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## **Using teaching observations to reflect upon and improve teaching practice in higher education**

**Douglas J. Atkinson<sup>1</sup> and Susan Bolt<sup>2</sup>**

*Abstract: In order to improve teaching and learning within a faculty, an action research intervention involving peer observation of teaching staff via an expert was designed and implemented. A total of ten staff (including the first author) were observed over the year. The process consisted of observation at class, a written report, discussion between teacher and observer, and a group debrief. A follow-up written questionnaire was emailed to the ten participants and the qualitative responses were analyzed. Key findings for practice were: that staff recommended the process be continued; that it remain voluntary; that an external expert be retained; that the group processes were important; and that there be ongoing follow-up.*

*Keywords: teaching observation, peer observation, teaching practice, university teaching*

### **I. Introduction.**

The scholarly activity of peer review of teaching is broader than the observation of teaching practices; for example, it includes course review, assessment practices, online learning environments, curriculum design and resource development (Harris, Farrell, Bell, Devlin, and James, 2008). However, the research presented in this paper focuses on the observation of face-to-face teaching. The current trend across Australian universities is to move toward online teaching practices. This trend has been brought about by pressures to cater to student demand for more flexibility, competition amongst universities, availability of online tools (learning management systems), standardization, and codification of teaching and learning. At Curtin University where the research was conducted, a “blended learning” approach has been advocated that involves a combination of face-to-face and online practices as appropriate. Curtin University is situated in sixteen different locations; the main campus is situated in Bentley in Western Australia but there are other regional, national and international sites. There are five separate teaching areas across the University, one of which is the business school (CBS). This research was conducted in CBS which itself is as large as some universities and is comprised of seven teaching areas which are known individually as Schools and numerous research institutes, areas of research focus and centers. There are over 15,000 students studying in business courses at the numerous CBS campuses (CBS, 2010). In particular, this research was conducted in one of the seven teaching areas. The research site is referred to as the ‘School’ throughout this paper. Within this context the authors have reflected on what is distinctive about the face-to-face experience. What is it that teachers and learners bring to this environment that is difficult to replicate or support in the online environment? Hence, the aims of this study were to encourage skilled staff to reflect on their own skills, improve them and share them with their colleagues as a

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means of lifting the quality of face-to-face teaching. Earlier research by Hodgkinson (1994) noted lecturers may perform differently when teaching in diverse face-to-face modes; so, in this research the observer reviewed a broad range of face-to-face teaching formats – lectures, seminars, tutorials and laboratory sessions.

Another trend in higher education is a strong emphasis on evaluation of teaching and learning, particularly the use of student evaluations (Centra, 2000). Since 2006, Curtin University has used an online tool called *eVALUate* to gauge the quality of units and teaching. Students' perceptions of units and teaching are measured using an online questionnaire with 11 questions with five point Likert scales and two open-ended qualitative style questions (Curtin University, 2009). The *eVALUate* metrics are used throughout the university and are referred to by senior management in key performance indicators. The *eVALUate*, however, is limited to student perceptions of the teaching and learning experience, and as such provides no direct feedback to teachers from classroom observers with formal qualifications and/or experience in teaching. Thus using *eVALUate* alone as a guide to improving teaching is akin to a tennis coach relying on feedback from his pupils alone to improve his coaching. The feedback from students tends to be whether or not they are satisfied rather than any deep insight into pedagogy. For this, one needs an expert teacher to observe and provide insight and feedback (Centra, 2000; Paulsen, 2002).

The idea for conducting teaching observations was triggered at an annual School strategy planning activity by a request for ideas for improving the quality of teaching and learning. School members agreed to several initiatives during the planning session including the decision to engage in teaching observations in 2009. The first author was a teacher who also held the role of Coordinator of Teaching and Learning within the School. As such the first author chaired the School Teaching and Learning Committee and shouldered leadership responsibilities for directing teaching and learning within the School, as well as a full-time teaching load. Consequently, the first author established a plan to conduct a series of teaching observations within the School. The researchers recognized the importance of participatory leadership and assumed that participants would be more likely to volunteer to have their teaching observed if the School Coordinator of Teaching and Learning was a fellow participant in the process.

Teaching observations were not new to the School. In the past some peer observation had been organized and unit coordinators had also arranged some observation of sessional staff. In these cases, a written template was used to record the observations and later debrief staff. School members expressed concerns that an outside expert party would be better placed to observe and comment on teaching practices, rather than an internal peer – for whom acting as an observer would increase their workload. The first author, thus, approached the CBS Teaching and Learning Coordinator (the second author) as an external expert to conduct the observations. The CBS Teaching and Learning Coordinator was a faculty member whose experience and qualifications were in education, and had provided leadership, consultancy and staff development in the area of teaching and learning across the seven business Schools. So, the second author was external to the School and discipline but internal to CBS. After some planning meetings it was agreed that the process would begin with five staff in first semester, with a view to continuing and improving the process and cycling through all the staff over several years. The first author emailed the five volunteers and the observer and included a list of the weeks that the observer was available and a suggested allocation of participants to designated weeks. It was then up to participants to contact the observer and negotiate a mutually acceptable time to schedule the observations. Once agreement had been reached about observation dates, times and

foci, the observer sent invitations to participants using Outlook. Participants then accepted the Outlook appointments.

The aim of conducting the teaching observations was to improve teaching and learning practice. At the end of two cycles of teaching observations, conducted over the two semesters of 2009, the authors gained ethics approval and conducted research to evaluate the usefulness of teaching observations as a method of improving teaching practices. The research question was: What are teacher perceptions of teaching observation as a method for improving teaching and learning? The authors collected data by conducting two focus group sessions and surveying staff. In addition, the authors conducted a review of the literature pertaining to peer review of teaching.

## **II. Background.**

Although teachers have relied on peers to help them reflect on their teaching practices since the 1950's, peer review of teaching has been less evident in the higher education sector (Bell, 2001; Harris, et al., 2008; Quinlan 2002). Even so there is evidence to suggest that the peer review of teaching in the higher education sector is gaining momentum and it is being recognized as a strategy that has the potential to enhance the quality of teaching (Harris, et al., 2008). Inherent in the increased interest in peer review is the recognition that teaching is a scholarly activity that can be reviewed just as research is peer reviewed (Boyer, 1990; Quinlan, 2002). However, the evaluation of teaching effectiveness appears to be more difficult to accomplish than judging the quality of research (Green, Calderon, Gabbin, and Habegger, 1999; Hodgkinson, 1994; Kenny, 1998). Academics across the world have sought to resolve the dilemma of evaluating teaching effectiveness (Bell, 2001, 2002; Blackmore, 2005; Green et al., 1999; Harris, et al., 2008; Hodgkinson, 1994; Quinlan, 2002). Consequently, a range of models and suggestions have emerged.

Gosling (2002, in Blackmore, 2005) identified three main models of peer review: evaluation (observation by senior staff); developmental (observation by educational developers); and peer review (teachers observing teachers). However the concept of 'peer' review is not understood consistently. According to Bell (2002) a peer could be a supervisor or expert – not necessarily a co-worker. Interestingly, Bell (2001) describes a Teacher Development Program (TDP) used at the University of Wollongong as part of their Introduction to Tertiary Teaching course. The TDP model consists of a three-way partnership: between an observed participant who subsequently submits a written reflection of the experience; a supportive colleague who observes the participant's teaching; and an educational developer who provides feedback to the participant on the written reflection and monitors the TDP. Although the TDP is a formal process within a specific course, peer review can also be informal and can be used both for teacher development and performance management (Bell, 2002).

Effective peer review is dependent on establishing collegial trust and respect, providing guidelines and resources and embedding the process into performance management, promotion and recognition policies (Harris, et al., 2008). Just as observation of teaching is only one element of peer review, multiple methods must be used to fully evaluate the wide range of activities associated with quality teaching; moreover, training must be provided for all participants in the peer review process (Blackmore, 2005; Brown and Ward-Griffin, 1994). To successfully embark on a peer review of teaching process, the exact nature of what is to be reviewed must be identified (Bell, 2002; Glassick, 1997; Green et al., 1999; Hodgkinson, 1994; Smith, 2000). Weeks and Scott (1992, in Smith, 2000) and Smyth (1984, in Smith, 2000) recommend a four

stage cyclical model for peer review. The cyclical process consists of a pre-observation meeting, observation, post-observation feedback, and reflection (Bell, 2002; Smith, 2000). Although the research referred to in this paper followed a similar peer review cycle, it was also based on three other cyclical theoretical frameworks: action research; experiential learning; and organizational learning.

#### *A. Action Research.*

Inherent in the idea of using peer review to enhance the quality of teaching and learning is the notion of sustainable change which, according to Lewin (1947), requires a three-pronged approach of research, training and action. Accordingly, action research is recognized as a research methodology that enhances transfer of learning because its iterative cycle includes; research on relevant issues, collaboration, action, and reflection (Cady and Caster, 2000; Caffarella, 2002; Creswell, 2008; Kolb, 1984; Waddell, Cummings, and Worley, 2004). Moreover, the collaborative nature of action research requires group decision-making and commitment to improvement. Group commitment can strengthen attitudinal change, enhance transformational learning and support cultural change (Coghlan and Jacobs, 2005; Dickens and Watkins, 1999). Thus action research aids both individual and group learning.

#### *B. Experiential Learning.*

Experiential learning as conceived by Kolb (1984) informed this research; individual staff engaged in a continuous cycle of experiencing, reflecting, abstracting, and testing as they participated in the teaching observations. Also, the concept of having experience and learning from experience is foundational to theories of adult learning. Hence, it is important to recognize adult learners' experience and integrate the combined wealth of experience into group learning situations – participants learn from each other (Knowles, Holton III, and Swanson, 2005). Nevertheless, it must also be recognized that such experience is not neutral, it is culturally bound (Burns, 2002). The issue of culturally bound experience is pertinent to the peer observation of teaching with regards to the debate of whether or not the observer should be a peer from the same discipline, a senior academic administrator or an educational developer. As people observe and interpret teaching performance from unique perspectives, it is most important to establish clear guidelines regarding the purpose of the teaching observation and operate in an environment of collegial trust and respect (Bell, 2001; Blackmore, 2005; Brown and Ward-Griffin, 1994; Harris, et al., 2008; Paulsen, 2002).

#### *C. Organizational Learning.*

The concept of cyclical learning shown in both action research and experiential learning is evident, also, in organizational learning. The 4I (intuiting, interpreting, integrating and institutionalizing) framework of organizational learning (Crossan, Lane, and White, 1999) informed this research and supported the transfer of learning from individuals to the School group and ultimately to faculty. Accordingly, Crossan, Lane, and White (1999) noted that an expert intuitively recognizes patterns which are unnoticed by novices; an entrepreneur intuitively makes novel connections, perceives new relationships and suggests new possibilities. Thus, the concept of intuition has implications for the selection of an observer of teaching performances;

both expertise and entrepreneurial skills are beneficial. Interpretation is enhanced through discussion, as participants share their unique perspectives; the aim is for groups to reach a common understanding. Integration is the embedding of the emerging common understanding within the group psyche; it is achieved through deeper discussion, conversation and the evolution of stories. Institutionalization is the embedding of new understanding and practices into the systems, structures and routines of organizations. In this research the observer was an expert with entrepreneurial skills and interpretation was enhanced through dialogue between the observer and participants. The use of focus groups at the end of each round of teaching observations enhanced integration. Institutionalization is a long-term goal but already the idea of improving the quality of teaching through teaching observations is being taken up by other Schools within the faculty.

The research further draws on the theory of knowledge conversions in which conversions between tacit and explicit knowledge hold the greatest promise of innovation (Nonaka and Konno, 1998). Within the environment of this study the staff accumulated tacit knowledge of teaching, and whilst some may be explicated in conversation, much of teaching practice in the face-to-face setting is better learnt through demonstration and observation. In this case the expert observer can act as the converter to explicit knowledge and provide feedback to the teacher. So there is a tacit-to-explicit conversion followed up by an explicit-to-tacit knowledge conversion. The researchers note that peer observation holds the advantage of tacit knowledge socialization without the filtering of the expert observer but there are the disadvantages of learning bad as well as good habits, so the allocation of peers needs to be thoughtful. A combination of expert and peer observer whilst expensive could combine the advantages of a skilled coach with the direct demonstration and transfer of skills.

Traditionally, in academic life both teaching and research have been individual pursuits. Lecturers at the university in which this research was conducted have the opportunity to apply for recognition of teaching excellence through reward systems at the faculty, university and national level. For example, the Curtin Teaching Performance Index (TPI) provides financial rewards and esteem for individuals and groups of teachers for good eVALUate results, gaining teaching grants and awards and scholarship in teaching and learning. All lecturers achieving these results can apply for recognition through TPI. Further to this the award categories of 'Teaching Excellence', 'Programs that Enhance Learning' and 'Citations for Outstanding Contributions to Student Learning' are available, competitively, at the faculty, university and national level (Curtin University, 2009). Although, organizational reward systems and structures support individualism there is some scope for recognition of excellence in teaching for team performances. Whilst this gives competitive advantages to individual creativity and innovation, it may be at the expense of the advantages of stimulation, sharing and synergy that come with group staff development activities. If universities want continuous improvement then there needs to be space for sharing of practices, so that individual innovators can share and learn with others.

According to research, although very few people are innovators many more people could be persuaded to adopt innovations even though it is likely that there would always be some people who would always resist change; participation in professional development was shown to increase the rate of adoption (Houle, 1980). To bring about organizational change it is important to engage sufficient people in an initiative until a tipping point is reached and the change becomes embedded in organizational culture (Gray, 2005; Loup and Koller, 2005). To reach a critical mass the change must be officially recognized, for example through alignment with

organizational reward structures. Second, the desired behavior must be modeled and incentives provided for early adopters (Gray, 2005).

In the context in which this research was conducted peer review has been flagged as an important aspect of the scholarship of teaching and learning and, although, it may contribute to promotion and recognition it has not yet been embedded in the culture and is not widely practiced across the university. Thus, in some pockets of the faculty there has been an emerging organizational awareness of the importance of peer review of teaching, the desired behaviors were modeled in this research and early adopters were intrinsically motivated to participate. Hence, the rationale for this study was to encourage voluntary participation in observation of face-to-face teaching practices and utilize both individual feedback processes and group debriefing sessions to foster collaboration and share knowledge. It was noted that several newer staff members were very positive about the benefit of having a small group with which they could share and learn teaching practices.

### **III. Methodology.**

This research sat within the interpretive paradigm. It was exploratory in nature because the systematic approach to conducting teaching observations with the use of an external party and the provision of feedback as described in this paper had not been undertaken in this setting previously. Accordingly, the authors knew little about teachers' perceptions of using this type of teaching observation as a method for improving teaching and learning. Qualitative approaches are best suited to investigating complex human behaviors and for investigating situations about which little is known (Cavana, Delahaye, and Sekaran, 2001). In this investigation, the researchers collected qualitative data because they particularly wanted to understand teachers' perceptions of their experiences with this approach to using observation to improve teaching and learning. The authors did not collect quantitative data at this stage of the research because Creswell (2008) recommended that, in exploratory research, qualitative data is collected first then analyzed to identify themes, from which an instrument can be designed and subsequently tested using a mixed methods approach. The authors envisage that, in the future, they could collect both qualitative and quantitative data in relation to voluntary peer review of teaching – assuming there were sufficient numbers of participants to support meaningful quantitative analysis of the data.

#### *A. How the Teaching Observations Were Conducted.*

A qualitative action research approach was adopted to facilitate change and improve the quality of teaching and learning in the School. As such, the first researcher had multiple roles as researcher, teacher participant, and the School Coordinator for Teaching and Learning. The second researcher was the observer; as the faculty Coordinator for Teaching and Learning she consulted across the seven teaching areas or Schools of the business school. It is important to note that the second researcher had considerable experience in action research. For a period of two years, in a previous role, she managed a nationally funded quality teacher program based on action research. In this role she trained groups of teachers to conduct action research in relation to their teaching practices, and monitored and evaluated the project across a metropolitan school district with 100 schools in it. Accordingly, the second researcher drew on these experiences in the development of her thesis in a postgraduate research degree in education. Hence, for this



research, there was no need to train the observer in the use of action research. The authors believed that the observers' reputation, qualifications and experience were appropriate for the task. However, for the practice of peer review to become sustainable and embedded in the culture of the university subsequent reviewers would require an induction into the program and ongoing coaching, depending on their level of expertise. The research captured in this paper describes the first year of the systematic implementation of peer review within a business school. It is expected that in the future many more participants would be involved.

Initially, participants were recruited by invitation of the School Coordinator for Teaching and Learning who invited five staff members to participate in first semester; they all accepted the offer and another five teachers agreed to participate in second semester. One teacher from first semester volunteered for another observation in the second semester to improve their teaching. A cyclic approach was taken whereby after observation participants received personalized oral and/or written feedback from the observer and after each semester there was a group debriefing session to facilitate general feedback and inform the next cycle of teaching observations. The observer scheduled teaching observations by making appointments with teachers as described earlier in this paper. The researchers recognize that the fact that teachers knew when they were to be observed may have influenced their teaching performances. However, it is the researchers' opinion that teachers performed within a 'normal range' of their typical teaching performances. In some cases teachers forgot the observer was coming or didn't notice the observer in the crowd. Some teachers commented that they were 'a little nervous', others commented that 'it didn't make a difference'. The observed classes were composed of adult learners from a range of backgrounds; for example, undergraduate, postgraduate, international and local students, school leavers and experienced professional full-time workers. Thus, the researchers noted that teachers typically taught diverse groups of students and unobtrusive observation would have minimal influence on changing teachers 'normal' teaching activities. Teachers did not appear to go out of their way to perform at a higher level than usual.

The observer gave each participant written feedback using a variation of de Bono's (1992) PMI which is a perceptual scanning tool that promotes broader perception of phenomena. The PMI is a framework for the categorization of plus, minus and interesting points and has the potential to generate ideas over a broad spectrum of perception. Hodgkinson (1994) noted that providing lecturers with feedback in response to the observation of their teaching can be time consuming and special consideration must be given to avoid being overly harsh or soft in the feedback provided. Previously, the observer had used the PMI successfully but considered the terms 'strengths', 'weaknesses' and 'ideas for consideration' to be more appropriate for providing feedback about teaching performances in higher education. The researchers believed the use of the revised terms could engender a greater sense of collegiality and recognition of professional expertise. At the end of each semester the observer summarized the feedback comments and reported the aggregated and anonymous strengths, weaknesses and ideas for consideration to the whole group. In this way, the researchers and participants were able to identify trends and practices that were common across the group. For example, they identified that whilst lecturers were experts in their fields many had difficulty in creating opportunities for interactive learning. At the group debriefing session participants shared what they did, as a result of the feedback, to make their lessons more interactive. Participants commented that the group sharing activity was particularly beneficial.

### *B. Data Collection.*

In second semester, the authors gained ethics approval to conduct research in relation to the teaching observations. As a result of discussions in the focus group sessions, the authors developed a written questionnaire which consisted of the eleven open ended questions, listed in Table 1; previously, the authors had asked participants eight of these questions at the semester one debriefing session but they discovered further questions were necessary. Consistent with the problem-solving and collaborative nature of action research, the researchers designed the questions to collect data about the participants' experiences with the teaching observations, evaluate the program and provide insight into how the program could be improved.

At the second semester group debriefing session one researcher asked participants the scheduled open-ended questions whilst the other took written notes. As only half of the participants attended the group debriefing session the researchers decided to email individuals the questions, so they could respond individually and in their own time. All participants completed the written questionnaire. The questionnaire was also given to the manager of the School to get a management perspective on the role of the teaching observations.

In addition to the questionnaire and the group debriefing sessions, the researchers interacted with the participants in the course of the teaching observations; this interaction was consistent with collection of data in as natural a setting as possible. In the role of School Coordinator of Teaching and Learning, the first author held informal discussions with staff members who had participated in peer observations, and a visiting teacher who had experience in an American university. The observer spoke to participants only when it did not interrupt their usual teaching activities. Participants introduced the observer to their classes when there were small numbers of students in the lectures, laboratory, and tutorial and seminar sessions. The observer sat at the back of the room as unobtrusively as possible and took notes. However in large lectures where there were often several hundred students present participants did not draw attention to the observer – who simply blended in to the crowd. When the observer did speak to participants she greeted them and chatted briefly to create a familiarity and calm any potential nervousness. The observer asked questions about what was happening in the class to get a sense of the context in which the teaching occurred. Typically, researchers use this approach to strengthen the interpretation of qualitative data; the oral and written feedback the observer gave to participants is a further example of 'member checking' used to validate the accuracy of qualitative research (Creswell, 2008). Participants noted the feedback was valid.

### *C. Research Limitations.*

The teaching observations described in this paper were the first foray into the implementation of a systematic voluntary peer review process and there were few participants; although there were ten teaching observations conducted there were only nine individual participants as one teacher was observed on two occasions. Hence the total population of participants was too small to generate a sample size suitable for robust quantitative research.

As peer review of teaching was not already embedded in the culture of the university and there were no direct rewards to encourage teachers to participate, the researchers suspect that it could be difficult, in the short term, to access high numbers of participants for further research. However, the results of this initial research indicate there is an appetite amongst participants to extend the program and include others in the systematic voluntary peer review of teaching. The

researchers identified several themes that emerged from the data analysis which could be developed into hypotheses and used as the basis for future quantitative research if a larger group of participants could be identified. The research findings are discussed in the next section.

#### **IV. Findings.**

The survey questions and the major themes that emerged from participants' responses are shown in Table 1. The percentages shown in Table 1 are linked to the number of respondents who identified with a particular theme rather than as a percentage of the total number of responses; in some instances a participant identified with more than one theme. In question 3 there were eight respondents rather than nine. Following Table 1, the authors present a discussion of the research findings in relation to participants' experiences with the teaching observations, evaluation of the program and insight into how the program could be improved.

##### *A. Data Analysis.*

The researchers began to get a feel for the data when they first questioned participants during the focus group sessions. Table 1 shows the final list of questions to which participants responded in writing. Although the researchers could have interviewed participants, it was less time consuming and therefore less intrusive to email the questions to participants. The researchers collected the responses and read through them to identify the major themes that are shown in Table 1. Following this the researchers categorized participants' responses to various questions in relation to the three thematic purposes of the research and reported the results narratively in the following sections of the paper.

##### *B. Participants' Experiences With The Teaching Observations.*

Participants commented on their experiences with the teaching observations in their responses to questions 2, 9 and 11. Slightly more participants had not been involved in teaching observations prior to this experience. It was not surprising that many lecturers had not participated in teaching observations given the relatively recent interest in teaching observations within the faculty and the heavy reliance on student satisfaction instruments such as *eVALUate* for judging and improving teaching performance. The majority of those who, previously, had been involved in teaching observations had observed sessional teachers or poor performing teachers. Two staff had done some direct observation either formally using a structured written format and/or informally as follows:

I have observed sessional staff informally by sitting in on the class and taking note of what seemed to work with the students and what not. Benefits: Self-improvement by incorporating positive pointers in own teaching style. Limitation: One observation is never sufficient to really get a view of what works well or not, but time limitations prohibit more extensive observations. (P3)

Part of the quote notes the benefit of teachers learning through observation, although this has to be tempered with problems of novices leading novices. It would make sense that the observer should usually have more expertise than the observee so there is some added value to

the observee in the feedback process. The second author benefitted as an observer by getting to know teaching staff and their varying levels of expertise. As the faculty Coordinator of Teaching and Learning the observer found it beneficial to know which staff members had particular strengths so that she could refer others who were seeking examples of exemplary teaching, to them. Also, the observer has gained discipline knowledge and been able to encourage exemplary teachers to become peer observers themselves. Participants were initially reluctant to consider taking on the role of observer but if peer observation is to be sustainable the load needs to be shared between ‘outsiders’ and ‘insiders.’ Understandably, novice observers would require induction and coaching to take on this role effectively. In the future, research could be conducted to investigate alternative dimensions of peer review.

All participants noted positive aspects including the individual observation by an independent person with teaching qualifications. For the majority of participants the most helpful aspect of the program was the feedback and advice they received from the observer. One staff member who was relatively new to teaching at Curtin found the first semester experience so useful that on their own initiative they invited the observer to a second observation in second semester.

