astronomers know the Sun is actually 400 times bigger than the Moon. What is the distance of the Sun, compared with the distance of the moon?**

   - 400 times larger
   - 20 times larger
   - The same
   - 400 times smaller
   - None of the above
The participant seems to have viewed the video vignettes for their own learning of astronomical issues, rather than as a teaching tool.

   i.e. And now I’m thinking basically, that the question that I answered (in the online quiz) was probably incorrect. So I’m learning from this video as well.

The statement demonstrates little/no analysis of the form, purpose or function of the astronomy demonstration, but has vague references to the accepted body of knowledge in astronomy.

   i.e. I’m not sure what she’s... I wonder if she tells how often there is a solar eclipse?

The purpose of the comment is to clarify or ask the researcher questions pertaining to the accepted body of knowledge in astronomy.

   i.e. Wouldn’t that (a solar eclipse) happen every month then?

The participant is commenting on his/her own understanding of a particular astronomical issue.

   i.e. Oh I’m starting to clue in. (laughs)

   i.e. Maybe I just know a myth! (laughs)

*Note that the term classroom management encompasses the skill of preventing and responding to student misbehaviour. Issues such as physical classroom set-up, materials distribution, lesson pacing, and lesson organization fall under the realm of classroom management.
The participant’s statement indicates/demonstrates analysis of superficial details of classroom management/form/structure, but rarely any deeper analysis of purpose/function of the astronomy demonstrations.

i.e. I like the use of the models here.

i.e. This makes sense, I could teach this.

i.e. I could follow exactly what she saying, and replicate it.

i.e. So I kind of lose attention that way because I can’t see the speaker (the demonstrator temporarily has her back turned to the audience).

i.e. The only thing I’m wondering right now is how many kids are watching this. I hope it’s a small group!

i.e. Now with primary kids, the lights would be off, and I think they would be kind of distracted. I don’t know how many would be watching.

i.e. She might lose their (i.e. the children’s) attention now. I think that’s too many rotations.

The comment demonstrates the participant’s effort to understand the form/structure of the demonstration.

i.e. Because I didn’t understand what she was doing (in Demo ii of "Day and Night")! Like, I was her eyes? Because I thought I’m looking at her. And when she turned, like, wherever she turns, there’s still going to be light.

i.e. I can see that she’s doing that because you can see the sun, and not see the sun. But she doesn’t look like the earth. You know what I mean? Like before, seeing the ball as the earth was a little easier to understand.
The statement is evaluative of the demonstration's form, and this evaluation does not stem from a misconception or lack of knowledge of astronomy on the part of the participant. Perhaps it includes a suggestion for an alternative that would contribute merely to the form/structure/management of the demonstration, but would **NOT** contribute to the function/purpose of the demonstration.

i.e. Because I didn't understand what she was doing (in Demo ii of "Day and Night")! Like, I was her eyes? Because I thought I'm looking at her. And when she turned, like, wherever she turns, there's still going to be light.

i.e. I can see that she's doing that because you can see the sun, and not see the sun. But she doesn't look like the earth. You know what I mean? Like before, seeing the ball as the earth was a little easier to understand.

i.e. Her voice is a teaching-to-children voice, not a teaching-to-adults voice.

The statement makes reference to the structure of the demonstrator's discussion, and this reference does not stem from a misconception or lack of knowledge of astronomy on the part of the participant. This reference **does not** relate to the underlying function/purpose of the demonstration. It **does not** touch upon educational pedagogy, or the body of astronomy knowledge.

i.e. Because she didn't really explain the solar eclipse.

i.e. See I'm glad she reminded me that she's the earth!

i.e. So I'm just following what she's saying. She's repeating it.

The statement expresses the participant's like or dislike of the video **without giving any reason** (i.e. references to pedagogical concerns)

i.e. They're (the demonstrations/vignettes) good introductions.
i.e. So yeah, I think these (demonstrations) are good.

**Pedagogical Lens (P)**

For the purposes of this study, please note that the term teaching pedagogy refers to the theoretical and philosophical basis, which determines an educator’s methodology.

The statement comments upon issues that are either related to content pedagogy; that is, the deep subject-matter understanding of astronomy. This statement demonstrates the participant’s deep understanding of astronomy and perhaps relates this to issues of teaching pedagogy.

i.e. Right, but I’m not understanding why she’s taking the moon with her, because the moon doesn’t move with us, as we’re turning on our axis — as the earth is turning.

i.e. That was good defining ‘eclipse’ as blockage.