[The observer] is an excellent facilitator of this program, and has observed my teaching two times now, including one time when I invited input from her. Her follow-up report promptly follows the observation session and is relevant, and provides professional guidance. She sat through the entire sessions, and the observations related to time usage, student interaction and student participation – all very relevant in a Master, case method environment. (P7)

A further positive aspect mentioned by several participants was the opportunity to share the experience and feedback in the group debrief. One participant particularly enjoyed the “frank and open discussions with other participants on what worked and what hasn’t” (P1). After the positive feedback from participants in first semester, the authors revised and repeated the group debriefing session in the second semester.

The researchers noted that the organizational learning literature included deliberate strategies for escalating individual to group to organizational routines as a means of exploiting and exploring innovation (Crossan, et al., 1999). The researchers perceived the group debriefing session to be a very useful tactic in sharing of tacit knowledge that had been made explicit through the observation and recording process.

Organizational change is difficult to achieve, it takes time and participants are often unable to put the required changes into practice (Gray, 2005; Loup and Koller, 2005). However, participants in this research indicated they had put a variety of changes into practice - with a common one being changes to improve student interaction. For example, one participant commented that “[the observer] gave very practical advice which I incorporated into my lectures. The resultant awareness created by this process was very useful and was directed at adult learning principles inherent in graduate programs” (P7). Other changes were consistent with changes from traditional lecture formats to more participative formats with emphasis on case studies, problem solving and question/answer dialogues. Given the move toward wholly online or blended learning, the authors believed it was significant that interactivity in the face-to-face teaching situation emerged as an area requiring improvement. Although face-to-face interaction

**Table 1. Survey Results.**

<b>Survey Question</b>		<b>Major Themes Emerging from Analysis of Responses</b>	<b>Percentage of Respondents (n=9) Associated with Themes</b>
1.	Do you agree with the purpose and method described? If not how would you would modify them?	Agreement	(100%)
2.	What were the best things about the teaching observation process you experienced?	Feedback from observer Discussion with colleagues Challenge Affirmation Commitment of staff	(88%) (44%) (22%) (11%) (11%)
3.	What things could be improved? (n =8 respondents for this question)	No changes suggested Observations should become more targeted Extend program to include all teaching staff Include a quantitative evaluation Improve general perception of peer evaluation	(50%) (12.5%) (12.5%) (12.5%) (12.5%)
4.	What format should the feedback be recorded in, and how should follow-up be conducted?	As is, written and verbal Aligned with eVALUate categories Use of tick-a-box format Links to feedback from previous observations Develop helpful practices manual	(66%) (11%) (11%) (11%) (11%)
5.	Do you believe the process should be expanded or disbanded? Why do you think so?	Expanded – being mindful of issues	(100%)
6.	Would you recommend others to undertake it? Why is this your recommendation?	Recommend to others – being mindful of the issues	(100%)
7.	Should it remain voluntary or become compulsory? Why or why not?	Voluntary Compulsory	(77%) (22%)
8.	Should the observations be done by outside parties or would it be better done by peers? Please explain why you think this.	Outside parties Peers	(77%) (22%)
9.	Have you ever undertaken observations of your peers and/or sessional staff? If so – How? and What were the benefits, limitations, or challenges?	No Yes	(55%) (44%)
10.	How else should teaching observations and/or development be undertaken?	No suggestions Use of video Observe exemplary teachers Peer observation for feedback Teaching Tips	(33%) (33%) (33%) (22%) (11%)
11.	Did you change any of your teaching practices as a result of the teaching observation? And if so, what did you change?	Yes No/not yet	(77%) (22%)

can be simulated online it is difficult to fully replicate and, when conducted skillfully, it can add value to the teaching and learning experiences of staff and students alike. Improvement of in-class interactivity is important given the availability of explicit knowledge in the form of document content (lecture slides, research papers, case studies, and web links) that is commonly distributed via the learning management system. There is now a greater need for teachers to make face-to-face classes distinctly focused on those aspects that cannot be done or cannot be done as well through online means.

Some staff mentioned that they were planning to incorporate changes in future semesters. This reinforces the issue of ongoing follow-up to support staff in development.

### *C. Evaluation Of The Program.*

The researchers used participants' responses to questions 1, 4 5, 6, 7 and 8 to evaluate the peer review program. In a nutshell, participants wholeheartedly agreed with the purpose of and method used in the teaching observations and recommended that the program should be extended and offered to others. The majority of respondents preferred participation in teaching observations to be voluntary and with an outside party conducting the observations. The majority of participants were satisfied with the current method of providing feedback; others suggested alternative ways of giving feedback and following-up on implementation of any suggested changes to teaching practices.

The purpose of the teaching observations was to help staff improve their teaching skills for both their individual professional development and the benefit of the student-teacher learning environment. The proposed method was through observation, interaction, and feedback from an experienced teacher, and sharing of these experiences with fellow participants. The second researcher was the experienced teacher who conducted the observations: she was deemed to be an experienced teacher because of her position within the faculty, her qualifications, previous teaching experience and reputation.

Although respondents recommended expansion of the program, there were some concerns about it being used for teaching performance management. One participant stated that "teachers should be observed and evaluated to ensure a high standard of teaching and striving for excellence in the [teaching and learning] experience of students" (P3). On the other hand another participant expressed concern about teaching observations being used punitively rather than developmentally.

If it is for benchmarking and comparing one versus the other or of a punitive kind or purely judging and comparing then it is a different issue altogether and many aspects of it need to be carefully planned and vetted out. (P9)

With respect to the underlying fears about how the process might be used by management it is noted that care is described as a foundation of knowledge creation (von Krough, 1998, in Jashapara 2004). If this is not cultivated and rather fear dominates then staff are more likely to abandon new ideas and stick to tried and tested routines, thus stifling the innovation that improves organizations. (Jashapara, 2004) This is the challenge for management to determine the balance of evaluation, benchmarking and control versus the need for creativity, exploration and innovation.

Methods of cultivating care include reward schemes, mentoring with senior staff and debriefings (Jashapara, 2004). Currently, although peer review has been identified as a goal in organizational planning documents, there is no immediate and direct reward for participating in the teaching observation process. The possibility exists for allowing time for participation in teaching observations as part of lecturers' workloads or providing rewards through the Teaching Performance Index. There is however the longer term incentive to use participation in teaching observation processes as evidence in promotion based on the scholarship of teaching and learning.

Given that participants understood the purpose of this peer review program was to help staff improve their teaching skills and not as a disciplinary measure they expressed their desire for others to have the opportunity to participate in teaching observations - although reinforcing having it be voluntary. One respondent thought that it would be helpful to have an observer who really understood specific barriers that student may have e.g. to compulsory units that were considered difficult and/or boring.

I should imagine most experienced lecturers have a fairly good idea of how effective their teaching is (student responses, week 4 feedback and eVALUate results) but may wish to know 'how to make things better'. It can be difficult to elicit positive student participation if the student has a barrier to learning that particular unit. An observer experienced in teaching such students could impart useful advice. (P6)

Participation in the current peer review program was voluntary. The majority of participants preferred teaching observations to remain voluntary; the School manager also preferred voluntary participation in peer review of teaching. However two of the nine respondents called for it be compulsory. The differing views are captured in the following quotes:

It should not be mandated. Lecturers need to be empowered – imposing this requirement could be de-motivational. The program needs to be promoted and evaluated on its merits. I for one, would highly recommend the program to all lecturers. (P7)

Compulsory. There should be quality control implemented in the teaching areas, as is the case with research publishing in rated journals, number of publications, etc. (P3)

The researchers noted that the voluntary aspect was often mentioned as desirable in responses to other questions. Given that other feedback such as eVALUate (the student satisfaction questionnaire) is already compulsory it is the authors' view that the benefits and costs of maintaining a voluntary program at this stage outweigh those of a mandated program. Through instruments such as eVALUate it is possible for Faculty Heads to identify underperforming teachers (based on student dissatisfaction) and then put in place interventions (such as mentoring and/or observation) to support teacher development.

The majority of respondents preferred teaching observations to be conducted by an external, independent teaching professional who understood the teaching context. Typically, respondents wanted the expertise and the impartiality of a person who was not in a direct working relationship. There were however two staff who saw value in peers. One thought that

peer observation could be a secondary, supporting observation to the expert observation. The following quote captures some of the issue of using peers;

[The teaching observations should be done] mainly independently, i.e. by someone who has no vested interest in the school. As if it's by peers then a whole lot of parameters need to be considered: it could turn out to be purely back thumping; or on the flip side, [they] could be overly critical – in case of some lack of trust, collegiality or due to some other vested and conflicting interest. (P9)

Following informal conversations with other staff members who had done peer observations in the past the authors noted that peer observation does have the advantage of increasing the skills of the observer/teacher as they observe other teachers directly. There is the possibility of tacit to tacit knowledge transfer. A thoughtful pairing of experienced and novice teachers additionally supported by the expert observer holds the promise of combining expertise, resources, and knowledge transfer. This three-way partnership between a supportive peer, a teacher and an education developer was used successfully at the University of Wollongong in their Teacher Development Program. In addition to the three-way partnership, training was recommended for all participants (Bell, 2001).

The majority of participants expressed satisfaction with the current approach to providing feedback on teaching observations. For example, one participant commented;

The written recorded feedback is good because it's permanent and relatively fast and convenient via email, and can be considered over time. Verbal discussion with the observer is also good to clarify and interpret, because it is important for both the teacher and observer to understand the context and goals. (P2).

One suggestion was that a framework could be developed and aligned with the *eVALUate* tool. There is some merit in a framework for the teaching observation. A structure might be used to focus or target particular areas. Aligning with *eVALUate* however, which is focused on student satisfaction would require some careful thought. There are many teacher observation instruments available in the literature which could be adapted and used (Bell, 2001, 2002; Blackmore, 2005; Brown and Ward-Griffin, 2005; Centra, 2000; Glassik, 1997; Green, et al., 1999; Harris, et al., 2008; Hodgkinson, 1994; Paulsen, 2002; Quinlan, 2002; Smith, 2000). The general approach (strengths, weaknesses, and ideas for consideration) used in the first two cycles of the teaching observations was aimed at being open and exploratory, allowing issues to emerge rather than adopting a very structured instrument.

#### *D. Insight Into How The Program Could Be Improved.*

The researchers considered participants' responses to questions 2 and 10 to provide insight into how the program could be improved. Whilst many participants struggled to provide ideas and reported that they were happy with the current process, there were some stated improvements. One participant noted an opportunity to focus the observation over time.

The observation could become targeted over time. For example if student/teacher interaction is chosen for improvement then specific interventions could be planned and



then observed in implementation by the observer. So the process and feedback becomes more focused and specific. (P2)

Another participant requested tracking over time in order to measure or observe self improvement. This was reinforced by a suggestion that there be follow-up observations to see how previous feedback had been incorporated. Other forms of follow-up or changes to the approach included the use of video to both observe one's own teaching and record the teaching of exemplary teachers so that others could observe them and the techniques they used more readily. Another suggestion from staff included having additional observations over time possibly using peers.

I once attended a seminar from a visiting lecturer in Biology who represented an 'exemplary teacher'. Of more importance than being observed I would like to observe such teachers in my teaching field. (P6)

A repository of teaching knowledge such as FAQs was also mentioned. Hence there appears to be several levels of scaffolding for teachers including use of explicit and tacit knowledge sharing and targeting at different levels of experience from novice to very experienced teachers.

## **V. Conclusion.**

The first year of the teaching observation process appears to have been successful in starting a dialogue amongst the teaching staff. In this situation, an independent teaching expert observed face-to-face teaching and gave feedback on teaching practices which facilitated individual and group reflection. The camaraderie and collegiality developed through the shared experiences is not to be underestimated in what can at times be an individual and somewhat isolating teaching journey. The group debrief at the end of each semester definitely added value to the individual experiences.

The researchers note further evidence of the success of this initiative by the interest it generated in other teaching areas of the business school. In 2010 the number of participants doubled as the initiative spread from being conducted in one School to two Schools. As more people hear about what we have done, they also have become interested in the possibility of participating in teaching observations. In the light of this initial success, the researchers offer the following suggestions for others who might also like to embark on a process of conducting teaching observations.

Participants in this research recommended that the 2009 teaching observation initiative should continue and be extended. Three key elements of the success of this program were that it was voluntary, collaborative and provided feedback regarding teaching practices. Therefore, the authors recommend that others seeking to implement similar programs should promote opportunities to participate in teaching observations on a voluntary basis. This overcomes a lot of resistance – if teachers don't want to join in they don't have to. The results of this research show that participation in teaching observations was a positive experience for the teachers. Typically, teachers were more enthusiastic about participating after they had been through the process – for example, one teacher in this research asked to be observed a second time and comments in the survey recommended follow-up observations. Thus, it seems that participation in the program

generated enthusiasm for the peer review of teaching; participants promoted the program amongst their colleagues and more people became involved. The researchers note that intrinsic motivation is more powerful than extrinsic motivation. Whilst the establishment of organizational infrastructures, such as rewards for teaching excellence and performance management processes are essential for the institutionalization of continual improvement initiatives such as the peer review of teaching, personal choice and the desire to excel in one's job are strong intrinsic motivators for participation in professional development programs.

In this initiative there was collaboration between a School and a faculty member and amongst peers within a School. The researchers recommend a collaborative approach. In the authors' opinions, total reliance on external support from an 'expert' is unsustainable and does not continuously build the capacity of teaching staff to understand and implement quality teaching practices; however, the researchers believe this approach could be used effectively as a catalyst for change. In 2010, the researchers continued and extended the 2009 process to gradually include peer observations. It is unknown as yet how effective this was; further research will be conducted once the process has been completed. Participants in this research recommended the combined use of 'expert' and peer teaching observations. Given the heavy workload of academics, the researchers postulate that an ideal scenario could involve the use of an 'expert' along with peer observations in which teachers could voluntarily agree to observe or be observed by another teacher. The initial teaching observation process was useful in identifying 'exemplary' teachers who could be observed by others or undergo an induction process to become observers themselves.

Participants in this research particularly noted the importance of receiving individual feedback in the form of identification of their strengths and weaknesses and the inclusion of ideas for consideration. In addition to this, participants stated that the group debriefing sessions at the end of each round of teaching observations gave them the opportunity to share with colleagues, enjoy camaraderie and benefit from each others' knowledge and experience. The authors recommend the inclusion of both individual and group feedback processes. Whilst the current approach of providing written and oral individual feedback was well received by participants, this research shows that there is potential to extend the range of feedback opportunities available to participants in successive rounds of teaching observations. For example, after an initial general teaching observation subsequent observations could target specific teaching areas and include fine tuned feedback.

In conclusion, the authors recognize that the research described in this paper was exploratory and described the preliminary findings of what has now become an ongoing study. The current research results showed that this approach worked. Consequently the program has been extended and there is opportunity for further research in the future. As a result of the current research several themes were identified from which hypotheses and instruments could be developed for more extensive qualitative and quantitative research.

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## **Evidence-based narratives to reconcile teaching practices in academic disciplines with the scholarship of teaching and learning**

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*Abstract: Connecting discipline scholars with the scholarship of teaching and learning (SoTL) is accepted as an essential part of professional academic practice across the higher education sector irrespective of discipline. To connect meaningfully with teaching practice, SoTL needs to be translated by the discipline scholar and narratives related to the discipline context constructed. Previous work on disciplinary diversity suggests that there is a need to take a more grounded approach to the development of discipline-based educational scholarship. How SoTL is defined is critical to how SoTL is interpreted within discipline contexts and some of the numerous models and definitions of SoTL transcend disciplinary boundaries, but there is no single agreed definition of what is meant by SoTL. This paper reviews some of the models of scholarly teaching and raises some questions about how the links between pedagogical theory and discipline teaching practice are made by discipline scholars. We advocate that by providing discipline scholars with ways to map and then collectively view their practices within disciplines that this is likely to provide information essential for exploring SoTL in each discipline and reconciling SoTL with academic disciplines.*

*Keywords: scholarly practice, academic disciplines*

### **I. Introduction.**

Higher education academics need to identify how their disciplines inform their SoTL practices as the critical step in unpacking the complexity and value of teaching practice within discipline contexts. The goal of this essay is to examine how these discipline-specific dimensions of SoTL might provide better links between educational theory and university teaching practice by: a) briefly reviewing how SoTL is interpreted as part of the professional practice of academics in the USA, UK and Australia; b) proposing a means by which individuals can gather and analyse their evidence of discipline-specific SoTL activity; c) examining the collected discipline narratives, with the view to resolve discipline patterns including to clarify where the discipline boundaries may lie. We<sup>3</sup> argue that clearer connections between SoTL and professional development and practice would elevate the status of scholarship in teaching and learning within the higher education sector. Connecting discipline scholars with pedagogical research and scholarship in teaching and learning (SoTL) is accepted as an essential part of professional academic practice

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and has been adopted into a set of professional standards in the United Kingdom (Prosser, 2008) and elsewhere.

It is misleading, however, to speak of SoTL as a monolithic term. There are different models and definitions of SoTL and while many of these are generic and transcend disciplinary contexts, “[I]ndividual disciplines and academics need to give those generic descriptions and ways of thinking meaning in their own teaching and learning contexts and practices” (Prosser, 2008, p 3). Critical engagement with the scholarly literature is necessary for academics to gain a realistic view of where their work practices are situated within the scholarly domain. Because academic staff are first and foremost disciplinary experts, they are best placed to comment on which models and practice of scholarship describe the scholarship of learning and teaching within the context of their own disciplines. Clegg (2008, p 5) states that “the way SoTL has approached making connections between scholarship and practice has been through the glue of disciplinarity”, which supports the view that the discipline expert is key to reconciling theory and practice.

## II. Interpreting SoTL.

### *A. National trends.*

Different national initiatives have interpreted the idea of the SoTL differently. In the USA, Boyer (1990) put forward the idea of scholarship as the link between research and teaching practice so that academics apply the same scholarly standards to their teaching as they would to research in their disciplines. Initiatives to promote the scholarship of teaching through organizations such as the Carnegie Foundation for the Advancement of Teaching draw on a pragmatic and experiential tradition with a long history in the US. This tradition, beginning with John Dewey in the early 20<sup>th</sup> century (Null, 2000) has resulted in a focus on documenting and making explicit the experience of teaching, with the evidence cited in publications describing university teaching practice usually being in the form of individual case studies or informal observations.

Kolb's (1984) experiential learning cycle, which is based upon empirical research on student learning in US universities, provides a conceptual model that can be applied to the scholarship of teaching. It describes an explicit development of theory that can be applied to the practice of individual academics as teachers within their disciplines. The academic reflects upon teaching experience, develops theories about what works best, and puts these theories into action to generate new experiences from which to learn. When individuals share the outcomes of this learning process with colleagues, through peer review, it builds scholarly knowledge about teaching practice. This interpretation of the scholarship of teaching relies upon the peer review process to measure the quality of the scholarship and the teaching practice.

The strategy in the UK of promoting scholarship of teaching mainly through acknowledging and rewarding individual lecturers who evaluate, reflect upon and publish papers about their teaching has been questioned. This is because professional development for academics by introducing them to scholarly educational literature has had limited results. In both the UK and the USA, schemes to promote the scholarship of teaching have mainly benefited a minority of highly motivated and tenacious individuals, rather than the broad majority of university teachers. There is a lack of convincing evidence for wholesale cultural change resulting from such initiatives (Gosling, 2004; Huber, 2001; 2004). A summative evaluation (HEFCE, 2005) of the outcomes from £181M spent 2000–2005 found that individual teaching

awards had limited impact on mainstream teaching quality and questioned their 'value for money'. This evaluation recommended more student-centred approaches. Subsequent funding was directed towards discipline-specific centres of excellence in teaching and learning (CETL). Formative evaluation of CETL identifies pedagogic research that ranges from informal individual and practice-based narratives to formal research of the type that meets established disciplinary research standards, but notes that most examples are in the former category and there are few in the latter (Saunders et al., 2008).

In Australia, there has been support for professional study programs to connect discipline academics with the scholarly literature of learning; yet, the UK experience has shown that this approach has had limited effectiveness as a sole strategy. There has been the additional strategy in Australia of using survey instruments such as the Course Experience Questionnaire (Ramsden, 1991) and the Graduate Destination Survey in a sensible attempt to measure the quality of student learning outcomes (Australian Vice-Chancellors' Committee and Graduate Careers Council of Australia, 2001). However, these instruments do not measure the direct influence of academics' scholarly input upon these outcomes either in terms of discipline research or pedagogical research excellence. It is therefore not clear whether, and if so how, the institutional and individual academic practices initiated in response to national policies have improved student learning. Nor is it clear how the scholarly input to teaching can be evaluated. This lack of an evaluation strategy remains a concern and, regardless of national context, the question remains: how do we measure the success of investing in programs to improve engagement of discipline academics with SoTL?

### *B. Scholarly teaching practice.*

Since 1990, there have been numerous attempts by higher education specialists (as distinct from disciplinary practitioners) to characterise and model levels of scholarly practice in teaching and learning informed by different national contexts. These models include a 3 by 3 matrix (Kreber and Cranton, 2000), two complementary 4 by 4 matrices (Trigwell, Martin, Benjamin and Prosser, 2000) and a model including student perspectives (Trigwell and Shale, 2004). A common thread is the focus on individual academics being responsible for providing the evidence for their scholarly practices.

Providing evidence of educational effectiveness, in a form that will be accepted by educational specialists, can be very difficult for academics in some disciplinary contexts. There are two aspects to this difficulty. One is that not only are the educational theories and research methods quite different from those used in some other disciplines, but the nature of what is considered valid evidence differs. The other is that different disciplines have different sets of tacit knowledge; Shulman (2005, p. 55) calls that which is left tacit the *deep structure* of signature pedagogies in professions and is the "set of assumptions about how best to impart a certain body of knowledge". What is valued, made explicit and articulated as academic knowledge in one discipline is left tacit in another (Toohey, 1999; Trowler and Cooper, 2002), which emphasises the importance of discipline perspectives in the SoTL dialogue.

By way of example, Borrego (2007a) notes the difficulties experienced by those engineering academics who wish to do educational research because it means engaging with a relatively alien domain and language, which requires unfamiliar research methods. Meaningful definitions of scholarly quality in university learning and teaching first requires different practices in their contexts – individual, disciplinary, departmental, institutional and national – to



be brought to the surface and articulated. Some disciplines have gone further in developing discipline-specific educational scholarship than others. Medical education, for example, has several well-regarded international journals that provide mainstream academic recognition for discipline-based educational research. Engineering is further behind (Borrego, 2007b). In our own university, support systems for research and evaluation of education are much better developed in Medicine than in Engineering. Even in preparing this paper we found that we had to reconcile different disciplinary views on what constitutes valid evidence in our respective research domains in order to assess what an “evidence-based narrative” of SoTL within the disciplines may look like. For example, in Law there is detailed attention to language and process. In this context narratives can have a particular validity in themselves as evidence of scholarship. In Engineering, narratives are just stories that need substantiation with measurable ‘facts’. Much of the knowledge about the teaching process remains tacit and unacknowledged, so there are missing links in the story of how teaching affects learning. Where the educational research is better organised, as in Medicine, this is less of a problem, because there is more language and more factual evidence to link scholarly teaching practice with measures of student learning. We explore the notion of discipline differences further in Section III.

In 2001, Neuman made the statement that discussions and decision-making in teaching, including policy, seem to be made based on past personal experience and, at the same time, policy makers “seem competent to talk about teaching, but its complexity is rarely acknowledged” (2001, p. 135). Trigwell et al., (2000) and Lueddeke (2008) suggest that the discipline expert is key. Because academics are the critical link between learning and the discipline content, we extend ‘scholarship’ to the initiatives that academics have undertaken to improve student engagement within the disciplines (and in general). However, it is not always clear how the scholarly literature has been used to inform either teaching practice or the institutional processes and practices that support teaching. We assert that transparency is called for.

The various perspectives on scholarly teaching practice reviewed here raise some questions about whether SoTL is: a) a community of practice for enthusiastic teachers to support and encourage each other; b) a field of expertise led by specialist researchers in higher education who can advise university teachers across disciplines, and are the arbiters of SoTL quality and/or; c) a process for developing new epistemological frameworks for disciplinary learning and teaching. We suggest that the third option needs more attention.

### **III. Discipline values and narratives.**

Within discipline communities, there is the potential for teachers to share teaching knowledge informally, by telling each other stories about their experiences. However, it is a challenge for academic staff to articulate their narratives about teaching practice in a way that meets the scholarly standards expected in mainstream academic research, either in their own disciplines or as specialists in higher education. It is also difficult to reconcile individual contractual obligations with the higher education institution’s legal obligations (Cowley, 2008), which is that one needs to be scholarly about teaching and research. The further challenge is to articulate such narratives beyond the discipline confines in a way that makes meaning to scholars from other disciplines. In order to resolve discipline values through SoTL narratives, we explore how research, teaching and professional development interact in the context of SoTL in a range of disciplinary contexts.

### *A. Research and teaching: discipline differences.*

In discipline-based university departments there is no simple functional relationship between research and teaching. Jenkins (2004) failed to find convincing evidence for the link between research and teaching activities in the UK and Australia. However, it is within the discipline that decisions about both teaching and research are discussed and organised and where both are shaped by the same disciplinary values (Becher and Trowler, 2001). Each disciplinary teaching and learning regime (Trowler and Cooper, 2002) has different concepts of identity, tacit assumptions, codes of significance, rules and recurrent practices. This helps to explain why staff development schemes that do not connect with disciplines have largely failed to influence teaching practices.

Teaching practice is expected to focus on student learning, assessment, curriculum development and on ensuring alignment between curriculum components. Linking theory to practice is an essential next step. To achieve linkage of theory and practice Healey (2000) argues that it is easier to engage some disciplinary practitioners with the scholarly literature than others due to the intrinsic natures of those disciplines and Borrego (2007a) supports this stance. How academics view the constraints of their home-disciplines at interfacing with SoTL theory and practice to effect change is therefore worthy of further exploration.

There is value in exposing discipline narratives within the institutional narrative in order to reveal key patterns. The discipline narrative will be an amalgam of the individual narratives and will be infused with disciplinary values to a greater and lesser extent. If academics were able to document all of their teaching tasks and annotate them with the rationale for undertaking them, it would be possible to distinguish similar approaches taken by those represented in by any given discipline. For example, Neuman (2001) used the 'hard', 'pure', 'soft', 'applied' discipline descriptors (Biglan, 1973) to map her work and asserts that each discipline uses the same sorts of teaching approaches but adapts them to their discipline. This is consistent with an analysis of individual academics' strategies for introducing and adapting information and communication technologies to teaching and learning (Russell, 2005), which showed patterns of difference between 'hard' and 'soft' disciplines.

### *B. Linking SoTL and professional development.*

Academics feel the need to account for activities (Reid, 2002, p. 3) because the demands of the job and the higher education climate of accountability does not allow for anything less. The activities that are measured by the national governing bodies and that are linked to funding are the most usual activities and outcomes reported. However, the work that academics do beyond reportable metrics is complex, diverse and difficult to capture. Wiese et al. (2007) in the USA took on the challenge to capture the breadth of activities (including 'service') normally engaged in by staff so as to facilitate a more transparent career development process for academics in the health care discipline. They found 55 activities that could produce measures of academic 'work' falling into four domains: classroom teaching, clinic, academic support, and research. Their paper describes how they developed a systematic transparent process for describing and ranking academic work (basing this on the work of Boyer). They linked these activities to an e-application for career progression. Palmer College, where this work was carried out adopted the definition of scholarship: "[S]cholarship and creative activity are understood to be intellectual works the significance of which is validated by peers and which is communicated. The principle

of peer review and recognition becomes increasingly important as [the academic] progresses through the academic ranks. Scholarship emphasizes project-oriented behaviour that results in a measurable product or outcome (e.g., a publication, written report, manual, or protocol)” (Wiese et al., 2007, p 530).

Because teaching is approached in discipline-directed ways academics should be in a position to defend the approaches chosen to support learning in their disciplines. Just what such a justification would look like in each discipline remains unclear and what excellence of practice would look like remains unresolved. We lack frameworks to incorporate the voices of discipline academics and ways determine at least the degree to which discipline values are evident in our teaching and scholarly practices. This is at odds with our practice as researchers where peer review is first and foremost the means by which we determine the calibre of our work. More recently national frameworks have been imposed on the higher education sector (e.g. UK Research Assessment Exercise – UK RAE; Excellence in Research in Australia -ERA). Such frameworks have been useful in highlighting just how diverse the definition of “research” is defined by those with disciplines.

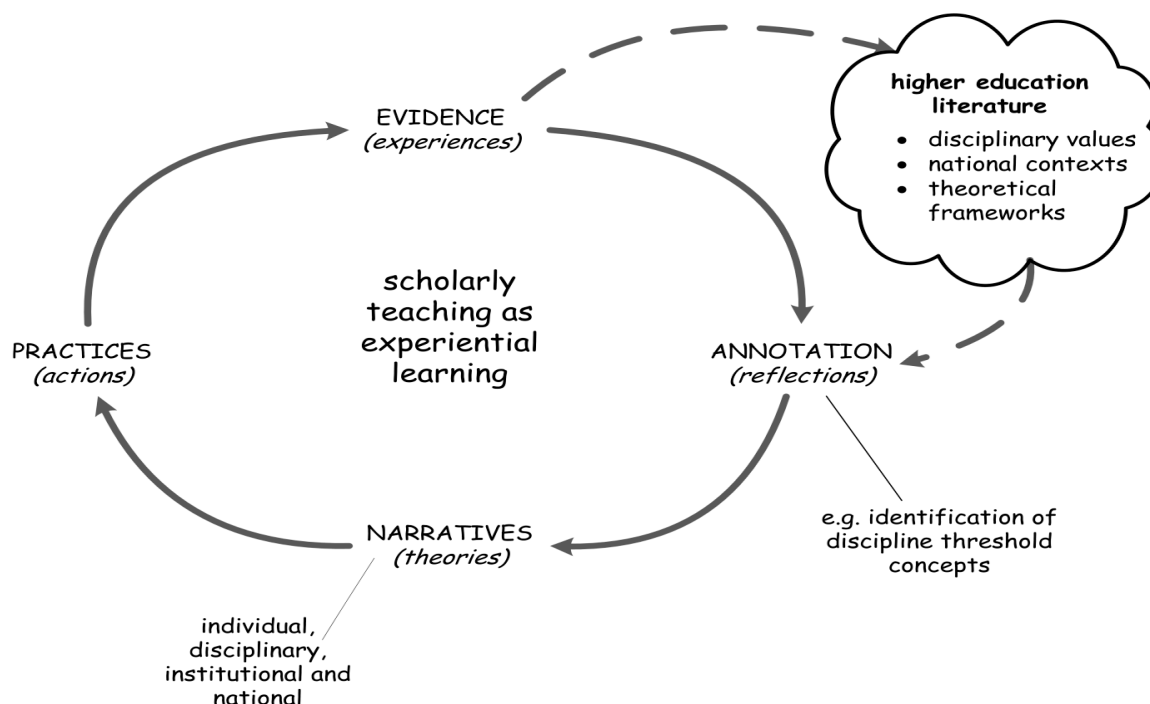
### *C. SoTL as a learning process.*

If disciplinary values impact on approaches to teaching, then there are likely to be discipline differences in both the evidence to support successful teaching practice, and how SoTL is narrated. These narratives are likely to reveal how SoTL within the discipline supports student learning and may explain and justify how practice and theory are linked. By examining our collective discipline annotations we may be able to resolve whether SoTL within each discipline is different, and if so how. We suggest that the process of collecting evidence, reflection and narrative are part of a learning cycle within disciplines (Figure 1) that can be aligned to Kolb’s work (1984).

### *D. Reconciling our teaching practices with SoTL.*

Higher education academics need to identify and reconcile tacit disciplinary knowledge with their SoTL approach in order to unpack the complexity and value of their practices. Like Trigwell et al. (2000) and Weise et al. (2007) we consider that the first step needs to be practice-led. The benefit of this is that it allows individual academics to start from a familiar place, their discipline-base, rather than from less familiar theoretical standpoints which can be problematic for academics new to SoTL. By annotating activities with where they map on the scholarly landscape, an individual academic can gain a clearer perspective of their scholarly progress and reflect on their dual roles as discipline expert and SoTL practitioner.

Given the interest in the ways that discipline values impact on teaching practices, we argue that there is value in creating ways to view the collective activities and practices of those within and across disciplines. By creating this collective disciplinary view the influence of discipline on SoTL will be revealed and understood. More importantly, by examining how the values of their home-discipline are reconciled with SoTL, academics are able to understand the impacts of scholarly approaches to their teaching practices as a way of reviewing their home-disciplines.



**Figure 1. Scholarship of Teaching and Learning as an experiential learning cycle for individual academics, disciplinary department and institutional support systems (based on Kolb, 1984).**

#### IV. Mapping SoTL theory and teaching practices.

The literature offers ways of bringing together theories and practices of SoTL (Kreber and Cranton, 2000; Trigwell et al., 2000). Kreber and Cranton devised a 3 by 3 matrix to bring together notions of knowledge (pedagogical, instructional, curriculum) and reflection (premise, process, content), which they say could be used by academic staff to indicate scholarly practices in teaching and learning.

Unlike the theory-led SoTL approach of Kreber and Cranton (2000), Trigwell et al., (2000), constructed their model of SoTL using the perceptions of twenty academic staff about their SoTL practices. The perceptions of these particular academics were categorised into five qualitatively different approaches to the scholarship of teaching. These were mapped within two different 4 by 4 matrices that linked staff perception with 'student-centred' and 'teacher-focused' strategies. This work offers a map of the "outcome space" of an academic's perceptions of learning and teaching practices. This can assist staff in identifying to what extent their work is student-centred. The multidimensional model defines SoTL as having four dimensions (informed, reflection, communication and conception). These dimensions describe the range of practice from informal to formal: through theorising, reflections and communications. The sample size used to generate the model is small. Despite this, the model provides a framework for academic staff to begin to gauge the merit of their own SoTL undertakings and accomplishments; the model does not, however, provide a way to identify the prevailing views within or between disciplines. Academics must consider what evidence is needed to substantiate their claim of being student-centred and scholarly.

A revised *Approaches to teaching inventory* has been published by Trigwell, Prosser and Ginns (2005). This inventory validates the earlier work of Trigwell and Prosser (2004) and is informed by the perceptions of nearly 2000 individuals. The usefulness of the inventory lies in providing a starting point for academic staff to describe, reflect and communicate their practices; academics are required to link their practices with supporting evidence. The alignment of our practices with models derived from the perceptions of academics in our own national context (Trigwell et al., 2008) seems to be a better fit than frameworks derived elsewhere (Nicholls, 2004). Regardless, linking extant theory and current practice can inform the ways forward for personal and career progression and the consensus is that critical reflection has an important part in the scholarly process.

Critical reflection on one's own practices can be viewed as an opportunity to identify the personal stumbling blocks, difficult transitions or major transformative moments in scholarly progress. The notion of transformative moments comes from the work of Meyer and Land (2003), who, with their *threshold concept framework*, have provided a useful way for academics to review their SoTL constraints as well as a lens through which to identify student learning obstacles and key disciplinary thresholds concepts. The theory of *threshold concepts* is being discussed internationally and is evolving within and across the disciplines. This offers a way for academics to identify challenges and to then describe what helped them through their own thresholds of learning in the SoTL domain. The whole scholarly practice and process could be better understood and further revealed by this process, but, more importantly, it would be delineated within the discipline itself.

Much can be learnt from highly aggregated collections of the information, the data, which we submit to our respective institutions. Goodyear (2005) analysed the evidence collected as part of the UK Research Assessment Exercise 2001 to answer the question "what does international excellence in educational research look like?" If we took a similar approach and if we generated a collective teaching inventory, we would be able to ascertain what excellence in teaching practice in each of the academic disciplines looks like.

## V. Conclusions and recommendations.

Whether or not the engagement in SoTL by discipline academics can drive institutional change in the higher education sector is still open for discussion. Roxå, Olsson, and Mårtensson (2007) have asserted that the way to bring about change for the organisation is through academic staff engaging with SoTL and this paper suggests a way to improve such engagement through the capturing and examining collective SoTL accomplishments, practices and activities. This will prove valuable for viewing practice at the level of the individual, the discipline, organisational unit, the higher education sector at large.

The first step, and one that we have begun in our own university, the University of New South Wales, is to begin collecting and organising evidence of all scholarly activity within each discipline, formal and informal, recognised and unrecognised. The usefulness of this lies in enabling to individual staff to more easily view and reflect on personal patterns, and more practically will be useful for gaining individual recognition for sustained SoTL practice (e.g., career progression, learning and teaching awards). Discipline academics are likely to benefit from viewing successful SoTL practices contextualised in their discipline. Educational experts and academic developers will benefit from having an institutional inventory of expertise in SoTL and a means for improving the visibility of all SoTL practices and communities of practice. The institution will benefit from having the departmental and institutional SoTL track records

captured, archived and fixed in the corporate history and at a highly aggregated level, discipline teaching practices may be resolved.

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## **The student-authored essay as a teaching tool**

**John R. Slade Jr.<sup>1</sup>**

*Abstract: Students who enter college dreading their “required” courses are understandably skeptical of their ability to succeed in first-year writing. Their lack of preparation added to their skepticism results in students with too little confidence that their writing will ever resemble the models used in textbooks. As a tool of engagement, student-authored essays provide writing models students readily identify with, thereby promoting confidence. This analysis examines student perceptions of the student-authored essay as a writing tool and the implications of its use to improve learning outcomes in first-year writing courses.*

*Keywords: composition strategies, essay models, first-year writing, foundation writing courses*

Uncertainty about the effectiveness of my teaching techniques created considerable stress during my first years as a composition instructor. Before I was introduced to the formal language of assessment, I employed the rudimentary practice of asking students every few weeks what they found particularly helpful or unhelpful about my teaching. The first time out, I phrased the call for feedback something like this: “Write down anything I’m doing that helps you learn the material along with those things that don’t help much.”

Student essays used as writing models garnered the most frequent and positive comments from my informal assessment. The feedback indicated that students felt closer kinship with essay models written by their peers. More captivating was the self-confidence created from the sense that they could reach levels of writing proficiency exhibited in essays by other students. Conversely, most suggested little assurance their writing would ever resemble that of the accomplished authors who appeared in their textbooks. Throughout those early years of community college teaching, I employed this crude but seemingly effective technique of formative assessment in most classes I taught. After returning to the classroom after many years in administration, I have resurrected this informal practice of real-time assessment. This paper reports on a formal follow up to that practice and examines whether students perceive student-authored essays as more beneficial teaching aids than professional writing models.

### **I. Background.**

This study was undertaken in fall 2008 and spring 2009 at NC A&T State University to examine the efficacy of a pedagogical tool, the student-authored essay. One of sixteen constituent campuses of the University of North Carolina System, NC A&T enrolled 10,388 students, 8,829 of whom were undergraduates, during the period of this study. Of the undergraduates, 1,607 were first-time freshmen with an average SAT score of 900 (442 verbal) for in-state students and 1,002 (493 verbal) for out-of-state students (NC A&T, 2010). The University of North Carolina (2010) reported the average SAT score for all sixteen campuses as 1,083. Forty-five percent of NC A&T’s fall 2008 first-time freshmen ranked in the top two-fifths of their high school class,

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and slightly more, 47 percent, ranked in the bottom three-fifths (NC A&T, 2010). The verbal score takes on a prescient nature if, as was the case for NC A&T in fall 2009, the SAT score is the only factor used in determining student preparation for placement in the first-year writing courses.

In fall 2006, North Carolina A&T implemented an ambitious general education reform program designed around the concept of interdisciplinarity. Critical Writing, one of five foundation courses required of all students at NC A&T, uses critical thinking explicitly as scaffolding for developing writing skills (Graves, 2006). Though approximately 300 freshmen enrolled in a developmental writing course, university policy did not obligate them to register for the preparatory course. This practice of optional placement combined with moderately low selectivity results in writing classes populated with students of wide-ranging abilities. As a member of the writing team, I can attest to the concerns voiced by writing faculty who often find it difficult to gauge how much review and remediation to provide. The division requirement to adhere to a common syllabus and assignments (in part to facilitate the collection of valid assessment data) in some ways conflicts with needed and appropriate remediation based on formative assessment.

As with any institution, NC A&T's student profile influences the day-to-day instructional challenges writing instructors must manage. Based on the institution's results from its participation in the Wabash National Study of Liberal Arts Education, NC A&T students do not place as high a priority on skills, behaviors, and dispositions generally associated with college success. In 2005 and 2007, the Wabash College-led study gauged student opinions and feedback from 27 institutions on several factors considered pertinent to college performance and success. NC A&T students ranked near the top in categories measuring aspirations such as desire to earn high grades, to draw a high income, and to engage in entrepreneurship. However, self-reported dispositions and behaviors normally associated with high ambitions placed NC A&T students near the bottom, 26<sup>th</sup>, for instance, when asked if they were willing to work hard to earn superior grades. They charted similar results in responses to questions about their reading habits, ranking 25<sup>th</sup> when queried about their willingness to stay with a good book without falling into boredom (Childress and Southerland, 2008, pp. 16-17).

The dichotomous attitudes students report in the Wabash study extend to their perspectives on learning to write competently. My own students generally agree with the utilitarian purposes of obtaining sound writing skills; however, far too many do not consider the far-reaching consequences of poor writing skills to a career. While such student attitudes stem in part from freshman naiveté, their erroneous notions sometimes persist until the alerts they eventually awaken to come too late for comprehensive treatment.

## II. Objective of Study.

This study aimed to gain some measure of how students perceive two types of writing models used in a foundation-writing course. In the Critical Writing course at NC A&T State University, instructors routinely employ as instructional tools model essays supplied by the textbook and its supplements. During fall 2008 and spring 2009, the Critical Writing courses used *Critical Thinking, Reading, and Writing* by Sylvan Barnett and Hugo Bedau (6<sup>th</sup> edition) as its primary text, which included a mix of writings by professional authors and student-authored essays, mainly intended to model application of various rhetorical modes. It seems intuitive that instructors would rely more heavily on the student-authored essays as models to develop student

writing since students are more likely to recognize their own writing patterns in the work of other students. What seems likely, however, is mitigated by another important goal of the instructor, which is to encourage students to develop reading habits befitting college students and eventual college graduates. As Emory University's Mark Bauerlein (2008) describes in his book about the digital age's effects on the intellectual development of today's youth, students who have relegated their sources of information and models of communication to informal and brief modes such as net magazines, social networking sites, and email are suffering predictable negative consequences. To reverse the decline, instructors battle back in one of the few ways they can, which is to assign well-regarded pieces of writing with hope that students will notice and emulate the techniques of good writers.

It is easily understood that students who bring less than adequate preparation for college writing coupled with dispositions that hinder their engagement with the subject are less likely to believe that their writing skills will ever match those exhibited in models highlighted in a textbook. This is the focus of this small study – to note student perspectives of writing models used in foundation writing courses at NC A&T. The broader question is whether the analysis of these perspectives can provide useful guidance in what may be more effective in teaching foundation writing courses, especially at an institution where under-preparedness and negative dispositions toward positive collegiate habits conflate to create even greater challenges to achieving proficiency in a fundamental skill.

### **III. Procedure and Results.**

This study surveyed freshmen students at North Carolina A&T State University enrolled in the university's required foundation writing course titled Critical Writing. Students from five classes (n = 84) were given a questionnaire that solicited feedback about the writing models used during the term. The questionnaire categorized the writing models as "student essays" and "professional essays," was administered the last day of class, and requested the following assessments from students: which category more clearly represented the concepts taught during the semester, which category they referenced more often when applying the concepts to their own writing, and which category they recommended for future sections of the course. In addition to choosing from given responses, students were given the opportunity to elaborate on their choices. The questionnaire also solicited information on previous college-level writing courses students had taken, what types of writing assistance (if any) did students utilize outside of class, and whether students were repeating the course. Twenty-two, or 26 percent, of the respondents completed other college-level writing courses prior to completing Critical Writing in either fall 2008 or spring 2009, and 12, or 14 percent, were repeating the course. All but 8 of the 84 students who completed the questionnaire sought assistance outside of class during the term. Writing assistance utilized while enrolled in the course included such services as the campus-based writing center, internet-based writing tools, tutors, and interaction with the instructor via email and office visits.

Survey responses shown in Table 1 below align with the anecdotal responses received from earlier experiences with community college students. By almost 3 to 1, students sampled in this study preferred the writing models by students to those authored by professional writers. In line with the community college students, freshmen at North Carolina A&T State University expressed similar reasons for preferring the student models. The most prevalent reason cited greater identification with the student papers and therefore more confidence in the ability to

successfully complete similar writing exercises. The frequency table below presents the frequency results:

**Table 1. Student preference for category of model essay (n = 84).**

	Frequency	Percent
Student-Authored Essays	63	75
Professional Essays	21	25

Students surveyed employed the word *relate* most often in detailing reasons for choosing the student essays. Based on the informal feedback from the community college experience, it was expected that students in first-year writing courses at the senior institution would match the sentiment.

It is necessary to note that students tended to provide their own gloss to the two core terms used in the survey: *professional essay* and *student essay*. Any essay appearing in the textbook, no matter its label or author, many students considered professional work. They reasoned that any essay in the textbook had earned its way in and therefore must be of superior quality. They then concluded that any essay, professionally authored or otherwise, between the covers of a textbook created a greater challenge to emulate and learn from (at least psychologically). Informal feedback suggested that the more likely students were to judge a textbook essay of “professional” quality, the less they felt it benefitted them as a learning tool. Consequently, class activities based on essays from the textbook yielded less discussion than student models provided from present or former students. Though students tended to draw some distinction between student essays in the textbook and those from their peers or former students, they overwhelmingly favored the student essay when presented as a generic category.

Student preference for the student-authored essay far outpaced the rate at which students reported how often they referenced this same category of essay, as Table 2 below shows:

**Table 2. Type of essay students referenced most often (n = 84).**

	Frequency	Percent
Student-Authored Essays	43	51
Professional Essays	38	45
Both about the same	3	4

The results above may mask a wider gap between how often students used one essay type over the other. In an informal follow up, students indicated that they defined a key term more broadly than anticipated. Some students interpreted *referencing* an essay as any use or mention of it. For instance, students considered an essay assigned as homework as a reference to it. Some students added to their count in-class uses of the essay, even those instances that I initiated. Therefore, it is a reasonable conjecture that the manner in which I referenced the essays in class and how often I directed attention to them likely influenced student responses concerning this variable. This is particularly noteworthy because it is true that I spent more time in sustained discussion of the essays from the textbook. I did so because of students’ reticence when discussing textbook-based essays. In terms of self-selected use, some students admitted that they never referenced the essays in the text beyond homework, class discussion, and explicit directions to review them (which was often). Therefore, it is possible that the mismatch noted could be a result of the manner in which students interpreted the term *reference*.

Verbal feedback from students combined with a cross tabulation analysis of the essay type preferred and the category referenced more often provided a clearer snapshot of student perspectives. Of the 63 students who judged the student-authored essay as more aligned with concepts taught in the course, 30 said they referenced the student essays more often and 30 made the opposite choice. Thirteen of the 21 students who viewed the professional essays as more representative of the course concepts reported using the student-authored essays more in completing their own assignments.

The lopsided results regarding recommendations students made for future foundation writing courses are more difficult to understand. As Table 3 below illustrates, students responding to the questionnaire overwhelmingly recommended both essay categories:

**Table 3. Type of Essay Students Would Recommend for Use (n = 84).**

	Frequency	Percent
Student-Authored Essays Only	11	13
Professional Essays Only	0	0
Both	70	83
No Response	3	4

None recommended the professional essay as a single source, and 11 respondents endorsed the use of student samples only. Though the numerical data favored both essay categories in this questionnaire item, written comments tended to nuance the responses. The remarks below typify feedback from students who recommended an even balance of student-authored and professional essays:

- *Although I liked the professional essays better, some students may be able to relate to the student essays.*
- *The professional essays make me think a little harder while the student essays you understand right away.*
- *Though professional [essays] may be easier to reference or go along with, the student essays may relate more to me and I can find similarities. The students peer edit and grow in that process.*
- *With professional [essays] it's easier to see more techniques; with students it is easier to understand.*

Overall, student comments showed clear recognition of the benefits and drawbacks to both types of essays as teaching tools. Several comments mentioned that the exposure to professional essays illustrated what students might achieve. In many cases, a student's desire for reliable and repeatable writing approaches applicable to other course work mitigated desire to emulate writers accomplished enough to have their work appear in a textbook.