The participant’s statement shows implicit attention to theories of science teaching and learning (teaching pedagogy). The statement perhaps implies ways to extend the demonstration in the classroom.

i.e. (Other characteristics of exemplary practice I found) Besides models and action – the way she was acting.

i.e. And I thought her pacing was good.

i.e. I like how she also sets up a question to think about before she starts to explain it.

i.e. It was very organized and very linear.
i.e. I’m wondering if she did this in front of a class, that she might integrate the kids coming up and taking on her role. And then add some repetition to it — it gets the children a bit more involved.

The participant’s statement indicates/demonstrates **deeper analysis** of issues relating to **function/purpose**, rather than superficial analysis of classroom management/form/structure.

i.e. Oh! Well if that’s the case, if it was meant for teachers to watch, then it’s (i.e. the video is) talking down to them.

i.e. I think sometimes when they do the kinaesthetic part of it, I think some kids learn better that way than just sitting back and looking at someone demonstrating—they actually move around like she did.

i.e. Right, but I’m not understanding why she’s taking the moon with her, because the moon doesn’t move with us, as we’re turning on our axis — as the earth is turning.

The statement is evaluative in nature. Perhaps it includes a suggestion for an alternative that **would contribute** to the function/purpose of the demonstration

i.e. They (the kids) should all be able to stand around this light in maybe a semi-circle, having 3 to 4 students doing it at the same time, maybe each with their own East/West signs, as they turn. Then they can pass those pieces of paper onto somebody else, so that each student gets to try that.

The statement makes reference to the nature of the demonstrator’s discussion, and this reference does not stem from a misconception or lack of knowledge of astronomy on the part of the participant. This reference relates to the underlying function/purpose of the
demonstration. It touches upon educational/teaching pedagogy, or the body of astronomy knowledge.

i.e. But she was equating those 2, as “no moon” and “new moon”.

i.e. I think the repetition is good, in case there was someone who wasn’t paying attention, they would have gotten it, and for those that were listening, it was reinforced.

i.e. That was good defining ‘eclipse’ as blockage.

The statement is a suggestion that would change the overall structure of the videos, to improve their value a professional development tools for teachers.

i.e. Unless you have some additional graphics being superimposed there (on the video), then that should be possibly a goal that one (i.e. video developer) can work towards, in order for these tools (i.e. video for teacher PD) to be really effective.

The statement expresses the participant’s like or dislike of the video with reason (i.e. references to pedagogical concerns)

i.e. Oh, (I’ve) probably (seen similar demonstrations) with the globe, although having the sun as the light bulb—the actual light coming, and then the rest being dark—I’ve never seen it done like that before, and that was very effective I think.

i.e. There again, it’s very visual. It makes it easy to understand.

**Surface-Level Media Lens (S)**

The participant’s statement demonstrates superficial analysis of the characteristics of the digitized video, including: lighting, sound, props, camera angle, focal points, demonstrator’s appearance, etc.
i.e. I wonder what the arm is, that she has the globe attached to?

i.e. There's a great shadow behind her. (Laughs)

i.e. It's a little difficult to make out, to follow it with it being in the dark.

i.e. Overall, the length (of the video) is great in this case, although this (i.e. "Moon Phases") is a little bit longer than the previous video (i.e. "Day and Night").

The statement is a suggestion relating to the characteristics of the digitized video, including: lighting, sound, props, camera angle, focal points, etc.

i.e. There are too many static shots.

i.e. The demonstrator does not need to be the centre of the camera shot here. It should be a close-up of the models.

It addresses surface-level issues pertaining to the demonstrator's appearance and demeanour.
Appendix E: Quick Reference of Lens Categories

Content Lens (C)

The participant seems to have viewed the video vignettes for their own learning of astronomy, rather than as a teaching tool.

The participant is commenting on his/her own understanding of a particular astronomical issue.

Participant may relate what they see to their performance on the online astronomy quiz.

Form Lens (F)

With respect to the demonstration's characteristics (form/structure), the participant expresses their like/dislike of:

- Repetition
- Models/3D
- Simplicity
- Visual
- Like/dislike of the videos in general (no explanation given)

Nothing relating to how students will think.

Shows the participant's effort to understand the form/structure of the demonstration.

Pedagogical Lens (P)

Anything relating to how students will understand or think about the concepts presented.

Participant draws on their existing knowledge of astronomy relevant to the demonstration, to:

- reflect on the demonstrations

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.
- critique the demonstrations
- suggest improvements to the demonstrations.

Participant’s thinking extends beyond the content of the video. Perhaps they’re thinking about how to adapt the demonstrations for their own classroom, or perhaps they are concerned with improving the video as a professional development tool for teachers.

**Surface-Level Media Lens (S)**

It addresses surface-level issues pertaining to the demonstrator’s appearance and demeanour, lighting, shadows, sound, camera angle.

No reference to the teaching or understanding of astronomy.