#### **IV. Discussion.**

It is clear that students in this study responded with marked difference to the two categories of writing samples used in class. Students interpreted value in both categories of writing samples but gave more credit for their writing development to student-authored samples, namely because they identified more with writers who were also their peers. Perhaps this perspective by students indicates that reading, discussing, and learning from a peer possibly provided a psychological lift that built confidence. The positive response to student-authored essays, which students believed more clearly delineated the structures, techniques, and rhetorical tools taught in foundation

writing courses, suggests that writing models perceived as accessible matter, especially for the marginal writer. In other words, the student-authored essays, especially those outside of the textbook, employed techniques and forms considered more basic and therefore more recognizable to developing (transitioning) writers.

But what is basic? To what degree is the foundation-writing course obligated to take a student beyond what some call the formula essay? Does the so-called formula essay do more harm than good for students? To address this question, I will examine a common component emphasized in the formula essay that is not always clearly reflected in professional essays used as teaching samples. This element is the *topic sentence*.

Crew (1987) points out that rules listed in writing texts and taught by teachers of composition often contradict the practices of professional writers (p. 346). To illustrate his point, he references Braddock (1974), who analyzed 25 articles from magazines such as *The Atlantic* and *The New Yorker* regarding the frequency and placement of topic sentences. Braddock's essay famously estimates that only 13 percent of expository paragraphs he reviewed began with a topic sentence and that uses of topic sentences vary by author. Many composition experts continue to connect Braddock's statistic to outmoded thinking regarding the necessity of topic sentences. However, reading Braddock more closely makes his often-quoted statistic seem out of context. Actually, his analysis leads him to the conclusion that composition teachers and writing handbooks should provide fuller disclosure about the lessons they teach and the contradicting practices of professional writers. In fact, as the passage below shows, Braddock indicates that more use of topic sentences in the samples in his study would aid reader comprehension, and he advocates that composition teachers should continue to illustrate for their students the benefit of the topic sentence in learning to develop good paragraphs:

In my opinion, often the writing in the 25 essays would have been clearer and more comfortable to read if the paragraphs had presented more explicit topic sentences. But what this study does suggest is this: While helping students use clear topic sentences in their writing and identify variously presented topical ideas in their reading, the teacher should not pretend that professional writers largely follow the practices he is advocating (Braddock, 1974, p. 301).

Rather selective readings of Braddock's essay fail to acknowledge the narrowness of his target; he limited his study to articles in popular magazines. As Popken (1987) points out, Braddock's analysis is instructive regarding the writing styles of general interest magazine authors, but their use of topic sentences – or lack of use – may indicate more about the interplay among topic, audience, and writing style than it does about the usefulness of the topic sentence. Viewed from this perspective, Braddock's article describes the stylistic practices and preferences of professional writers and simply alerts teachers to reframe their instruction regarding the necessity of the topic sentence as a rhetorical tool. Therefore, it is inaccurate to suggest that his study assails the topic sentence.

However, since Braddock's article is often cited and the implications perhaps too broadly applied, Popken's article calls for further studies to correct misapplications of Braddock's conclusions. D'Angelo (1986) responds to those who move past Braddock and who actually campaign against the topic sentence as nearly useless in teaching composition. He counters with research in reading comprehension that demonstrates better student recall and efficiency when

students read information organized with topic sentences and other structural techniques (p. 438). He concludes the following:

If we base the teaching of writing on the way people actually write (i.e., on rhetorical performance), then the topic sentence will be of limited use in the teaching of writing, since many professional writers do not use topic sentences. But if we base our teaching on what people can accomplish with language (i.e., on rhetorical competence), as it seems to me 19th-century composition theorists did, then the topic sentence can be a useful resource that writers can turn to if the need arises. (D'Angelo, 1987, p. 439)

Comments from students who participated in this study of student-authored essays illuminate a remnant of D'Angelo: Student writers long for instruction and instructional tools that emphasize immediate and practical uses.

As has been pointed out, Braddock's research on the topic sentence limits its analysis to pieces from popular magazines, which led some to question whether its results generally applied to academic forms of writing such as those found in textbooks. Smith (2008) returns to Braddock's influential research and re-examines his method as well as replications of it, concluding that Braddock's deduction does not generalize to forms of writing students most often encounter in courses outside of composition and literature classes. Smith's research analyzes journal articles in history and shows that 95 percent of what he calls discourse block units (one or more paragraphs that develop a sub-topic of the main topic) are controlled by an explicit topic idea. More to the point, his analysis finds that a topic idea appears at the beginning of the discourse block two-thirds of the time (p. 89).

Though Smith (2008) applies the implications of his research primarily to developing reading skills, he does mention its applications to writing instruction (pp. 78-79). For a student, writing must be practical. While most students will agree in principle that their writing skills may matter some to their future career, finding a successful formula for college writing assignments supersedes four years hence. From this perspective, students hold greater appreciation for writing instruction that will help them achieve success in other courses. Their responses in this study suggest that the student-authored essay as a teaching tool more effectively and efficiently aids the goal of transferring writing skills to other college courses. Not only do students psychologically identify with student samples, they also can detect in them a formula they cannot always see in the highly stylized professional writing samples offered up in college readers and composition texts.

A writing model derived from a "formula" is likely to remind composition teachers of the much maligned five-paragraph theme, which many instructors consider the result of a mechanical, stifling process that results in empty prose. However, the degree to which students are concerned with the freedom to experiment with various techniques and stylistic embellishments may depend somewhat on the preparedness of the individual student, and it seems reasonable that entering students would desire a basic set of writing tools applicable to most formal composition assignments. Not all skills may require even distribution; the level of a student's competency in a skill depends largely upon how essential it is to success in the discipline. The need for history majors to master math at the same level as chemistry majors is debatable. This is not to say that history majors are incapable of learning complex math or that chemistry majors cannot or should not become good writers. This merely implies that in some cases, proficiency may suffice for a skill that is tangential rather than central to success. Average

students need and desire writing models that clearly illustrate rhetorical tools and techniques reflected in learning goals, and the stylized presentations of professional writers often contradict the basics students need. Think of it in sports terms. Beginning amateur golfers who take lessons will encounter basics, not techniques intended to resemble the greatest golfers in the world. Professional athletes, aided by some natural ability, have developed their talents well beyond rudimentary principles. Put another way, professionals are so accomplished in the fundamentals of their craft that they can interpret and reconfigure the basics into a style of their own.

Style is often a seamless combination of small, imperceptible elements that only the trained eye can detect and truly appreciate. And it is style that marks the professional essays often assigned to beginning student writers. As Jenkins (2010) aptly comments, “. . . some writers may, over time, move beyond formulas. They may develop the desire to explore meaning more deeply and discover for themselves how organization can derive organically from content. In fact, we have a name for such writers. We call them ‘professionals’” (para. 23). It is true that some students are accomplished enough in their writing to create clever metaphors and turn colorful phrases that tend to impress their teachers. Effective essays, however, should not belong to the artistic alone; in fact, Jenkins asserts that the formula essay is the right tool to develop good writers, and this seems the prevailing sentiment of freshmen I have taught.

Before Jenkins, Haluska (2006) enthusiastically endorsed the formulaic essay as an all-purpose tool for the college student. He argues precisely what students in my freshman composition classes beg for, which is a technique that will serve them effectively from course to course and from one semester to the next. He acknowledges the potentially reductionist nature of quantifying aspects of composition (the five-paragraph theme, for instance), which inadvertently influences some student writers to limit rather than enlarge how they think about and develop their topics. An acceptable trade-off is an efficient and effective tool adaptable to writing assignments common to most college coursework.

## **V. Implications for Teaching and Learning.**

Some will likely argue that advocating that students emulate each other's writing restricts rather than develops their abilities. Capping student development is far from the intention; instead, results of this study show that skillful use of student-authored essays may do just the opposite. This study indicates merit in placing greater emphasis on student-authored essays as a writing tool, as student writers, especially average and marginal ones, need accessible models that clearly reflect the rhetorical elements and skills they are expected to learn.

There are richer implications and lessons to take away from this study. First, the students' feedback suggests that either category of essay deserves more sophisticated handling as a teaching tool. The well-crafted student-authored essay, especially one that illustrates the flexibility and the adaptability of the so-called formula essay, can serve as an all-purpose writing tool that can handle most writing jobs adequately for the two-year or four-year college student. Broadly considered and taught well, the formula essay, as Haluska (2006) points out, is flexible yet muscular enough “to accommodate reading reactions, term papers, doctoral dissertations, letters home pleading for money, and so forth” (p. 51). Since students enter postsecondary institutions with the five-paragraph theme ingrained, it is reasonable to believe that an approach that can build upon what they already know offers some advantage. In other words, students who are unsure of themselves as writers find benefit in a recognized and repeatable approach.



Results from this study also imply that students consider peer-authored writing samples less intimidating; therefore, their own confidence as writers seems to receive a boost from exposure to writing by their peers. Notably, though, this same cohort shunned in-class activities built around peer critiquing and tended to distrust their peers' judgment of their writing. This seemed particularly true of better-prepared students whose reading and writing habits were advanced enough to discern the stylized ways in which accomplished writers use different techniques and rhetorical tools. Perhaps the general lesson to take away from this study is the need for more deliberate planning in the use of both student-authored and professional essays as teaching tools. Students in this study were more likely to discuss the strengths and weaknesses of a student-authored essay because they accepted without question that an essay by a non-professional contained room for improvement.

On the opposite end, students in this study were more reticent in discussing strengths and weaknesses in professional essays. Some students reasoned that professional essays equated to perfection and that only exceptional examples would warrant inclusion in a textbook. To a degree, this sentiment applies as well to student-authored essays that appear as samples in the textbook. Therefore, it is worth noting that increased and more skillful use of student essays written by current and former students with no connection to professional documents may prove even more effective in achieving learning outcomes. To return to the general result of this study, the students surveyed preferred and benefitted more from the work of accomplished novice writers to that of professionals. The general implication may be that some students, especially those whose writing skills are marginal, find the work of their peers more recognizable and therefore more attainable in their own efforts.

## **VI. Limitations of Study.**

Sample size and population profile limit widespread implications of the results. This study included a small sample size limited to first-semester freshmen at North Carolina A&T State University over two semesters. Though frequency counts of responses are notable, a close examination of the written comments provided more substantive and supportive data than anticipated. The nature of the written responses encourages follow up and refinement of the study design to include formal interviews that might provide greater insight into students' stated preferences for one type of essay sample over the other. As presented earlier, wide ranges of student preparedness and a voluntary system of placement in writing courses might also influence whether the results of this study can be generalized to other populations of students.

## **VII. Conclusion.**

This small study aimed to validate the degree to which first-year students at a public HBCU find two categories of writing samples useful as teaching tools. Students in this study generally perceived professional essays as inaccessible and felt less capable of emulating professional models. As studies referenced in this paper show, professional writers often stylize their prose with techniques too advanced for the average and marginal writer to imitate with confidence. Participants in this study characterized the student-authored essay as a more accessible teaching tool than the professional essay model and judged it more representative of learning goals and writing techniques taught in class. Focused modeling of student-authored essays shows potential

for strengthening learning outcomes in first-year writing courses, especially for average and marginal writers.

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## **Applied and transformed understanding in Introductory Psychology: analysis of a final essay assignment**

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*Abstract: This paper describes a case study of the impact of the introductory psychology course on students' understanding of their life experiences and course-related ideas. Student responses to a final essay assignment were analyzed to construct composites for areas of applied and transformed understanding. Results are important for psychology teachers and general educators seeking to better understand the potential applicability of course concepts to students' lives. The study also has broader cross-disciplinary relevance in demonstrating the use of the final essay assignment for promoting concept application and reflection and for assessing the impact of our courses on student understanding.*

*Keywords: concept application, critical thinking, teaching of psychology, undergraduate education, classroom assessment*

### **I. Introduction.**

Education should provide students something of value with impact beyond the classroom. This requires that teachers go beyond merely transmitting fragmented knowledge (e.g., disconnected facts and definitions) to assisting students in understanding the core ideas of their disciplines. In addition, teachers should help students connect new ideas to their own thoughts and experiences. Students should be encouraged to apply concepts to their lives and use what they have learned to better understand themselves, their experiences, their communities, and their world. They are more likely to understand and remember course ideas they find meaningful for their lives (Hettich, 1976). They are more likely to be motivated in courses they deem relevant to their goals and experiences (Brender, 1982; Brophy, 1998).

Many theories of learning and cognitive development have emphasized the importance of connecting new concepts to students' prior knowledge and experiences. Kolb's (1981) experiential learning theory emphasizes the importance of connecting abstract concepts and generalizations to concrete experiences. According to Piaget's (1952) theory of cognitive development, individuals construct knowledge structures (or schemes) as they interact with the world and try to make sense of their experiences. Understanding develops as we fit new experiences into existing structures (assimilation) or adjust our ideas to fit new experiences (accommodation). Thus, from this constructivist perspective, learning always takes place in the context of students' prior understanding. Course concepts can help students organize their experiences (e.g., recognize previously overlooked patterns) and adapt or transform their understanding to better account for their experiences as well as research findings. Vygotsky's (1978, 1986) sociocultural theory further emphasizes the importance of learning concepts through social interactions with more knowledgeable others. Course concepts can be viewed as

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cultural tools that enable us to extend our thinking and understanding. Teachers can assist or “scaffold” students’ use of new concepts to better understand their experiences and their world.

The importance of concept application has also been central to recent national discussions of general learning outcomes for

higher education. The National Leadership Council for Liberal Education and America’s Promise (LEAP) examined the knowledge and skills essential for all U. S. undergraduate college students in order for them to be successful in the twenty-first century (Association of American Colleges and Universities, 2007). Their report identified “essential learning outcomes” for a liberal education that help students become engaged responsible citizens and lifelong intentional learners who can contribute to a dynamic global economy and a diverse democratic society. In addition to knowledge and skills, it promotes “integrative learning” that involves the application of knowledge to complex problems and real-world setting.

In my discipline of psychology, the American Psychological Association (APA) has emphasized application and the development of personal understanding in its *APA Guidelines for the Undergraduate Psychology Major* (APA, 2007). Goal 4 (“Application of Psychology”) states that “students will understand and apply psychological principles to personal, social, and organizational issues” (p. 10). This includes relating concepts to everyday life and applying psychological concepts to solve problems. Goal 9 (“Personal Development”) states that “students will develop insight into their own and others’ behavior and mental processes and apply effective strategies for self-management and self-improvement” (p. 10). This includes using psychological concepts to reflect on personal experiences and foster personal health and growth.

Psychologists have also emphasized the importance of educating the general public about the applicability of psychology to people’s lives. As APA president, George Miller (1969) famously called on psychologists to “give psychology away” to the public. Miller’s call has been echoed by recent APA presidents. Zimbardo (2004) urged psychologists to inform the public on how psychology makes a difference in our lives. Levant (2006) called on psychologists to “raise the visibility of psychology and its perceived relevance to solving a wide range of personal, health, educational, social, and family problems” (p. 383). Moreover, in APA’s recently developed strategic plan, its goals included to educate the public about psychology and to promote psychology’s applications to daily life (Farberman, 2009, p. 77). Our courses provide an important means of educating others about the personal and societal relevance of our disciplines.

This emphasis on relevance and connecting concepts to students’ lives seems especially important for introductory courses. For psychology majors, introductory psychology serves as a foundation to be built upon in later psychology courses. However, for the majority of students who are non-majors, this course may be their only direct exposure to the discipline of psychology. Thus, the course must deliver on its own in making an impact on students’ understanding of the nature of psychology and its relevance for and applicability to their lives. As our knowledge base grows, it becomes increasingly important that teachers identify what content is most important and relevant for students (Makosky, 1985). Although content choices should not be dictated by consumer demand, they should be informed by students’ perspectives. Whereas there has been much discussion about what core concepts should be emphasized in introductory psychology as a foundation for the major, there has been less emphasis on how the course can provide students with conceptual tools for better understanding their life experiences.

In this paper, I describe a case study of what students in two sections of the introductory psychology course reported as the most important changes in their understanding as a result of the course. The focus of the study was on identifying content areas in which students applied

course concepts to their life experiences or changed their understanding on topics with impact beyond the course. I refer to these as applied and transformed understanding, respectively. The purpose of the paper is two-fold. First, I aim to provide a portrait of such applied and transformed understanding as reported by students in a “final essay assignment.” This can be useful for psychology teachers to better understand areas in which students connect course content to their lives. It is also relevant for those interested in the role of the introductory psychology course in general education. Second, I aim to demonstrate the value of this final essay assignment (in this and other courses) in promoting concept application and reflection as well as for assessing the impact of our courses on students’ understanding.

## **II. The Introductory Psychology Course and the Final Essay Assignment.**

Introductory psychology at my institution is a one semester, three credit hour course called General Psychology. Data for this study come from two sections of this course (in spring 2008 and spring 2009) for which I was the instructor. The class met twice a week for 75 minutes over 15 weeks. Bernstein and Nash (2008) served as the textbook and all chapters were assigned. Greater emphasis (2 to 3 class sessions per chapter) was given to the introduction to psychology (perspectives and methods), biological bases, sensation and perception, learning, memory, human development, personality, psychological disorders, and social psychology. Less emphasis was given to consciousness, thinking and intelligence, motivation, health psychology, and treatment.

The focus of this study was on student responses to a “final essay” assignment. Students wrote a three to five page essay due during the last week of classes. The primary goal for the assignment was to engage students in using course concepts as tools for better understanding events and experiences in their lives beyond the classroom. Additional goals were to promote an end-of-semester review of course concepts and students’ reflection on how they had benefited from and been impacted by the course. The essay counted as five percent of the course grade.

In this final essay assignment, students were asked to identify the ten course ideas (i.e., concepts, principles, and research findings) that had the greatest impact on their understanding. Specifically, students were asked what ideas helped them understand something (in themselves, others, or society) in a better or different way; assisted them or others in solving problems in their lives; helped them in making decisions in various roles (e.g., as students, parents, workers, friends, citizens); motivated them to make changes in their lives or take action in relation to social issues; or otherwise had a significant impact on their understanding, thinking, motivation, and/or behavior. Students were provided with several example responses. To encourage students to explore ideas from across the course, they were expected to include concepts from at least six different textbook chapters. Student essays were graded based on the quality of the connections made as well as conformity to assignment specifications and writing clarity and mechanics.

## **III. Method.**

Essays from the two sections of introductory psychology were combined for qualitative analysis (Institutional Review Board approval was obtained). I received essays from 64 students, 58 of whom provided their consent for inclusion of their essays in this study. All essays identified ten ideas, for a total of 580 response items. Response items were first categorized by textbook chapter topic. Most items clearly focused on a concept or set of concepts from one specific

chapter. Those items including concepts from multiple chapters were categorized according to which topic received greatest emphasis in the response.

The analysis focused on identifying categories of responses relating to content areas in which students demonstrated applied or transformed understanding. Applied understanding refers to applications of concepts to understand specific life events or experiences. Transformed understanding refers to instances where students described a change in their understanding on a topic (e.g., abnormality, intelligence) with impact beyond the course. Many responses included elements of both forms of understanding and no attempt was made to categorize items in terms of this dichotomy. Items where students just reported information they found important or interesting were not included if there was no indication of a change in understanding beyond their learning the concepts themselves. For example, items merely reporting brain lobe functions or Piaget's stages were not considered to reflect applied or transformed understanding.

Specifically, analysis involved the use of the constant comparative method from the grounded theory approach (Glaser and Strauss, 1967; see also Merriam, 1998). Categories were developed to fit the data through repeated interactions between the data and the emerging categories. Analysis involved four complete reviews of the response items. On the first review, brief notes were taken on the key ideas in each response and tentative categories were identified for each chapter topic. The categories were refined in the second review of the items to improve their fit with the data. As most identified categories had at least five response items associated with them, this was taken as a minimum cutoff for a category being included in the final list.

In a third review of the response items, the emphasis was on combining smaller categories or breaking up larger categories. Categories with three or four items were combined with related categories. For example, conformity was combined with the bystander effect to form a *social influence* category. Categories with ten or more items were assessed to determine if they could be divided into two distinct subcategories (e.g., stress into the *effects of stress* and *coping strategies*). In some cases, a subcategory was identified along with a general category to include other responses (e.g., *psychological disorders* along with the more specific *anxiety disorders*).

With categories identified, composite responses were constructed from the student responses to represent each category. Each composite included ideas from at least two students and was limited to 80 words or less. All ideas included came from the students, as did much of the wording. However, student excerpts were edited to integrate ideas from multiple students, improve grammar, and make responses more concise. In some cases, details were changed (e.g., "sister" to "friend") to protect the identities of students or their family members. A final review of the response items helped in refining the composites and checking them for accuracy.

#### IV. Results.

Students' response items covered a wide range of concepts across all textbook chapters. Topics with the most response items were human development ( $n = 71$ ), learning ( $n = 67$ ), memory ( $n = 57$ ), psychological disorders ( $n = 49$ ), motivation ( $n = 47$ ), introduction to psychology ( $n = 47$ ), and consciousness ( $n = 44$ ). Topics mentioned less often were biological bases ( $n = 35$ ), social psychology ( $n = 35$ ), personality ( $n = 31$ ), thinking and intelligence ( $n = 30$ ), health psychology ( $n = 27$ ), sensation and perception ( $n = 26$ ), and treatment ( $n = 14$ ).

There was also considerable diversity in terms of the roles to which students made connections. Roles frequently mentioned included student, parent (as a present or an anticipated role), partner (spouse, boyfriend/girlfriend), other family member (sibling, cousin, child,

aunt/uncle, grandparent), and friend. The role of worker was also common, either in relation to current employment or anticipated careers (e.g., as nurses, teachers, managers, psychologists, and engineers). In addition, concepts were applied to sports, hobbies (e.g., art, music, and photography), babysitting, and pet training. Some students took the role of concerned citizens, addressing societal problems relating to drugs, education, politics, the media, and the economy.

Based on the analysis, 39 categories emerged as areas of applied or transformed understanding. Composites generated from student responses, organized by chapter topic, are provided below. Two pairs of chapters were combined—motivation with personality and psychological disorders with treatment—because ideas from these chapters were interrelated. The number of students providing a response relating to each category is given in parentheses. The codes in brackets at the end of the composites refer to themes that will be discussed below.

#### *A. Introduction to Psychology.*

- *The nature and breadth of psychology* (6). Psychology is much broader than I thought—it is about more than just how people feel. There are many different types of psychologists (some I had not heard of). I began the class thinking psychology was a pseudoscience based on the ramblings of a cocaine addict who had problems with his mother. I learned psychology is a science, with research methods to test hypotheses while minimizing bias. I also learned that Freud's view is not even currently the most influential. [PSY]
- *Psychological perspectives* (12). Psychologists use six modern perspectives to understand behavior and mental processes. Each perspective has its own idea of why people do what they do or think the way they think. This forces me to look at situations from different angles. The perspectives are not right or wrong but rather different ways to look at something from a psychological standpoint. [PSY]
- *Critical thinking* (9). Critical thinking is the process of assessing claims and making judgments on the basis of well-supported evidence. This has helped me realize that it is okay to question what I hear or read. It can help people be more open to different theories and escape biases and preconceived views. What we choose to believe should be based on solid evidence and, until evidence is provided, we should keep an open mind to avoid jumping to conclusions. [CRIT]
- *Correlation versus causation* (10). Correlation does not imply causation. When I was playing basketball in high school, I used to wear the same socks (my lucky socks) until we lost. I thought there was a relation between our success and my socks, but there really wasn't. When we hear two things are related or happened at the same time, we should explore other possible explanations rather than just assuming one thing causes the other. [CRIT]

#### *B. Biological Bases.*

- *The biological bases of mental processes* (9). I had never considered thoughts and emotions as being connected to biological factors. The brain changes as we learn due to our brain's plasticity. Neurotransmitters actually affect psychological processes such as memory,

impulsivity, sleep, and hunger. Neurotransmitter imbalances can cause emotional and personality changes as well as mental disorders. [PSY, CHAL]

- *Effects of brain trauma* (10). Knowing the functions associated with specific brain areas helps me understand the effects of brain disorders and injuries. I better understand why my grandfather couldn't talk or remember very well after his stroke. I understand the role of the hippocampus in my grandmother's Alzheimer's disease and why she acts the way she does. As a future nurse, it will be helpful to know how brain injuries affect how people act. [CHAL]

### *C. Sensation and Perception.*

- *Sensory problems* (7). I have gained a better understanding of my own farsightedness and how glasses help. I also better understand my son's colorblindness. Our senses are important and should not be taken for granted. We should be cautious in certain situations to keep them safe. I have friends who have hearing loss from working in factories and I will now advocate for safeguards to protect the ears from permanent damage. [CHAL, HLTH]
- *Perceptual differences* (10). People can differ in how they perceive the same situation or event. We can often look at something in more than one way and there may not be a single correct perspective. Differences can result from individuals paying attention to different details or using different schemas, perhaps acquired growing up in different environments. Knowing this can help us be more sensitive to these differences and have more tolerance and understanding for others in society. [CRIT, SOC]

### *D. Consciousness.*

- *Sleep problems* (10). I better understand my mother's nightmares and I learned my brother's sleepwalking will probably disappear as he grows up. I also better understand my father's difficulties working the third factory shift due to our circadian rhythms. I learned how jet lag causes fatigue, irritability, and sleep problems when I travel across time zones. [CHAL]
- *Effects of sleep loss* (9). Our society needs to recognize how sleep deprivation contributes to illnesses and accidents (e. g. , car crashes, medical mistakes). Lack of proper sleep can affect mental functioning and cause learning difficulties. I understand it is important to get enough sleep before exams and staying up all night studying is not effective. I have tried to go to bed earlier and have noticed an increase in my energy and ability to concentrate in my classes. [HLTH, LRN]
- *Effects of psychoactive drugs* (15). I have told friends addicted to drugs to just quit—it didn't seem that hard. After studying how drugs affect neurotransmitters, I understand the troubles they face and can be more supportive. I also understand how psychological dependency led my cousin who had been in prison without cocaine to return to using after being released. I have told my younger sister how drugs can cause dependency and brain damage. I now also better understand my own addiction to nicotine. [CHAL, HLTH]



### *E. Learning.*

- *Conditioned aversions* (12). We can learn taste aversions and phobias through classical conditioning. This explains why I cannot eat Cajun chicken pasta any more. I ate it once and got really sick from food poisoning. Now I cannot look at it, even though it used to be my favorite. I also have a fear of spiders due to early childhood conditioning. I understand why my mom is scared to go into a parking garage after being severely injured in one. [CHAL]
- *Reinforcement and punishment* (23). I now understand why my 6-year-old niece sometimes behaves as though she is two. I love her and hate to see her upset, so if she cries, I usually cave in. I am therefore reinforcing the behavior I want to stop. When babysitting, I give kids privileges if they behave and take away privileges if they misbehave. When coaching soccer, I reinforce good behaviors with praise. I also used treats to potty train my dog. [CHLD, SOC]
- *Concerns with punishment* (5). I never have spanked my kids often and still feel sometimes it may be necessary. However, I didn't think about the fact that it models aggression, doesn't teach alternative responses, and is often administered while the parent is angry. After our discussion, I agree it should be used as a last resort and reinforcement is best. You can also punish without spanking by taking away privileges. With these strategies, parents can use less physical punishment and still have well-behaved children. [CHLD]
- *Observational learning* (8). I did not realize the impact of observational learning until my daughter started replicating my bad habits. For example, she wants salt on her food because I do. More positively, after watching me study and seeing how proud I am when I get good grades, she now wants to do well on her own homework. Parents, teachers, and coaches need to be good role models. We also need to think about what behaviors our children are learning from watching television. [CHLD, SOC]

### *F. Memory.*

- *Elaboration* (16). All my life, I thought the best way to memorize something was to repeat it over and over. However, I learned elaborative rehearsal is more effective in getting information into long-term memory. I will remember better if I relate new information to what I already know or to important things in my life. For example, when studying psychological disorders, it helped when I connected the disorders to people I know who seem to have them. [LRN]
- *Mnemonics* (12). Mnemonics have improved my grades and made me feel more confident when taking tests. When studying the eye and brain, I made up words that sounded like the actual words so it was easier to remember. For my anatomy test, I thought up a way to remember whether arteries or veins were red or blue. "Arteries" has an "r" for red. Using "b" for blue and "v" for veins, I remembered to "be very careful not to forget." [LRN]
- *Study habits* (13). The study habits I had in high school don't work well in college. I now try to read the chapter before class, take notes while reading, and reread the unfamiliar parts to help store information in long-term memory. I also now take notes in class. Instead of

cramming for exams, I use distributed practice to spread my studying out over several days. Due to attention limitations, I now understand why watching television while doing homework just doesn't work. [LRN]

### *G. Thinking and Intelligence.*

- *Problem solving strategies* (9). Using means-end analysis to think about the best way to move toward your goals is important for school and one's career. There is value in combining divergent and convergent thinking—first brainstorm and then choose the best idea. Cognitive restructuring can also be useful for seeing things in a new way. In band, I broke a difficult piece down measure by measure. I changed my expectations about being able to learn it just by changing how I thought about it. [CRIT, LRN]
- *The confirmation bias* (5). We often pay more attention to evidence that supports our hypothesis than to evidence that doesn't. My uncle always discussed the good things about President Bush but not that he was costing us billions. My co-workers at a correctional facility sometimes notice problem behaviors they expect while overlooking other evidence. This bias can maintain prejudices if we only accept information supporting our attitudes about a group. We should strive to consider all observations objectively before coming to a conclusion. [CRIT, SOC]
- *Multiple intelligences* (6). I have always resented persons being considered intelligent based on academics alone. Gardner's theory goes beyond "book smarts." People differ in how they learn best and those challenged in one area can succeed in others. Standard intelligence tests are useful in some ways, but educators and parents should realize they do not provide a complete picture of a child's intelligence or worth. Gardner's theory has also helped me understand that I am more intelligent in some areas than others. [LRN, SOC]

### *H. Motivation and Personality.*

- *Motivation for success* (13). Setting challenging but realistic goals is important for success. I understand how sometimes people lower their goals to avoid failure. When something doesn't happen the way I want, focusing on effort attributions rather than blaming external circumstances can motivate me to try harder. After learning about extrinsic versus intrinsic motivation, I am considering changing my major. I would like to feel my degree is not just about extrinsic rewards (e. g. , a diploma) but that it has some intrinsic worth. [LRN]
- *Self-efficacy* (8). You are more likely to do something if you believe you can succeed. In high school, I never tried out for the basketball team, because I was nervous and didn't think I would make it anyway. In golf, I thought I was bad, but my dad told me to believe I could be good and this led to drastic improvements. When I have kids, if I encourage them to believe in themselves, they will have a better chance at success. [LRN, CHLD]
- *Maslow's hierarchy* (11). Maslow helps me understand a friend who has great potential but is flunking her classes and engaging in destructive behavior. This may be because her basic needs are not met. Her mother rejected her growing up and now she struggles financially

with no support system. My cousin also may have joined a gang to get respect and feel like he belongs. In schools, children will not be all they can be if their basic needs are not met. [LRN, SOC]

- *Motivational conflicts* (12). We often experience motivational conflicts. We must balance what is pleasurable (id), what society says we should do (superego), and what we think is best (ego). Conflicts can arise around eating. My eyes have been opened concerning anorexia—it is not just attention seeking but an illness that can lead to heart problems, bone fractures, and death from starvation. Young girls get the message that “thin is beautiful.” Parents and teachers should help children accept themselves as they are. [CHAL, SOC]

### *I. Human Development.*

- *Parenting styles* (14). My father was authoritarian and our relationship suffered because of his lack of warmth. As a parent, I will try to have an authoritative style—firm but warm and understanding. Children should have freedom to make decisions but within reasonable boundaries and with the help of a responsible adult. Parents should also explain their rules. Growing up, I was told to follow the rules “because I said so.” I never understood why, which may be why I broke so many. [CHLD]
- *Prenatal and infant care* (9). It is shocking how much parents can change a child’s future by the decisions they make. Our society should be more informed about teratogens. A pregnant woman who drinks alcohol puts her unborn child at risk. Smoking increases the risk of low birth weight and SIDS. After birth, children need a secure attachment so they know they are loved. As a working mother, it was comforting to learn that children in daycare can still develop healthy bonds with their parents. [CHLD]
- *Cognitive development* (15). Piaget’s theory helps me understand kids. Recently, an infant I was babysitting screamed for her bottle when I paused to burp her. It occurred to me that by placing the bottle out of sight, I could focus her attention on something else—and it worked. Learning about egocentrism also helps me understand my 3-year-old niece, who often interrupts me when I am studying. I need to correct her while realizing it is difficult for her to take other people’s perspectives. [CHLD]
- *Psychosocial development* (8). Erikson’s stages help me understand what people may be going through in their lives. The autonomy stage explains why my two-year-old often wants to make her own decisions. I experienced an identity crisis in adolescence. Leaving high school, I had no clue what I wanted to do. I floated around before deciding to go to college and better my quality of life. I also now better understand what to expect as I enter middle adulthood. [CHLD, SOC]

### *J. Health, Stress, and Coping.*

- *Effects of stress* (11). Everyone experiences stress in our fast-paced society, but chronic stress can be bad for your health. Stress can interfere with immune system functioning and increase your susceptibility to illness, even heart disease and cancer. It can also affect your

mood and memory. I experience stress as I try to balance school, two jobs, and family responsibilities. I stress out about not doing well in school and often get sick before exams. Reducing stress could improve my health and school performance. [HLTH, LRN]

- *Coping strategies* (14). We can reduce the impact of stressors by focusing on the positive and seeing something as a challenge rather than a threat. We can also avoid ruminating about the past and catastrophizing about worst-case scenarios. I worry about situations like tests too much. I will try to not get worked up over small things and confront minor problems so they don't grow bigger. I can also manage stress by working out and relying on social support. [HTLH, LRN]

#### *K. Psychological Disorders and Treatment.*

- *Understanding abnormality* (12). We need to be careful labeling someone abnormal when they may simply be different. Our class activity made me realize that maybe I am not as open-minded as I thought. What I considered odd, others considered normal. A lot of things people consider abnormal in our culture are normal in other cultures. There is a fine line between abnormal and normal behavior. If people realized this, they might be less judgmental and more tolerant and understanding of others. [CRIT, SOC]
- *Anxiety disorders* (13). My wife suffers from generalized anxiety disorder and a friend has a slight case of OCD. I better understand their daily struggles. I also tend to worry about things and this class has helped me identify some of my catastrophizing and ruminating thoughts. I have a phobia of public speaking and get stressed over taking speaking classes. I also have a fear of the dark. I recognize there are ways to overcome these if they interfere with my life. [CHAL, HLTH]
- *Understanding psychological disorders* (13). I talked with a friend of mine who has schizophrenia. He said hallucinations are the hardest part, because he cannot grasp what is real and what is not. I always thought individuals with schizophrenia were crazy. Now I realize they are normal people challenged everyday by their own minds. Some of my relatives also battle depression. I thought this was a mindset you could overcome if you had the will. I now have more sympathy for what people go through. [CHAL, SOC]
- *Treatment* (9). Effective treatments are available for many psychological disorders. Depression is common, but many people do not get help even though treatments are available. It is important to find the right therapy for a person's problem. I think systematic desensitization could help my wife with her fear of spiders. I actually applied this to my own fear of heights and last week I was hanging stage lights at church—it works! [CHAL, HLTH]

#### *L. Social Psychology.*

- *Attribution biases* (6). I see biases at work when people take responsibility for successes but not failures. Politicians also take credit for good things while blaming bad things on others. We often attribute others' behaviors to internal causes but our own to external factors. At work I asked why I was the only one responsible enough to always be on time. Then one day

I got stuck behind a train. I will try to remember this so I don't judge others so quickly. [CRIT, SOC]

- *Self-fulfilling prophecies* (6). I had heard a woman I met recently was not polite, so I ignored her (and she ignored me). After studying self-fulfilling prophecies, I began smiling at her and talking to her, and there is no longer tension. Self-fulfilling prophecies can also maintain prejudices. If we perceive certain individuals as a threat, we may be defensive and hostile toward them and they may react similarly toward us. We should get to know people rather than assuming they fit our stereotypes. [CRIT, SOC]
- *Social influence* (9). People may conform to fit in, leading them to act in ways that seem out of character. In high school, kids may go along with the crowd so they are not made fun of. Individuals also may not help because they think others will. A girl at my friend's apartment complex was beaten by her boyfriend and no one called for help. Understanding this, I believe in an emergency I will be more likely to ask if others need help. [SOC]
- *Obedience to authority* (6). In the Milgram studies, individuals obeyed authority even when it was against their better judgment. I now understand that when under authority, normal people are capable of doing terrible things they never would do under normal circumstances. People need to be aware of this to prevent it from happening to them. Just because someone is an authority figure, that doesn't mean you should do what he or she tells you to do. [SOC]

## V. Discussion.

The above composites provide a portrait of applied and transformed understanding as reflected in student essays from two sections of my introductory psychology course. They demonstrate the ways in which the course content is relevant and applicable to students' lives. For teachers of the introductory psychology course, this can help them identify areas in which further applications and transformations can be promoted and supported. For educators in other areas, it can help them understand the course's potential contributions as part of the general education curriculum.

In reviewing the above categories, several themes emerged that reflected broader patterns of applied and transformed understanding. Specifically, again using the comparative method, I identified seven themes and associated each response category with the one or two themes it most reflected. The themes are summarized below. Categories associated with each theme are presented in Table 1. Codes at the end of the composites above also link them to these themes.

1. *Psychology as a Discipline* (PSY). Students gained greater understanding of the discipline of psychology, including that it is a science and has many subfields. They learned psychological topics can be looked at from multiple perspectives, including a biological perspective. Their inclusion of concepts across multiple topic areas also reflects their understanding of the breadth of the field.
2. *Critical Thinking* (CRIT). Students noted the importance of critical thinking, including exploring assumptions, examining evidence, and being open to divergent perspectives. They recognized how personal biases (e. g. , confirmation and attribution biases, self-

fulfilling prophecies) can influence our thoughts and actions. They learned to be careful in distinguishing correlation from causation and when labeling someone as abnormal.

3. *Student Learning and Success* (LRN). Students learned how they could become better learners by improving their study strategies (e. g. , using elaboration, mnemonics, and distributed practice). They gained greater insight into factors (e. g. , self-efficacy, needs, goals, attributions) influencing their motivation to learn. In addition, they became more aware of the impact of sleep and stress on their success as students.
4. *Personal Health* (HLTH). Students learned how they and others could make healthier life choices. They discussed the negative effects of stress and drugs as well as the importance of protecting the senses and getting enough sleep. They gained understanding about ways to cope with stress and available treatments for anxiety and depression.
5. *Psychological Challenges* (CHAL). Students gained insight into various psychological challenges (e. g. , schizophrenia, depression, anxiety, brain trauma, sensory and sleep problems, eating disorders, conditioned aversions, addictions) faced by others or, in some cases, themselves. They learned about common characteristics and experiences, biological bases, environmental contributors, and treatments relating to these challenges.
6. *Social Influence and Diversity* (SOC). Students broadened their understanding of social interactions and various forms of diversity. They learned how we influence and are influenced by others. They gained insight into how biases can maintain prejudices and affect our behaviors toward others. In addition, they learned how people differ in terms of their perspectives, needs, motives, intellectual strengths, development, and mental health.
7. *Children and Childcare* (CHLD). Students demonstrated greater understanding of children, including reasonable expectations for children of various ages. They reflected on the impact of their interactions with children (e.g., as parents, aunts/uncles, babysitters, coaches). They recognized the importance of providing a supportive environment and concerns associated with prenatal risks and physical punishment.

The above themes provide psychology teachers a framework for thinking about the impact of the introductory psychology course. The themes are consistent with the goals identified in the *APA Guidelines for the Undergraduate Psychology Major* (APA, 2007). Collectively, the responses reflect students' development relating to APA Goal 1, "Knowledge Base of Psychology," and Goal 4, "Application of Psychology. " APA Goal 1 includes a suggested learning outcome, "characterize the nature of psychology as a discipline" (p. 11), that links to the "Psychology as a Discipline" theme. APA Goal 4 specifically mentions applications relating to healthy lifestyles ("Personal Health"), abnormal behavior ("Psychological Challenges), and interpersonal relations ("Social Influence and Diversity"). APA Goal 3, "Critical Thinking Skills in Psychology" directly connects to the "Critical Thinking" theme. APA Goal 9, "Personal Development," is supported by understanding relating to "Student Learning and Success," "Personal Health," and "Psychological Challenges. " APA Goal 7, "Communication Skills," and Goal 8, "Sociocultural and International Awareness," are supported by understanding of "Social Influence and Diversity. " Although not specifically mentioned in the APA goals, understanding

of “Children and Childcare” is arguably an important additional outcome for our students, many of whom do or will interact with children in parent, teacher, childcare, or health care roles.

**Table 1. Emergent Themes of Applied and Transformed Understanding.**

<i>Psychology as a Discipline [PSY]</i>	<i>Psychological Challenges [CHAL]</i>
The nature and breadth of psychology	The biological bases of mental processes
Psychological perspectives	Effects of brain trauma
The biological bases of mental processes	Sensory problems
	Sleep problems
	Effects of psychoactive drugs
	Conditioned aversions
	Motivational conflicts
	Anxiety disorders
	Understanding psychological disorders
	Treatment
<i>Critical Thinking [CRIT]</i>	<i>Social Influence &amp; Diversity [SOC]</i>
Critical thinking	Perceptual differences
Correlation versus causation	Reinforcement and punishment
Perceptual differences	Observational learning
Problem solving strategies	Confirmation bias
Confirmation bias	Multiple intelligences
Understanding abnormality	Maslow’s hierarchy
Attribution biases	Motivational conflicts
Self-fulfilling prophecies	Psychosocial development
	Understanding abnormality
	Attribution biases
	Self-fulfilling prophecies
	Social influence
	Obedience to authority
<i>Student Learning &amp; Success [LRN]</i>	<i>Children &amp; Childcare [CHLD]</i>
Effects of sleep loss	Reinforcement and punishment
Elaboration	Concerns with punishment
Mnemonics	Observational learning
Study habits	Self-efficacy
Problem solving strategies	Parenting styles
Multiple intelligences	Prenatal and infant care
Motivation for success	Cognitive development
Self-efficacy	Psychosocial development
Maslow’s hierarchy	
Effects of stress	
Coping strategies	
<i>Personal Health [HLTH]</i>	
Sensory Problems	
Effects of sleep loss	
Effects of psychoactive drugs	
Effects of stress	
Coping strategies	
Anxiety disorders	
Treatment	

These themes also support the role of introductory psychology for general and liberal education (APA, 2007; Cole, 1982; Costin, 1982). They are aligned with the LEAP initiative’s four “essential learning outcomes” for all college graduates: “Knowledge of Human Cultures and the Physical and Natural World,” “Intellectual and Practical Skills,” “Personal and Social

Responsibility,” and “Integrative Learning” (Association of American Colleges and Universities, 2007, p. 12). The course directly contributes to students’ breadth of knowledge. Intellectual and practical skills are addressed by the themes “Critical Thinking,” “Student Learning and Success” (for learning and problem solving skills), and “Social Influence and Diversity” (for teamwork skills). Personal responsibility is reflected in the themes “Student Learning and Success” and “Personal Health,” while social responsibility is supported by “Social Influence and Diversity,” “Psychological Challenges,” and “Children and Childcare” (for better understanding of and concern for others). LEAP defines integrative learning as based on the application of knowledge to real-life problems and settings. Thus, students’ demonstration of applied understanding reflects progress toward this advanced outcome.

As with any case study, a limitation concerns generalizability. To what extent do student responses reflect various idiosyncrasies of my particular classes (e.g., class activities, examples, topic coverage)? Students from other classes would certainly generate different response items and similar analysis would be expected to yield some category differences due to variation in instructor emphasis and student interests (among other factors). However, given the reported similarity in the organization and content of the introductory psychology course across instructors and institutions (Miller and Gentile, 1998), it seems reasonable that there would also be much overlap in the emerging categories. Moreover, there would likely be even more stability in the broader themes given they emerged across multiple content areas. Regardless, the above categories and themes demonstrate the *potential* of the course for impacting student understanding beyond the classroom. In addition, they identify areas that instructors could *target* to promote such understanding. Further studies could address this issue of generalizability.

## **VI. Evaluation of the Final Essay Assignment.**

A secondary goal of this paper was to present the final essay assignment as a pedagogical tool for promoting concept application and reflection in students. The literature provides many activities that involve students in applying concepts. For example, in psychology students have been asked to use course concepts to analyze feature films (Boyatzis, 1994; Conner, 1996), literature (Boyatzis, 1992), and media reports (Lawson, 1994; Rider, 1992). These assignments, however, do not directly connect concepts to students’ lives. Journals have been used to more directly encourage students to make connections to their own observations, thoughts, and experiences (Conner-Greene, 2002; Hettich, 1976, 1990; Miller, 1997). Journal writing can also promote reflection and critical thinking (McGovern and Hogshead, 1990; Wade, 1995). The final essay assignment provides an alternative to journals that can promote end-of-the-semester reflection on the most important and relevant ideas students think they have learned in the course.

The final essay assignment can also serve as an assessment tool. It can complement more quantitative measures by providing specific examples of student learning. Classroom assessment techniques such as the minute paper (where students report at the end of class the most important things they have learned and questions they still have) have been used to assess critical thinking and learning (Angelo and Cross, 1993). The final essay assignment can similarly assess the impact of our courses, providing a broader view at the end of the semester of what students consider most important, what applications they have made, and how the course has changed their understanding. Such assessment can help instructors identify opportunities for curricular change to facilitate meaningful learning with impact beyond the classroom. For example, my students did not make as many connections to social psychology concepts as I had expected. I



now give greater attention to assisting students in applying these concepts. The essays can also provide feedback on specific topics the instructor has targeted for promoting applied or transformed understanding. For example, I have analyzed the essays to understand students' views on parenting styles/practices and abnormality after class discussions and activities on these topics.

A final use of the final essay assignment is to identify student misconceptions. For example, in addition to a couple expected confusions (e.g., negative reinforcement vs. punishment), a misconception I had not considered emerged in relation to the concept of self-efficacy (the expectation that one can succeed at a specific task). A couple students went beyond stating self-efficacy is important for motivation to the claim that it is all you need to succeed. For example, one student stated: "If you have a positive attitude and know you can do something, then you can." I now address this misconception in class.

In conclusion, I hope this paper promotes reflection among psychology teachers on the ways our students are making connections to their lives and how this can be promoted through class lectures, discussions, activities, and assignments. I further hope it can help those from other disciplines better understand how the introductory psychology course can contribute to general education. Finally, I hope the final essay assignment can serve as a useful learning and assessment tool for other instructors aiming to scaffold students' conceptual development and their application of course concepts to their lives and experiences beyond the classroom.

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## **Inscriptional practices in undergraduate introductory science courses: a path toward improving prospective K-6 teachers' understanding and teaching of science**

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*Abstract: Inscriptions play a critical role in the creation and communication of scientific knowledge, yet are afforded little status in traditional science education research and practice. In the vast majority of science classrooms, K-12 and university alike, inscriptions are treated as transparent, unproblematic illustrations of the “content” rather than complex, nuanced renderings of natural phenomena that are part and parcel of the content itself. In an effort to better understand the science preparation of pre-service K-6 teachers, we observed lectures and labs in two introductory non-majors science courses, biology and geology, paying particular attention to instructors' inscriptional practices with an awareness of the constraints under which instructors in such classes do their teaching. Based on these observations as well as formal interviews and informal conversations with course instructors, we present four episodes from course instruction to illustrate both the nature of instructors' inscriptional practices in situ and how one might build on these practices in ways that would support the development of deeper understandings of what it means to do science. We argue that expanding the purview of the science lecture to include inscriptional practices (and other practices in which scientists regularly engage) will better prepare pre-service teachers to support their students development of deeper understandings of the scientific enterprise and more broadly contribute to increased scientific literacy in the general population.*

*Keywords: undergraduate science teaching, pre-service teachers, inscriptional practice, visual representations*

### **I. Introduction.**

To ensure that elementary teachers acquire an adequate foundation in mathematics and science content, state licensure requirements typically include at least two undergraduate courses in these domains. Yet, several decades of research suggests that the correlation between undergraduate coursework and teacher subject-matter knowledge is weak at best. Pre-service teachers emerge from undergraduate courses with “mechanical” or static views of the disciplines – able to recall facts or follow rules, but unable to explain underlying systems (McDiarmid, 1992; Floden and Meniketti, 2005).

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In science, the gap between ideal and real has been attributed to a gulf between a “reform” vision for K-12 science learning and instruction (cf. Gamoran et al., 2003; Lehrer and Schauble, 2004) and the views of the science disciplines communicated in undergraduate education. At the heart of the reform vision are teachers who possess flexible understandings of “big ideas” in science, understand how scientific knowledge is generated and revised, and who recognize scientific theories as responses to conceptual problems (Hewson et al., 1999). However, undergraduate science courses typically immerse students in a flood of detail, offering little sense of the conceptual connections or lines of inquiry – much less the norms of practice – in which such details gain significance (McDiarmid, 1992; Sunal et al., 2007).

This paper delves more deeply into the dynamics of undergraduate science courses typically taken by prospective teachers, exploring how disciplinary norms and practices are communicated to students. Drawing on data from a longitudinal study of elementary teachers’ learning in mathematics and science, we focus on how one key disciplinary practice, inscription, is enacted in two introductory science courses, biology and geology. We use the term inscription to denote material, non-prose *externalizations* of scientific models, concepts, and phenomena ranging from near literal depictions such as photographs to data displays to mathematical equations to structured text (i.e., lists and outlines). The term representation is reserved to refer to *internal* or *mental* representations (Roth and McGinn, 1998). Following the lead of other researchers in the fields of the sociology of science and science education, we make this distinction both for the sake of clarity and to recognize these displays and their use as distinct components of scientific practice.

Probing the nature and use of inscriptions in these courses, we offer a set of observations that are consistent with prior research, but also point to opportunities to make this and other forms of disciplinary practice more explicit even in the confines of “traditional” introductory courses. The kinds of changes we propose are intended as a “first step” in broader institutional reform. Given the slow nature of such reform (and the many sources of institutional resistance), we believe it is useful to look carefully at what kinds of incremental shifts have the potential to affect students’ understandings of scientific practice.

## II. Background.

The primary goal of both K-12 and undergraduate science education, especially for non-science majors, is commonly considered to be the development of scientific literacy. While the term scientific literacy lacks a singular, broadly held definition (Baur, 1992; Laugksch, 2000; Lehrer and Schauble, 2006; McGinn and Roth, 1999; Roth and Barton, 2004; Shamos, 1995), in the corpus of scholarship on science education and philosophy of science, it is possible to identify a set of shared themes regarding what a person should know and be able to do as a citizen and as an individual. Chief among these are knowledge for personal wellness and understanding of the nature of science and scientific inquiry (Bybee, Powell, and Trowbridge, 2008).

Missing from this consensus, and indeed from the traditional definitions of both the nature of science and scientific inquiry, however, are insights provided by socio-cognitive and socio-cultural views of the scientific endeavor (Roth and Barton, 2004). These insights derive from studies of science in practice, which make evident the need for science education to provide opportunities for student engagement in “science-in-the-making” as opposed to student exposure

to the “ready-made-science” (Latour, 1987) of textbooks, lectures, and traditional as well as many reform laboratory experiences.

An essential component of scientists’ engagement in science-in-the-making are the myriad inscriptions they produce and use as reasoning tools and communicative devices. Research on the history and sociology of science (Lynch and Woolgar, 1990; McGinn and Roth, 1999; Kozma and Russell, 2005), analysis of scientific texts (Lemke, 1998; Pozzer and Roth, 2003), science teaching and learning (cf., Gilbert, Reiner, and Nakhleh, 2008; Kindfield, 1993/1994, 1999; Lehrer, Schauble, Carpenter, Penner, 2000), as well as compilations of interdisciplinary research (e.g., Biannual International Conference on the Theory and Application of Diagrams, 2000-present) demonstrates that practice and communication in science rely on what Lemke (1998) calls “semiotic hybrids” or descriptions of phenomena that are “simultaneously and essentially verbal, mathematical, visual-graphical, and actional-operational.” Lemke notes that “To do science, to talk science, to read and write science it is necessary to juggle and combine in various canonical ways verbal discourse, mathematical expression, graphical-visual representation, and motor operations in the world” (p. 87). Inscriptions<sup>3</sup> and inscriptional practices are critical to *doing* science, yet they are afforded little status in traditional science education practice and research. In the vast majority of instructional settings and materials, inscriptions of the *products* of science, such as a display of the DNA double helix, are used as illustrations to transmit “the content” as if they are transparent and unproblematic. Yet, in doing, talking, reading, and writing science, inscriptions are complex, nuanced tools that are integral to creating and communicating knowledge. As described in the literature cited above, in the lives of scientists, inscriptions serve as means of expressing research goals, reasoning tools, communicative devices within one’s community of practice, boundary objects for communication across communities of practice, means of verifying research results, rhetorical devices to persuade the scientific community of the validity of created knowledge, and means of confirming membership in a community of practice.<sup>4</sup>

Using inscriptions in these ways requires certain kinds of competence. Two of the more obvious competencies are the ability to produce and interpret canonical inscriptions. More interesting are those which diSessa (2004) defines as “*metarepresentational*”: competencies that go beyond production and interpretation. Among the *metarepresentational* competencies identified by diSessa and others are the abilities to invent or design new inscriptions; to critique and compare the adequacy of different inscriptions; to understand purposes for which, contexts in which, and ways in which inscriptions do work; to explain the inscription itself as well as connections across different inscriptions; and to engage with new inscriptions in meaningful ways.<sup>5</sup>

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<sup>3</sup> Of the four semiotic types delineated by Lemke, we identify mathematical expressions and graphical-visual forms as inscriptions.

<sup>4</sup> An example of this last purpose comes from our observations of undergraduate biology majors participating in a summer research immersion program at a Research I university. As part of the program, students attended a weekly journal club, which was dominated by the interpretation and explanation of complex figures in scientific research papers. Participants also spent significant time crafting professional talks on their research findings. Key to this work was optimizing inscriptions they had gathered or created during their tenure. One of the mentors in this program went so far as to say that a successful tenure for a summer intern was one that resulted in the production of a research-paper-worthy figure (unpublished data). Thus it appears that understanding inscriptions and inscriptional practices was considered a significant component of the participants’ initiation into this community of practice.

<sup>5</sup> Returning to our undergraduate summer research example, what we likely were seeing at least in part was research community support of the development of metarepresentational competencies.

In the context of scientific practice, inscriptions are products of science-in-the-making, constructed and employed to accomplish the purposes delineated above. The referents of inscriptions are natural phenomena and means of capturing relevant data (e.g., a structured investigative protocol, a diagram of an experimental procedure, a photograph of a piece of equipment, etc.). Inscriptional competencies are the abilities that allow scientists to connect natural phenomena and descriptions of natural phenomena.

The profoundly complex relationships among the uses, inscriptional competencies (both simple and metarepresentational), and referents of inscriptional practice are exemplified in Bruno Latour's (1999) analysis of the work of a botanist, pedologist, and geomorphologist who seek to understand the dynamics of the savanna-forest border. In his essay "Circulating Reference," Latour addresses the inevitable trade-offs as one moves from phenomena to inscription and vice versa. As observable phenomena are transformed into inscriptions, certain aspects of the phenomena are reduced to a form that can be circulated among relevant parties regardless of their physical proximity. This reduction necessarily means that some irrelevant information is lost and relevant information is compacted into inscriptions that can be circulated. Recipients who are knowledgeable in the domain can use their specialized competencies to unpack these inscriptions and in a sense return to the phenomena. Those who lack such knowledge and competency have little, if any, capacity to understand the inscriptions beyond their surface features.

Lowe's (1994) work on the relative ability of professional meteorologists and college graduates unfamiliar with the discipline to work with weather maps exemplifies this point. Lowe describes diagrams as presenting "a highly selective view of the subject matter" (p. 468) that require domain-specific knowledge for their interpretation and use, a description borne out by the domain experts in his study being able to meaningfully interpret and extend a weather map while the novices in the study could not. The college graduates in Lowe's study were much like our target population, pre-service K-6 teachers, who come to their survey science courses with little substantive disciplinary knowledge. If prospective teachers are to become scientifically literate and able to support the development of scientific literacy among their future students, they must be provided experiences that promote the development of inscriptional and metarepresentational competence as an avenue to understanding disciplinary content and practices.

Yet, in typical undergraduate and K-12 science instruction, students are exposed to surface features rather than substantive practices of scientific inquiry. This superficial exposure combined with the obligatory lecture on the nature of science serves as the foundation on which students are to become scientifically literate. Consequently, students walk away from their science classes with little understanding of either general or discipline-specific features of authentic scientific work. Whereas there is broad recognition that these outcomes are problematic, the norms sustaining typical practice are deeply ingrained. Those who would even attempt to teach from a science-in-the-making perspective at any level confront a host of cultural and logistical constraints. As a result, we find ourselves in an entrenched cycle in which teachers from elementary school through college teach science as it was taught to them – giving content-jammed lectures driven by inscription-packed slides that are treated as unproblematic illustrations, and running labs that at best include contrived inquiry projects but more often than not follow a cookbook model.

There are some documented attempts to move in the direction of teaching undergraduates from a science-in-the-making perspective, particularly with regard to inscription. Lunsford et al. (2007) designed and implemented a biology laboratory course for prospective science teachers in

which students have free access to the laboratory and inscriptional practices play a prominent role. Bowen and Roth (1998) have reported on the use of graphs in an introductory ecology lecture. Whereas both studies shed light on inscriptional practice in undergraduate science classes, the former focuses on supporting the development of inscriptional competence among a small number of students ( $N = 15$ ) in the context of an inquiry-based lab and the latter provides a microanalysis of the use and interpretation of one type of inscription in the context of a science lecture course. Our study extends this work by considering a range of inscriptional types appearing in biology and geology lectures, and by delving into the relationship between instructors' dual identities as research scientists and teachers of introductory science and the problems and possibilities of inscriptional practice in these contexts.

Our understanding of the relationship between identity and inscriptional practice is informed by the work of Lave and Wenger (1991). In their view, identity is constituted in terms of one's membership within a social community; individuals construct identities with respect to their evolving participation the social practices of that community. As participants in multiple communities of practice, human identities are complex and multifaceted. While in universities the communities of research science and the introductory science lecture overlap in membership, their practices, roles, rules, and relationships remain distinct. Indeed, these communities of practice exist as unique "figured worlds" (Holland et al, 1998).<sup>6</sup> Periodically, however, the instructors in our study consciously or unconsciously blurred these boundaries of practice with varying results. In these occasions, we observed both trouble and opportunity.

The research presented here is part of an ongoing study of prospective K-6 teachers' developing understandings of learning in mathematics and science, the enactment of these understandings as they begin teaching, and the learning outcomes of their students. The objectives are to build models of teacher learning trajectories that might inform the design of teacher preparation programs, and to support the development of appropriate tools to assess the impact of teacher preparation program features on early childhood and elementary-school student learning. Toward our goal of documenting the development of teachers' science knowledge for teaching, in the first phase of our study we sought to understand the forms of inscriptional practice that prospective teachers encounter in their university science courses. Because elementary school teachers take only introductory-level science courses (to fulfill distribution requirements), we devoted our attention to the two courses most commonly taken by our undergraduate teacher education candidates. An overview of the courses and the instructors' impressions of the context in which they teach follows.

### III. Courses, Context and Constraints.

We want to emphasize that our intent in what follows is not to critique individuals' instructional practice. Rather, we seek to document features of preservice teachers' encounters with inscriptional practices in order to understand the experiences they would bring to their science foundations and pedagogy courses. The framing offered by Bowen and Roth (1998) resonates for us: "As a member of a culture, the lecturer merely represents practices common in the enculturation of students to the discipline ... and this analysis should not be viewed as any indictment of the particular lectures analyzed" (p. 78). This section is intended to orient the

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<sup>6</sup> We elaborate on the work of Holland, Lachicotte, Skinner, and Cain (1998) in our discussion of the study context below.



reader to several key elements of the culture within which our focal instructors and prospective teachers were immersed.

Biology 100 (abbreviated below as BIOL 100) is a course for non-science majors that offers broad coverage of the biological sciences. Particular emphasis is placed on basic biological processes in cells and the relationships/interactions between organisms and their environment. The instructors further describe the course as offering a biological “way of thinking” and vocabulary for students to apply biological principles in their lives. Enrollment in this three one-hour lecture/one three-hour lab per week course ranges from 90 to 120 students (lab sections are capped at 24 students). At the time of our data collection, the fall and spring offerings of the course were taught by Professor Dillon and Professor Wiley<sup>7</sup> respectively using virtually the same lecture and lab syllabi. Both are senior lecturers and experienced research scientists.<sup>8</sup>

Geology 101 (abbreviated below as GEOL 101) is an introductory-level geology course, focusing on processes affecting the earth, relationships between these processes and products (earthquakes, minerals and rocks, mountains, ocean features), and the impact of these interactions on the earth and humans. Like BIOL 100, the course includes three one-hour lectures and one three-hour lab each week. Enrollment ranges between 120-130 students per semester. An overarching goal of the course is to help non-majors look at the physical world around them with greater appreciation of the natural forces at work, as well as to provide students with some knowledge that might position them to think critically about public policy on topics such as global warming or energy conservation. For example, during the semester we observed, students were required to attend a screening and panel discussion of *An Inconvenient Truth*.<sup>9</sup> Also like BIOL 100, GEOL 101 is offered during both the fall and spring semesters, and while taught by two different instructors, syllabi and assignments are virtually identical. During the semester that we observed most intensively (Spring 2007), the course was taught by a senior lecturer, Professor Brown, who had served as a petroleum geologist for a major oil company in addition to pursuing academic research at the university.

At the surface, our observations confirmed prior research characterizing undergraduate introductory-level science lectures. The courses met in large, theatre-style halls, with all seats facing a lectern at the front and a large screen hanging from the ceiling behind the instructor. Instructors stood at the lectern and talked for most of the period, projecting PowerPoint slides to support their presentations of content. While these slides included some prose, the vast majority of slides (over 70%) relied on other inscriptional forms to develop content. On average, biology lectures included 10-12 slides; geology lectures included closer to 20. Occasionally, the instructor used a board or overhead to elaborate or simplify one of the images projected.

The four instructors involved in prepping and teaching both BIOL 100 and GEOL 101 were personable, approachable and prepared for each class session. They enjoyed teaching these courses and were committed to providing opportunities for undergraduate learning. When asked about the kinds of constraints they perceived in teaching this type of course, instructors noted numbers of students,

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<sup>7</sup> Instructor and course names are pseudonyms.

<sup>8</sup> Whereas the senior lecturers teach the lecture portion of both BIOL 100 and GEOL 101, biology labs are primarily taught by senior undergraduate biology majors; geology labs by graduate students in geology. Lab TAs typically lecture for 10-15 minutes at the beginning of each lab and circulate during the remainder of the lab while students carry out the day's activities.

<sup>9</sup> BIOL 100 students also watched *An Inconvenient Truth* during one of their lab sessions for similar purposes especially as they related to ecological impact.

Yeah, I think the institutional constraints more revolve more around the size of the class, you know the facilities that you have, you know. I've noticed that in the years that I've been doing this if you can have them in small groups every thing works out so much better but you can't do that when you have 120 students enrolled in the course. It's just not possible to give everyone individual attention every day...Even in the lab, you still have 24 students you still have to take care of and you have one TA to help, there's just no way you can get around to all of them and that's just the nature of how this works (Wiley interview, February 26, 2007).<sup>10</sup>

the nature of the teaching space,

You know this course could be probably a third as long as it is if we could teach it in the field. That would be the best way to teach this class. It's terrible to try to teach anything about the natural world in a lecture ... in a lecture room that's below the ground surface even (Brown interview, March 29, 2007).

and lab access

Wiley: Yeah I would change the lab in, what I'd like is to have more time ... I would love to have lab day you know but I can't do that ... You could do so many different things if you had either longer blocks of times or more variable blocks of time.

Interviewer: Would you advocate ... free access to the lab?

Wiley: I would love to have that. Yeah. I mean I have thought about doing that in my genetics lab. But I keep being told there are liability issues ... But yeah I would love to have free access to the lab (Wiley interview, February 26, 2007).

The instructor for the fall biology course, Professor Dillon, similarly expressed a desire to make labs more inquiry based but noted that it is difficult to manage the "realities" of real inquiry such as providing unscheduled lab access, overcoming an entrenched and inflexible university master schedule to allow for different configurations of meeting times, and protecting instructor time to "come up with a good plan" (Dillon interview, October 20, 2006).

As student numbers, lecture halls, lab access and the university master schedule posed institutional obstacles, so too did the available range of published instructional resources and the time (or lack thereof) available for curricular design. For example, typical introductory biology textbooks and ancillary materials present topics in a standard "levels of organization" sequence (i.e., from atoms and molecules to ecosystems) that most readily supports teaching introductory biology, both lectures and labs, according to this sequence. Deviating from this sequence would require time on the part of the instructor not to simply rearrange topics but to reconceptualize the course according to a new framework that is not supported by most available resources. Even if

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<sup>10</sup> Throughout the paper, quotations from interviews for which we have transcripts are shown either in indented paragraphs or quotation marks. Close paraphrases from class sessions, based on observers scripted notes, are shown in italics.

an alternative resource were available, the instructor might not find it suitable as noted by one of our biology instructors,

I've sort of experimented in past semesters, like the text up there, *Bio Inquiries*, ... presents things in a different order starting with ... DNA, genetics, then evolution and then coming back to cell biology and more biochemistry stuff at the end. I ... actually like that sequence better, but it's hard to do with Campbell [and] I don't like the Pruitt text enough so ... you got to pick and choose [supporting materials]... [A]s I said if I had my choice I would present things in a slightly different order ... but the text sort of keeps you from doing that. The one year I did that [using the standard text], kids never knew where we were in the textbook (Wiley interview, February 26, 2007).

Beyond the constraints of time, space, and resources were the disciplinary and student norms for introductory science courses. As PhD scientists, the instructors approached their courses knowing how the pieces fit together in the larger context of the discipline and having a sense of what “should” be included. Their “should” list was informed by their experience as students, textbooks designed for such courses, syllabi from prior offerings of the course, and their respective perceptions of their disciplines. In addition, there were more general departmental criteria for what “should” be covered (though fewer than would exist for an introductory course for majors). This created a tension between covering all the “stuff” in a topic and keeping up with the syllabus that delineates a long list of topics. Different aspects of this tension were evidenced by our instructors in both interviews and informal conversations. One such conversation occurred between one of us (AK) and Professor Wiley after the March 21, 2007 biology lecture. With two slides left to go and one minute left in the lecture, Wiley covered both slides, contending with increasing noise from the students as he went overtime by about two minutes. In conversation after class, Wiley confessed that he knew he had gone past 10 a.m., but, with good intention: he just wanted to get the last two slides in because doing so made the lecture complete and would allow him to begin a new section of material that according to the syllabus should have started on March 19. In an interview, Wiley addressed a different aspect of “coverage”:

I would say probably the most challenging thing is not getting bogged down with the minutia, all the details, but still not simplifying it so far as to make it meaningless. I mean it is sometimes hard to decide what to leave out and what to put in. I mean today's lecture [about DNA replication] is a prime example. You know I wrote my thesis on how chloroplast DNA is replicated in algae. So I could go on and on about leading and lagging strands and all of these wonderful details but as soon as you do that you, you lose the points you want to make ... to me that's the most difficult thing, figuring out what details to leave in so that you don't dilute it so much that it's meaningless versus how many details do you put in so [it] doesn't become overwhelming. Because I think that the vast majority of kids that are in this class are not interested in science because they think it is overwhelming and they think they are not going to be any good at it (Wiley interview, February 26, 2007).

Instructors also noted how student expectations confounded the pressure for coverage. Students wanted instructors to “stay on track”: one of our instructors said that when she got one or two days behind, students complained mostly because it raised confusion about what would be

on the test (Dillon interview, October 20, 2006). This remark highlights what often appears to be the overriding student concern in a large lecture: knowing and paying attention to what will be on the test. Students who come to class arrive with a model that this concern will be addressed by listening to the instructor talk while they take notes. They frequently remind instructors to indicate when material at hand will be on the test vs. when it is tangential—and in our observations, instructors typically complied. Finally students expect and prepare for test questions (and other assignments) that are fairly straightforward, with right or wrong answers.

I think that's the nature of students especially at an institution like [this]. There's a right and wrong answer and darn it, I want to get the right answer. So yeah I think that's the biggest thing that we have to defeat is the mindset that there is a right and a wrong answer and you know and it's not whether it's right or wrong, it's whether your data can support your conclusions or not ... I can feel good I think if I have 5 to 10 students who really have an answer where they're writing it down, it's their thoughts and their words and their sort of probing beyond where the level that I presented them rather than just the superficial answer which is the bulk of what I get (Brown interview, March 29, 2007).

The lab is the place that they are supposed to put science into practice. So it's the place where they're supposed to form a hypothesis, test a hypothesis, and draw a conclusion based on the data that they have generated and decide whether their data supports or refutes their hypothesis. That's what's supposed to happen ... I think they forget the hypothesis part. They're ready to generate whatever data they're going to generate, analyze it in whatever way we've asked them to analyze it, you know whether it's do a calculation or whatever, and then ask whether it's right or not ... (Wiley interview, February 26, 2007).

The instructors' comments support the view that a variety of institutional constraints and cultural norms converge to shape the implementation of undergraduate introductory science courses, defining many aspects of what might be covered in these courses and how. These norms and constraints are formidable, enmeshed in ways that make significant change seem nearly impossible – especially change involving the incorporation of disciplinary practices as objects of instruction. In conceiving of what might be entailed in this change, we find it helpful to draw on the conceptualization of “figured worlds” by Holland, Lachicotte, Skinner, and Cain (1998). As defined by Holland and her colleagues, a figured world is “a socially and culturally constructed realm of interpretation in which particular characters and actors are recognized, significance is assigned to certain acts, and particular outcomes are valued over others” (p. 52). As illustrated above, in undergraduate science lectures, instructors and students (actors) are understood to have particular roles and responsibilities, and are expected to carry these out in particular ways. Instructors are obliged to present information through both assigned readings and exercises and by talking through slides projected on a large screen. These activities are supposed to prepare students for tests. Officially, students are expected to attend, listen, take notes, read, and complete assignments in order to prepare for tests.

Within this figured world there exist distinct rules for discourse, for example negotiated times during which an instructor may pose a question to the class and other times when students may pose questions of the instructor. Violation of these norms by faculty may carry the consequences of low instructor ratings on course evaluations. The time frame of introductory science class is also clearly bounded. While most students were attentive to the instructor during

lectures, toward the end of the hour all students packed up books and computers, letting instructors know it was time to wrap up the presentation.

Figured worlds are also distinguished by the ways in which artifacts are used and interpreted. For example, while the same *types* of inscriptions appear in both the figured world of science-in-the-making and the figured world of traditional introductory science (e.g., graphs, diagrams, maps, etc.), the inscriptions take on wholly different meanings. These meanings are shaped by the conventions for engaging with the inscription (*inscriptional practice*) and the use or *purpose* to which the inscriptions are put. In our study it was quickly evident in observations and interviews that for instructors, inscriptions were layered with meaning and purpose associated with the enterprise or figured world of scholarly science. It was equally evident that the undergraduates imputed very different meaning and sense of purpose to these same inscriptions, enacting the figured world of traditional introductory science.

Significantly, figured worlds are dynamic rather than static: change results from human improvisation as well as the appropriation and reshaping of practice. As we explained to the instructors when we sought permission to observe their lectures and labs, one of our hopes was to find “leverage points” – experiences in undergraduate science from which prospective teachers might build as they transform their knowledge of central scientific concepts into a pedagogy of elementary science. Thus, through our observations and analysis, we not only began to establish a picture of the forms of disciplinary practice our prospective teachers encountered in their Arts and Science courses, but also began to identify moments in which disciplinary practices from the figured world of scholarly science *could* become objects of instruction and appropriated into the figured world of undergraduate science.

#### IV. Episodes of Practice and Pedagogy.

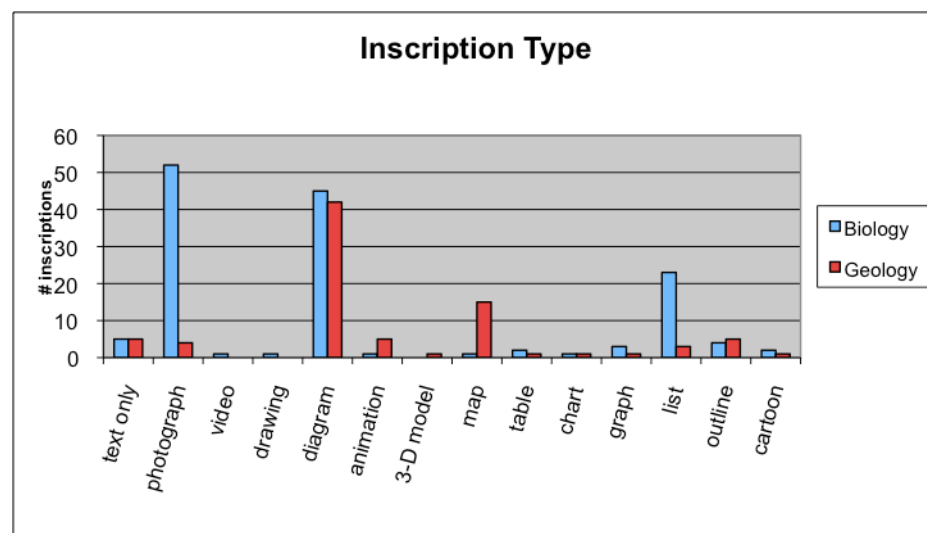
In our analysis reported here we focused on ten lectures (six in biology, four in geology) for which we had the most robust sets of observer notes synced with the instructors’ PowerPoint slides. The format, discourse patterns, and activity structures in this sub-sample strongly resembled the other lectures we observed in each course.

As a first step in examining inscriptional practice, we analyzed each slide that had appeared in the instructors’ presentations. We characterized each slide along four dimensions: Type, Purpose, Practice, and Instructional Mode in order to get an overall sense of each display supporting the lecture. Categorization within dimensions was not mutually exclusive: a number of slides involved more than one type, purpose, practice, or mode. Our slide-by-slide examination made visible the episodic structure of each lecture. Episodes, constituted of one or more slides and the discourse and activity structure associated with them, thus became our unit of analysis for describing opportunities for making disciplinary inscriptional practice a more explicit component of introductory undergraduate science instruction.

Given the logistical and normative constraints within which instructors operated, as well as our familiarity with the traditions of university lecture courses, we were not terribly surprised by the broad patterns that emerged from our counts of *types* of inscriptions used in lecture and our coding of pedagogical purposes, inscriptional competencies, and instructional mode accompanying these inscriptions. Turning first to inscriptional types, Figure 1 shows that in geology, the large majority of inscriptions were diagrams, followed by maps and then slides with text only. In biology, photographs and diagrams dominated.

For each inscription or set of inscriptions that constituted an episode, we coded the instructor's apparent pedagogical intent(s) or *Purpose* for displaying the inscription(s) according to a set of purposes that emerged from our analysis. These purpose categories are defined in Table 1.

As shown in Figure 2, instructors generally drew on displayed inscriptions to explain or exemplify phenomena related to the lecture topic.



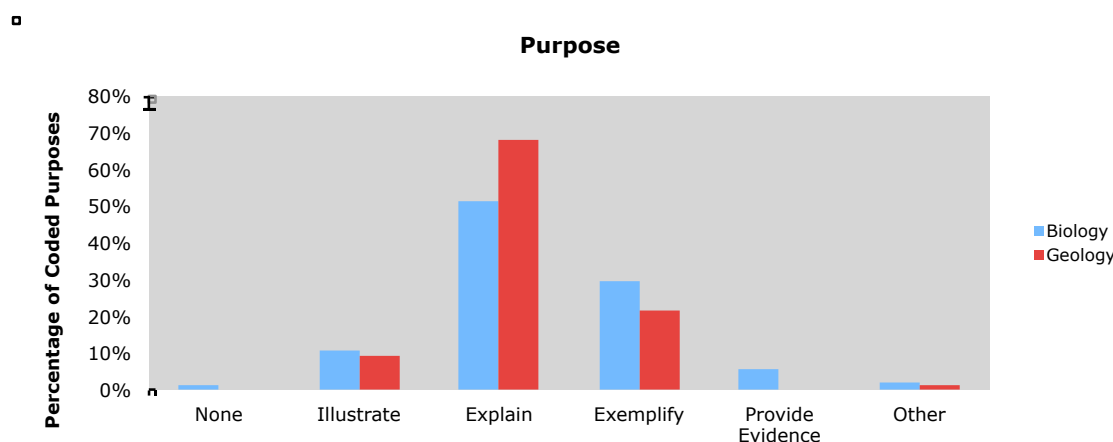
**Figure 1. Types of inscriptions displayed in lecture.**

**Table 1. Descriptive categories for purpose.**

Category	Description
None	No apparent purpose
Illustrate	Show what something looks like – offer a visual “definition”.
Explain	Clarify some dimension of a phenomenon with a focus on what it is, what it consists of, or how or why it “works”.
Exemplify	Offer a depiction as an instance of a broader class of phenomena (“This is what it <i>can</i> look like.” or “Here’s one.”).
Provide Evidence	Provide evidence in support of a phenomenon or claim under discussion.
Other	Grab students’ attention, change mood (e.g., with humor), etc.

**Table 2. Descriptive categories for Inscriptional Competence.**

Category	Description
Take as Given	Offer inscription as information – as if completely transparent. Treat the inscription as the phenomenon, not an inscription of the phenomenon.
Decode	Point out some aspects of the inscription for clarity; explain key conventions.
Interpret	Draw some scientific inference from the inscription.
Critique Superficially	Comment on how well an inscription represents a phenomenon although not to the point of comparing inscriptions or explicating affordances, etc.
Generate	Produce a “standard” inscription of a phenomenon.



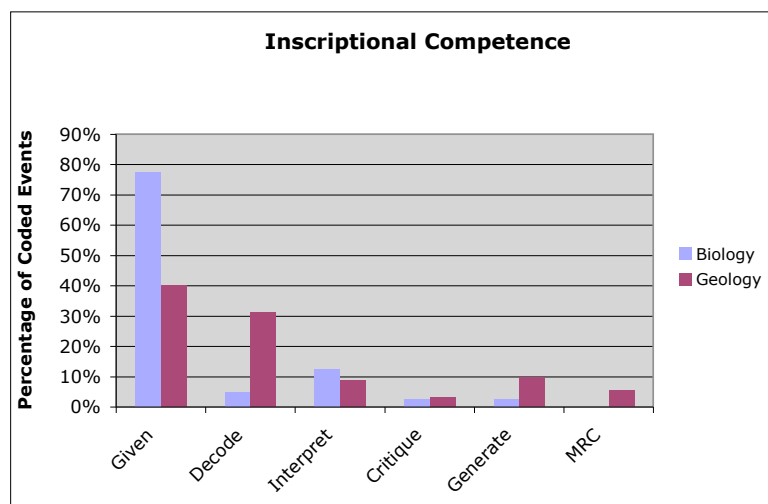
**Figure 2. Purposes for which inscriptions were used in lecture.**

For each inscription or set of inscriptions displayed we also developed categories of *Inscriptional Competence*. These categories were largely empirically derived but roughly correspond to basic representational competencies. They include: take as given, decode, interpret, critique superficially, and generate. Each category and its meaning is shown in Table 2. In the course of data analysis we also considered a set of potential metarepresentational competencies adapted from diSessa (2004). While we rarely observed these competencies, we found it useful to keep this level inscriptional competence in mind, as it helped us identify opportunities for instructors to utilize metarepresentational competencies to advance students' understandings of scientific ideas in the context of a large lecture.

In both courses, the dominant inscriptional competency was “take as given”. By this we mean that the inscription was not treated as an object of instruction. However, in the geology course, the instructor did spend time helping students “read” the slides – decoding inscriptions (30% of coded instances), identifying what meaning he drew from the slide, and in a few instances, addressing the affordances of particular strategies for representing three-dimensional phenomena (see Figure 3). This attention to how an inscription made particular features visible was consistent with his interest in problems of visualization. As he noted during our interview: “Within geology I do something called structural geology. [You look at the] folding and faulting of rocks, the deforming of rocks in different ways... I’ve spent a lot of time looking at things in three dimensions in my research in academics and professionally as a petroleum geologist” (Brown interview, March 29, 2007).

Whereas in biology 75% of the inscriptional practices displayed were coded as “take as given” there were several instances of “decode,” “interpret,” and “generate.” Interestingly, instructors in biology were more apt to “interpret” (an action typically not made explicit by the instructor) than “decode” (an action made explicit by the instructor) with three of the four instances of decoding paired with interpreting. In other words, relatively speaking, there were a number of instances where the instructor clearly made an inference from an inscription (e.g., stated the meaning of a graph) without articulating how s/he “read” the inscription to arrive at the inference.

Finally, we considered the *Instructional Mode* or ways in which the instructor positioned her/himself and students in relation to content. While purpose and inscriptional competence are important primarily in relation to materials (i.e., the slides) presented by the instructor, the



**Figure 3. Inscriptional Competence displayed by instructors during lecture.**

importance of the instructional mode dimension lies in its capturing instructor/student interactions. The categories along this dimension were largely empirically derived and include: tell facts, tell stories, tell reasoning, tell inscriptional conventions, model reasoning, model use of inscriptional conventions, invite to name facts, invite reasoning, and invite to practice using inscriptional conventions. Each category and its meaning is shown in Table 3.

In both courses, the dominant mode of instruction was coded as “tell facts” and to a lesser extent “tell reasoning” or “invite to name facts”. In geology, however, we noted several examples of the instructor modeling reasoning, and even a few cases in which the instructor invited students to reason or practice conventions. While biology instructors did occasionally model reasoning as well as invite students to model or practice reasoning, we observed no instances of these instructors working directly with inscriptional conventions by telling, modeling, or inviting students to practice them (see Figure 4).

Although these patterns echo themes in earlier investigations of undergraduate science teaching, over the course of our observations we came to realize that there is more to be understood here. In the exceptions—represented on the further end of the continuum of inscriptional competence and instructional mode—something interesting was going on. While lectures were highly constrained, periodically they also became sites in which instructors revealed their identities as research scientists by appropriating not only artifacts but also practices from the figured world of scholarly science. As illustrated in the following episode (Geology Episode 1), such moments raised the question of how instructors might leverage their dual identities to bridge introductory level science with scientific practice.

*A. Geology Episode 1: Revealing, but Marginalizing, Professional Inscriptional Competence (January 15, 2007).*

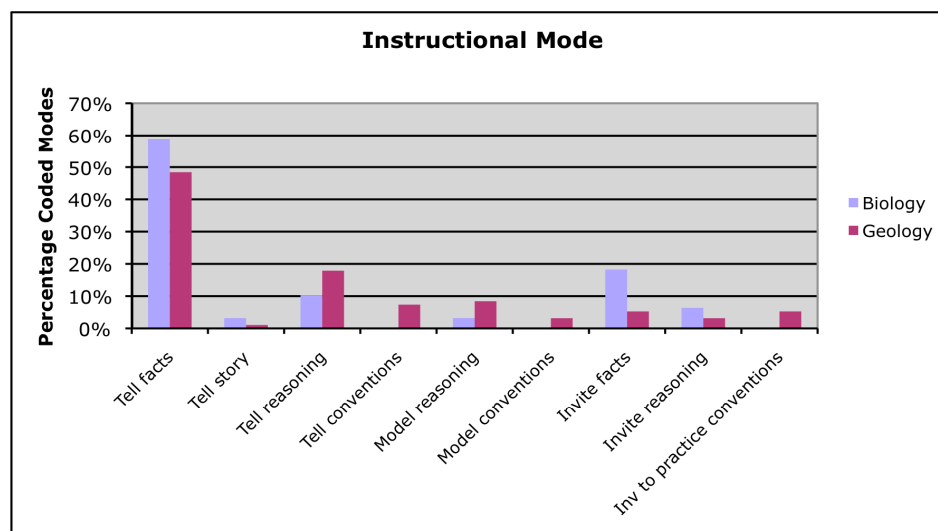
Professor Brown opened the third lecture of the course by noting that he wanted to provide some clarification on the notion of physiographic provinces discussed in the prior lecture. During the earlier session, Brown had defined a physiographic province as



[A] region all parts of which are similar in geologic structure and climate, and which has consequently had a unified geomorphic history. A region whose pattern of relief, features, or landforms differs significantly from that of adjacent regions (Brown lecture slide, January 12, 2007).

**Table 3. Descriptive categories for Instructional Mode.**

Category	Description
Tell Facts	Provide end-product knowledge (the “facts”).
Tell Stories	Present “disciplinary lore”—canonical stories about findings, progress in the field, etc.
Tell Reasoning	Describe how scientists in the discipline (including self) think about particular problems or phenomena.
Tell Inscriptional Conventions	Note the meaning of different components of an inscription.
Model Reasoning	Demonstrate how scientists in the discipline think about particular problems or phenomena by “thinking aloud”.
Model Use of Inscriptional Conventions	Explicitly apply conventions for representing a phenomenon or reading an inscription.
Invite to Name Facts	Ask students to recall information (from a previous lecture or elsewhere) typically using IRE.
Invite Reasoning	Ask students to think about a problem or phenomenon from the perspective of a scientist. When invitations are “successful”, students are visibly engaged in reasoning about a scientific idea or problem.
Invite to Practice Using Inscriptional Conventions	Ask students to try/apply conventions for inscribing a phenomenon or reading an inscription. When the invitation is “successful”, students connect directly with content by reading or making an inscription.



**Figure 4. Instructional Mode when displaying/using inscriptions in lecture.**

He had then begun to outline major divisions of the continents (students had a handout that characterized these divisions, as well as divisions of the oceans). Now Brown projected and decoded a shaded relief map of the United States, saying: *All of the bumps, that means*

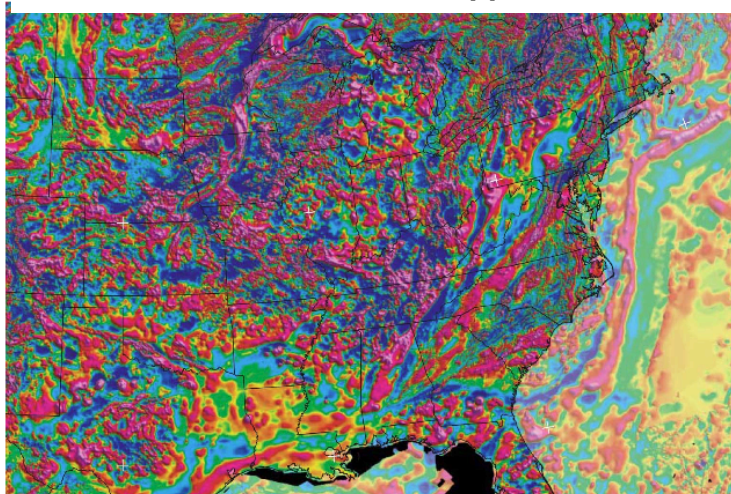
*something. If you look you can begin to see defining features. The Mississippi River runs through here and it's ultra flat; in contrast note the Appalachian Mountains here. Those broad definitions are physiographic provinces. Over the next few minutes, Brown projected several more topographical maps for different physiographic provinces around the world.*

Then he announced: "I'm going to diverge a little. I want to talk about the connection between the landscape and plate tectonics." The next slide he projected was a magnetic map featuring the eastern portion of North America with the title: "Who Cares? A tangent into Brown's world – Amazonia in Appalachia" (see Figure 5).

*Brown: This is a magnetic map of the US. It is derived from people flying low in airplanes and doing measurements with magnetometers. Then all of the data are compiled in a map. It looks maybe to you like nonsense, but in the colors there seem to be patterns. Note the line from Alabama to New York. A line that exists in covered shield [points out lines in the covered shield indicated by magnetometry readings].*

*Brown: This is what is really cool. We - I - just found out over the summer that in those rocks, way below the surface, there are places where two pieces of continental crust are glued together. If you go on the other side of this line [points to reddish line on the magnetic map], all of the rocks in that basement – the lower levels – are from South America. This is something new and fascinating. I hope it gives you an idea about why it's neat to think about physiological provinces in ways I'm encouraging you do.*

#### **Who Cares? A tangent into Dr. Brown's world – Amazonia in Appalachia**



**Figure 5. Slide display of magnetic map featuring the eastern part of North America.**

Image is provided by the US Geological Survey [<http://crustal.usgs.gov/projects/namad/DNAG.html>].

In this very brief (approximately two minutes) episode, Professor Brown shared a particular form of data display, a magnetic map, organized to reveal distinct physiographic characteristics of a location familiar to the students, the United States. Recognizing that for students the map might look "like nonsense", he briefly decoded and interpreted the significance of the colors as he gestured to the line from Alabama to New York. Brown further suggested that such data have contributed to the recent discovery that "all of the rocks in that basement are from South America." Hence, the slide also exemplified the collection and reading of data in relation

to a theoretical model, plate tectonics. Finally, Brown linked this ongoing research back to the concept of physiographic provinces, which the prior lecture had begun to define.

Brown's apparent intent was to show how a scheme for characterizing parts of the earth's crust had advanced a theory that revolutionized the subfield of geology (and which animated the course), plate tectonics. As we examined this episode, we were taken with Brown's move to open a window on the use of a particular form of data representation in supporting, or constructing, a scientific explanation. Magnetometer readings assist geologists in determining the placement and types of rocks below the surface of the earth. Coordinating these readings enables researchers to identify significant similarities and differences in crustal features, and to make conjectures about how they came about. Hence, for practicing geologists the magnetic map is an inscription that does work. While in the prior lecture the term "physiological province" existed as one of many vocabulary items, here Brown reframed it as a construct that, like the map, is a tool of practice.

And yet, Brown labeled the slide and his discourse around it as a *tangent*. This was not the usual business of GEOL 101, but a detour into Brown's world outside the lecture hall. In that figured world of research science, the purpose of an inscriptional display is scientific—organizing data, supporting reasoning, providing evidence—rather than simply explanatory or illustrative. Accordingly, competent "reading" of such displays involves understanding these purposes, recognizing the work that they do and assessing their affordances and constraints in relation to other inscriptions. Of course in this other world, inscriptional competence also includes the generation of new and sometimes novel inscriptions. Here in the lecture hall, however, Brown only alluded to this intricate task of reading.

Episodes like "Amazonia in Appalachia" made clear that instructors brought a rich sense of the conceptual and empirical significance, purposes, and limits of the images they shared with students. As with Latour's (1999) pedologist, these images were part of a complex chain of reference, telescoping the features of phenomena observed in scholarly investigation to systems of conjecture and hypothesis. For these instructors, even textbook diagrams could reference and connect to more "scientific" displays. However, such sense was invisible to students. While inscriptions projected via PowerPoint were an all-pervasive feature of the undergraduate lectures, for the most part, they remained unexamined enactments of practice.

Given our view that understanding of inscriptional practice is an essential dimension of science content knowledge for teaching, we found ourselves drawn to those rare moments when faculty in some way called attention to inscriptional work, signaling a different kind of engagement with the content. At these times, the instructors drew explicitly on their experiences as practicing scientists in the fields of structural geology and tectonics (Brown), ecology (Dillon), and microbial genetics (Wiley). Our coding scheme tended to pick up these moments in two ways: either coders indicated "higher" level descriptors (interpreting rather than taking as given; modeling reasoning or conventions, rather than telling, etc.), or we had some initial disagreement about how the episode should be coded and sometimes ended up "double-coding", for example, as tell *and* invite reasoning.

We consider these episodes to be not merely interesting examples of instructors' converging identities, but also as opportunities to be exploited. In the following pages, we present and comment upon three more episodes to illustrate how, even within the constraints of space, time, number, and normative culture, introductory level science lectures might become spaces in which practices of science take a more central role in pedagogy.

*B. Biology Episode 1: Navigating Multiple Inscriptions of the Same Phenomenon (February 26, 2007).*

During weeks 7-8 of the 15-week Spring '07 semester, Professor Wiley devoted 3 lectures to the primary processes of molecular biology, DNA replication, transcription, and translation. The lecture from which this episode derives was the second lecture in this set. His goal was to explain various aspects of DNA replication. During this 25 minute episode, Wiley referenced the 3 slides (see Figure 6).

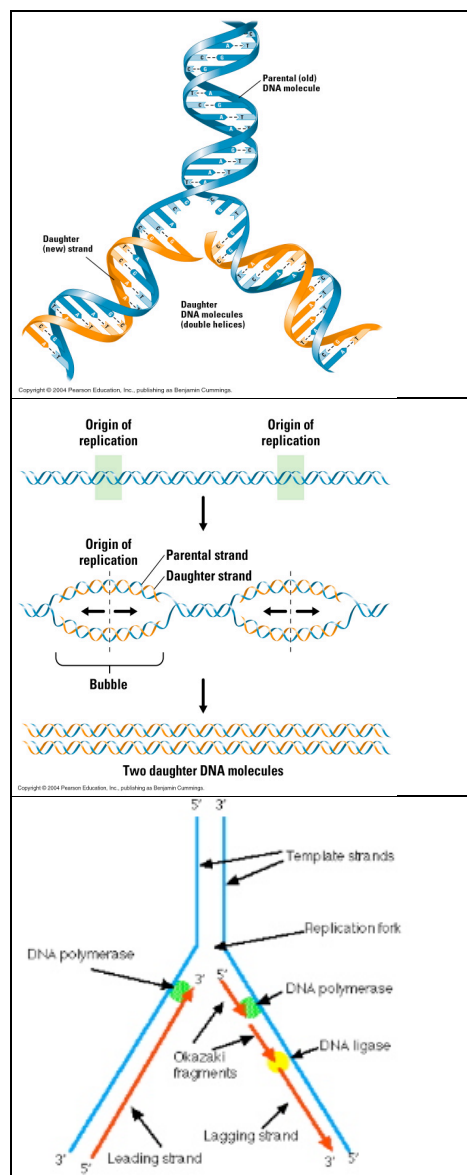
All three slides in the episode depict DNA replication; different aspects of the process are made salient on each slide. The first slide (Figure 6: top) focuses on the semi-conservative nature of DNA replication. It shows the double-helical structure of the DNA, and uses color to distinguish “old” strands from “new” strands. The double helix and the color convention are retained on the second slide (Figure 6: middle), which focuses on origins of replication and includes depictions of pre-process, in-process and post-process DNA molecules. The third slide (Figure 6: bottom) focuses on the actual process of replication. Although the color convention for the “old” and “new” DNA strands is retained, other inscriptional elements vary considerably in relation to the first two slides: the helical nature of the DNA molecule is no longer depicted, many parts are labeled, and two entities are added (the enzymes DNA polymerase and DNA ligase). Interestingly, the inscriptions of the DNA molecule in the first and third slides are quite similar; they could easily be superimposed, retaining many of the same features. The first two slides were from the textbook; Wiley had obtained the third from a website associated with a similar course at another university. Wiley used each of these slides extensively, pointing to various locations and adding his own diagrams to the first and third slides:<sup>11</sup> the three sets of paired lines on the middle right (ultimately with nucleotide letters—not shown) on Slide 1, and the group of geometric figures under “Step 2-Elongation” on Slide 3. He progressed from one slide to the next, periodically asking students to name facts (e.g., *What’s needed to go into mitosis?*) but answering most of questions himself due to lack of student response.

In addition to inviting students to name facts, Wiley invited students to practice reasoning by posing a “riddle” (his words) early in the episode while still using the first slide. The riddle concerned how one aspect of the process of replication could occur (i.e., overall 3' => 5' synthesis of a DNA strand) given a constraint inherent in the process (nucleotides can only be added to a growing strand in the 5' => 3' direction). He said,

*I am going to present you with a “riddle”. Which way do you think this [DNA replication] is happening? ... One chromosome is growing this way and one the other [pointing to diagram], but I’m going to tell you in just a minute that DNA only grows in one direction. This causes a problem. How can this be? ... DNA polymerase [is the] major enzyme that copies DNA ... it can only add new nucleotides to the 3’ growing end of the chain. The reason for this is at the end you have a 3’ OH group hanging off – so [the] strand only grows in 5’=>3’ direction ... I am going to leave you with a little riddle [posed earlier] that we will try to answer in a minute.*

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<sup>11</sup> Wiley used an overhead and transparencies of his prepared PowerPoint slides, making it easy to add to them during a lecture. He routinely elaborated text on a slide and twice (both in this episode) generated his own diagrams during a lecture.



**Figure 6. Slides of DNA replication.**

Slide #1 – From Campbell, Neil A., Reece, J.B., and Simon, E. J. *Essential Biology*, 3<sup>rd</sup> Edition, 2007, p. 176, Fig 10.6. Reprinted by permission of Pearson Education, Inc., Upper Saddle River, NJ.

Slide #2 – From Campbell, Neil A., Reece, J.B., and Simon, E. J. *Essential Biology*, 3<sup>rd</sup> Edition, 2007, p. 177, Fig 10.8. Reprinted by permission of Pearson Education, Inc., Upper Saddle River, NJ.

Slide #3 – From <http://www.uic.edu/classes/bios/bios100/f05pm/lect10.htm> by Michael Muller, 2010. Reprinted with permission.

The answer to this riddle was depicted in the third slide, but when he reached the third slide and posed the riddle again, students remained silent. Because the first slide did not provide information that would have been useful in solving the riddle, to respond when the question was initially posed, students would have needed to refer to another source, perhaps a reading assignment. The third slide however did contain use information for solving the “riddle”, had students used the slide as a reasoning tool and been able to interpret it. When no one offered a solution upon seeing the third slide and hearing the riddle again, the instructor provided the solution using the slide as part of his explanation.

Clear in this episode was Wiley's strong metarepresentational competence. Wiley moved fluidly between different inscriptions of the same phenomenon, adapting textbook images by adding diagrams that included only the features necessary to highlight particular aspects of the phenomenon of interest, simplifying even to the point of misrepresenting some (i.e., the relationship between the various enzymes which was clarified by Wiley's diagram). These adaptations emphasized the relationships across the slides. For example he added a diagram to the first slide using the convention for representing DNA that would be used later in the third slide (i.e., straight parallel lines for the DNA double helix as opposed to paired helical lines). He added a diagram to the third slide of the protein complex that orchestrates the different replication events, two components of which were shown as separate entities in the provided diagram and one that was not shown at all.

However, this complex inscriptional knowledge was not an object of his instruction. Instead, he treated each inscription as a transparent illustration. Wiley's ability to meaningfully navigate the inscriptions remained tacit in the figured world of the introductory science lecture. What might it look like to make the inscriptional work more visible? One possibility would be for Wiley to pose the riddle with the third slide projected and to encourage students to see if they could figure it out *using* the displayed inscription. He could engage the students in a conversation about what the components in the diagram might mean and what they might indicate about the process of DNA replication. Or to provide even more challenge, he might pose the riddle without the red arrows labeled "Okazaki fragments" in the diagram, asking students if they could figure out how to solve it. The riddle is an interesting one – and a question that scientists trying to understand the process asked themselves. One can imagine these scientists generating diagrams much like the one shown based on the data they had and wondering if the pieces now known as Okazaki fragments could be the solution and if so, how the gaps in between them be sealed.<sup>12</sup>

An alternative approach might be to include in his explanation something about the relationships among these inscriptions, especially between the very similar first and third slides. Taking this tack one step further, he might ask the students to look across the inscriptions to identify the relationships among them and the representational conventions being used and to speculate about the differences among them in relation to the particular content being considered. This would introduce students to metarepresentational competencies as well as provide an avenue toward a deeper understanding of the process being represented.

### *C. Geology Episode 2: Visualizing As an Explicit Instructional Goal (March 30, 2007).*

"Strike and Dip" is a convention by which geologists display 3D structure in two dimensions. In this next section we describe an ambitious attempt to help students understand this key inscriptional tool of structural geology. In the episode described below, Brown placed in each student's hands a simple model (what he called a "strike and dip machine" comprised of two intersecting index cards) and asked students to manipulate the cards in order to visualize 3D structure represented by the 2D strike and dip notation. The episode, during which the instructor momentarily stepped away from the projected image, stood out as the clearest effort we observed to develop students' metarepresentational competence and as such provides a unique example of how such competence might begin to be addressed within the lecture hall. Also important here was Brown's productive leveraging of his dual identities: Brown deliberately enjoined his

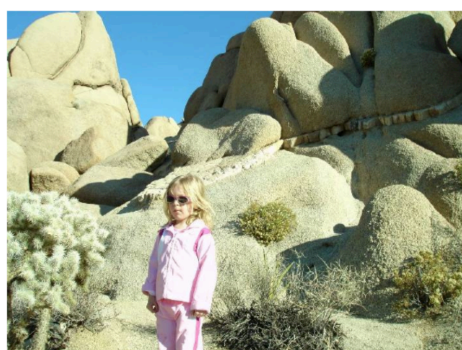
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<sup>12</sup> They are sealed by the enzyme DNA ligase.



experience and expertise as both scientist and instructor as he worked to make the notational practice and purpose accessible to students.

The structural geology unit came in the 11<sup>th</sup> week of the 15 week course, and was designed to engage students in one of the central tasks of geology: representing geologic structures and processes – which are three (and four) dimensional phenomena – in two dimensions. This practice is, as the instructor put it, basic to “what geologists do” in academic and commercial enterprises. In the homework assignment and lab that accompanied the three unit lectures, students were asked to “read” two-dimensional inscriptions, visualize the geologic features represented, and also use the notational system to inscribe hypothetical geologic data. While earlier in the course, Professor Brown had shared different representations of data – for example magnetic, thermal, and topographical maps – this was the first time that he asked students to read *and* produce conventional inscriptions.



**Figure 7. Photograph taken at Joshua Tree National Park.**

Used with permission from Dr. Brendan Bream, Production Geoscience-Special Studies Group, ExxonMobil Production Company.

Brown launched the unit with a photograph (projected in his PowerPoint slides) of a young girl standing in front of an outcropping at Joshua Tree National Park (see Figure 7). He immediately noted the photograph’s limitations:

*What you can’t see, is in the dike if you could follow around the outcrop, there’s a different expression of it here... [?] a bit of a different resistance to weathering. This is pure geometry. Rocks have some inherent geometry to them. Not like sedimentary rocks, which are flat all the time. There are variations in thickness in the exposed dimensions. I want to teach you the way that geologists take this 3-dimensional structure and represent it on a map.*

For the next half hour Brown projected diagrams, via PowerPoint slides, schematizing the forces that act on the earth’s crust to create different kinds of deformations above and below the surface: “The big thing to get today is that you can deform rocks with differential stress, and it modifies how the rocks look and the volume they occupy” (lecture, March 30, 2007).

Then Brown turned up the lights in the lecture hall to introduce a “strike and dip machine”. Strike and dip, he explained, is the way that geologists represent on a map the results of stress and strain – like the outcropping in the photo he showed at the beginning of class. *The strike and dip is the most regularly used way to obtain information about the geometry of the rock. You first take a compass and measure in the field to get the exact orientation of a plane.*

Here, Brown paused to distribute two index cards to each student in the lecture hall, and asked students to hook the cards together to form two intersecting planes.

Brown: *If you have two planes that intersect, what do they define?*

Student 1: *A line.*

Brown: *A line. We define that as a strike. So use your larger card to represent the imaginary horizontal plane. The strike line is where the two planes intersect. My imaginary plane is the white note card. My inclined surface is the purple note card. Where they intersect defines the strike line. As you rotate the cards around this way, the strike line swings. You get the angle relative to north-south. So now orient your intersecting planes so the strike line is north-south. (Brown establishes that students in the lecture hall are facing south and students adjust.) One line has to be horizontal. How would you rotate your cards so the strike was east-west?*

*This is the place where some people say, what are you talking about? ...Who has no clue what I'm talking about? (About 10 hands go up.) Okay, I'll go over it again.*

Anticipating that many students would have trouble “seeing” the model, Brown repeated the explanation. Then he asked students to hold up their “strike and dip machines” to define a strike line that is northwest-southeast. As students reoriented their cards, the instructor pointed and nodded to those who “had it”, and nudged his own cards to suggest change to others. He continued,

Brown: *So we have a loose orientation of strike. We do this because geologic information about rocks is always 3-dimensional. This usually is not taught in introductory classes, but because it's what I do, I like teaching about it.*

*We can show the orientation with a number, how many degrees rotated from north- south, or with a pair of directions that are 180 degrees from each other, northeast-southwest. Who is comfortable with this concept?*

*(Two students raise hands.)*

*So that's the first half. The second part is the dip. If I were blindfolded, how would you tell me about this line?*

Student 2: *It's diagonal.*

Brown: *Directionally, how is it oriented?*

Student 3: *Northeast-southwest.*

Brown: *Okay, so take your plane and align it. The dip is oriented at 90 degrees off the strike line, and shown as a tick off the strike line. What dip tells me is at a cross-sectional view the number of degrees from horizontal that I go down on an inclined plane. Putting these two things together, we know everything we need to about the inclined plane.*

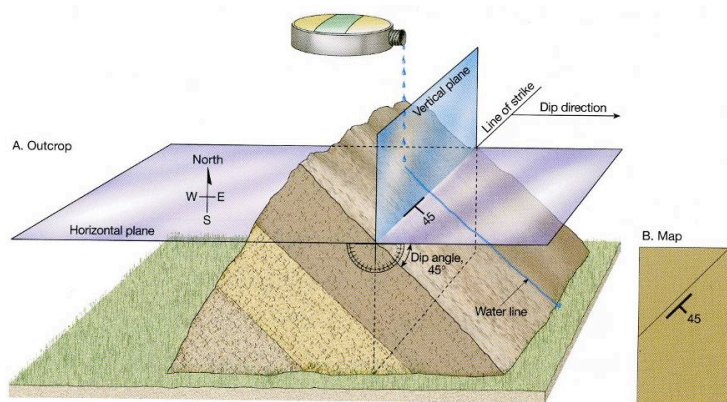
*So now orient your cards so strike line is NE-SW. What direction is it dipping? You can take your card and force it to dip to the SE 30 degrees. A strike on a map and a dip and a number tell me how a formation is oriented. With the*



*dip on this side, can be 0-90 degrees. Why not greater? Because past 90 degrees it's dipping in another direction.*

*One way to help you visualize is this: You have the imaginary horizontal plane. One way to think about it is that it intersects top of surface, and you get the strike line. The dip line shows slope of formation away from strike line [Brown refers to slide shown in Figure 8].*

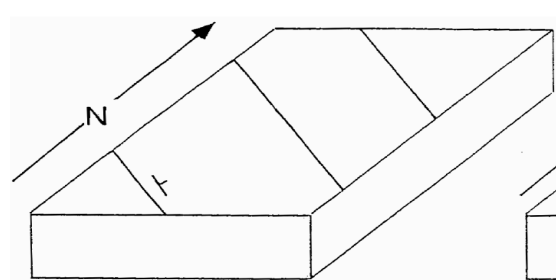
*One thing we tell people to do when they are learning to be geologists – is to drip some water on the outcrop. The direction the water goes is equal to dip – it is the fastest way to go down. So the water will run off in dip direction. The dip angle is magnitude from the horizontal.*



**Figure 8. Slide of a three-dimensional view of the imaginary plane.**

From American Geological Institute, AGI/NAGT; Busch, Richard, M., Laboratory Manual in Physical Geology, 8<sup>th</sup> Edition, 2008, p. 196, Fig 10.1. Reprinted by permission of Pearson Education, Inc., Upper Saddle River, NJ.

Thus, while Brown opened the lecture with a fairly “standard” review of the forces which act on the earth’s crust to produce different kinds of rock formations, half way through he shifted away from the PowerPoint to help students visualize how an inscriptional convention (strike and dip) coordinates the relationship between the orientation and slope of an outcropping. In the final minutes of the lecture, Brown introduced one further abstraction, block diagrams (see Figure 9). Unlike most of the diagrams students had encountered to this point, block diagrams lack any sort of literal depiction of the contours of an outcropping. However, through a combination of lines (marking sedimentary layers) and directional notations, these diagrams enable one to convey important information about relative age, orientation, and slope.



**Figure 9. Slide of a block diagram.**

Used with permission from the Department of Earth and Environmental Sciences, Vanderbilt University.

In our interview on the day preceding this lecture, Brown noted that structural geology is an unusual topic for a non-majors course.<sup>13</sup> However, because of his own academic and applied interests in this area (noted above), he had been excited to learn that the topic was included by the senior faculty member who designed the course. Brown iterated this connection in lecture: *This usually is not taught in introductory classes, but because it's what I do, I like teaching about it.*

This was not the first time we had observed Brown expose students to a set of problems that are central to his identity as a researcher and petroleum geologist. Interestingly, each of those cases surfaced fundamental problems of “seeing” and inscribing. In earlier lectures, Brown had juxtaposed “birds-eye” and cross-sectional views, highlighting the constraints of each in making geological features visible. At one point, realizing that one of the slides was confusing to students, Brown drew a simplified diagram on the board and pointed out that the way the slide rendered 3D information distorted (and confused) the view he sought to project. In the lecture described here, he problematized everyday ideas about representation – showing students that literal depictions like photographs actually obscure what may be happening below the surface. We were further intrigued to realize that the sequencing of slides in the lecture reinforced and extended this counter-intuitive notion: over the course of the March 30 lecture, Brown projected a set of representations that grew increasingly “sparse” and yet which conveyed dimensions a photograph could not. In the lectures that followed, Brown continued to assert the necessity of an inscriptional convention to distinguish one formation from another in a two dimensional representation. The “content” was not merely a set of different types of geological formations, but rather tools and strategies for representing important distinctions among them. Like Wiley, the content and crafting of his lectures revealed sophisticated metarepresentational competence.

And yet we fear that this move to draw students into the realm of disciplinary practice may have been subsumed by the institutional and cultural constraints of the undergraduate lecture hall. First, while the challenge presented was to move from three-dimensional phenomena to two-dimensional representations, students started from two-dimensional images. Students were not in the field encountering 3D features to be conveyed to colleagues positioned elsewhere. Rather, they worked to inscribe hypothetical data presented as text/numbers on the block diagrams included in their homework sheets. Thus, the problematic relationship between inscription and landform disappeared. For Brown there was a clear chain of reference from inscription to a geological outcropping of a sort he has encountered up close; for students the references were back to two dimensional objects, whether photographs or block diagrams. While ideally students would seek to visualize the phenomena represented by their inscriptions, we wonder whether students took this step. In the lab sections that week, students were asked to fold cardstock prints into block diagrams, to color in particular sections, and to interpret the contours and relationships among the layers depicted. It was unclear that students linked these representations to real or hypothetical landforms. Student conversations as they worked suggested the block diagram problems seemed more like puzzles (often confusing), than inscriptions for geologic data. Even as the instructor spoke the language of scientific practice, students mostly worried about getting the information they needed for the test. Unlike the “Amazonia in Appalachia” episode, inscriptional practice *was* the subject of learning here. However, as the square peg of disciplinary practice was squeezed into the round hole of

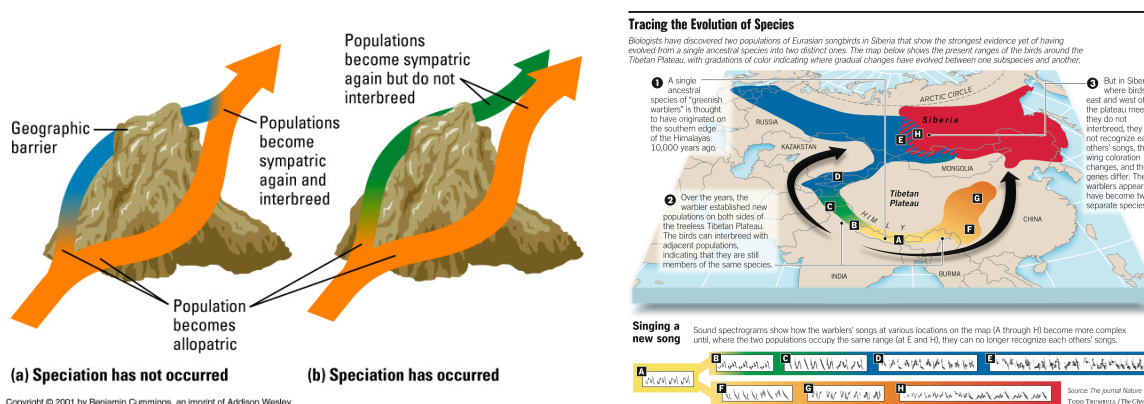
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<sup>13</sup> And in fact, this focus on inscriptional conventions stood out in a course designed to support students as thoughtful citizens able and critical consumers of environmental policy.

introductory course norms, from students' perspectives the inscriptional task became decontextualized, and so unproblematicized.

This is not an indictment of Brown's skill as an instructor. Indeed, in introducing the index card "strike and dip machine", Brown established a bridge between the two dimensional notation developed by field geologists and the three dimensional perspective the notation signifies – an insightful pedagogical move.<sup>14</sup> Rather, we are interested in the opportunity (not pursued here) to problematize the notational solution and so further develop students' metarepresentational competence. To take this next step, Brown might ask students to wrestle a bit with the problem before providing a solution – for example asking them to consider what features of an outcropping ought to be conveyed, and to justify their choices by explaining why such features would be geologically significant. In this scenario, students might assume a geological perspective to explain why features like orientation and slope are important in the first place. In both semesters, the geology professors periodically posed questions during lecture and asked students to talk to their neighbors about their answers. Here Brown could solicit and share inscriptional solutions, again highlighting why certain dimensions were geologically significant, and comparing the affordances and constraints of each. Or, perhaps he might pose several different solutions (conventional and non-conventional) for students to consider, asking them to consider the tradeoffs among those. Yet another possibility would be to ask students to use the conventions to describe 3D phenomena that they observe – a desk, a building, a sculpture, and *then* choose. In these ways, Brown could highlight a representational challenge and a conventional solution, establishing the basis for developing metarepresentational competency.

#### *D. Biology Episode 2: Reasoning About Evidence in a Complex Inscription (November 13, 2006).*



**Figure 10: Generic slide of allopatric speciation and slide of a putative example of allopatric speciation.**

Left image - From Campbell, Neil A., Reece, J.B., and Simon, E. J. Essential Biology, 3<sup>rd</sup> Edition, 2007, pp. 276, Figs 14.9. Reprinted by permission of Pearson Education, Inc., Upper Saddle River, NJ.

Right image – From Trumbull, T., San Francisco Chronicle Graphic Titled "Tracing the Evolution of Species". All Other Rights Reserved by San Francisco Chronicle. Credit: Photog/San Francisco Chronicle.

<sup>14</sup> Moreover, the size of the index cards made visible not only the intersecting planes described in the notation, but also student comprehension – a quick glance around the lecture hall told Brown who was following and who was not.

Clearly there is a tradeoff here. Bringing such an activity into the lecture hall would take a precious half session away from another topic. However, we also believe that such a trade might enable more students to understand deeply the central unit challenge: visualizing and representing three-dimensional phenomena.

Scientists routinely incorporate evidence and arguments into inscriptions but inscriptions that contain these components of science-in-the-making are not often included in introductory science lectures. In this episode, a set of interrelated inscriptions originally intended for a science-savvy audience was used to present a putative present-day case of allopatric speciation (speciation that occurs as a result of geographic isolation). In her discussion of the evidence-presenting slide (see Figure 10), Professor Dillon interpreted and reasoned with the various inscriptions in the slide. However, she did not explicate what she was doing and how she was doing it. Much like what we saw in Biology Episode 1, when acting in the figured world of a lecturer, Professor Dillon used skills common to the figured world of a scientist without treating these skills or their application as objects of instruction.

During weeks 10-12 of the 15-week Fall '06 semester, Professor Dillon devoted 8 lectures to the topic of evolution. The lecture from which this episode derives occurred halfway through the evolution segment. In this lecture, Dillon used 14 slides, 10 of which displayed inscriptions. The two slides shown in Figure 10 were used during this 8-minute episode.

The first (Figure 10: left) is a figure from the textbook depicting a generic population (represented by colored arrows) splitting into two populations by virtue of a mountain in its midst and coming back together either as the same species or as two different species, the latter of which specifies an allopatric speciation event. This slide not only provides an abstracted visual of geographic isolation but also indicates that geographic isolation does not necessarily result in speciation but it can. The second (Figure 10: right) is a complex slide, the primary source of which was the scientific journal *Nature* (Dillon's source of the image was the *San Francisco Chronicle*). It displays two pieces of data that serve as evidence for allopatric speciation, a map showing the territories of 8 subspecies of warblers as distributed around the Tibetan Plateau (a "circular" geographic barrier) and sound spectrogram of each subspecies' song arranged in a divergence pattern. Subspecies E and H no longer interbreed, making this an excellent example of speciation.

In this episode, the first slide was displayed for approximately three minutes while the instructor explained allopatric speciation with specific reference to the slide and talked more generally about difficulties associated with mounting an argument for speciation given the vast amounts of time over which most speciation events would occur:

*The problem biologists have when we find two different species is we question did they diverge from a single species ... it is difficult to know if they started out as the same species because of the time it took.*

This slide served as a segue to using the second slide for approximately five minutes to exemplify, explain further, and provide evidence for a speciation event for which space rather than time was the more critical factor. While displaying this slide, the instructor told both facts and reasoning, and modeled reasoning as she interpreted each of the two primary components of the slide, the map and the sound spectrograms, and coordinated them to come to the conclusion that subspecies E and H have evolved into separate species as follows:

*These are subspecies, not different species, because there is an indirect gene flow. A can exchange genes with B, B with C, C with D, but D can't exchange with A. This example looks at the different songs of related birds and whether or not they will mate ... the species are changing as they go around the plateau—the real suggestion that actual speciation has taken place are at spots where the two ends of the plateau come together [Professor D. points to the overlapping territories of species E and H]—now the two species at the two ends can't interbreed ... showing us how the slow process could have occurred ... and that's what we are all looking for, any type of evidence for this [speciation].*

This episode highlights the instructor's ability to interpret, coordinate, and reason about evidence presented in inscriptional form. In her explanation Dillon appeared to follow a chain of reasoning to make the case for speciation—invoking indirect gene flow,<sup>15</sup> evidenced to her by the territory distributions on the map, and song divergence, as evidenced to her by the sound spectrogram display. Given their richness and intent, the focal inscriptions offer a ripe opportunity to model and guide student development of multiple inscriptional practices. However Dillon made no explicit reference to *how* the map “showed” indirect gene flow or *how* the sound spectrograms, individually and by their arrangement, “showed” song divergence or *how* the two displays taken together made a case for speciation.

Imagine if at this point, the instructor had taken reasoning with this slide one or more steps further, an ambitious step for an instructor in courses of this ilk but one with high potential payoff in the realm of exposing students to and engaging them in scientific practice. Given the partial voicing of her reasoning using the inscriptions on the slide, one possible move may have been to elaborate that reasoning so that students could observe more elaborate modeling. This elaboration could have taken the form of a more detailed “think aloud” or could have explicitly moved between pedagogy and practice with the instructor making explicit connections between her thought processes and components of the inscriptions (e.g., the territory markings on the map indicate indirect gene flow because...). Another possible tack might have been to shift from *showing* students reasoning by talking it through, starting with the claim that material on the slide provided evidence for allopatric speciation and engaging students in the reasoning. This could have been accomplished by posing questions like (a) what is the relationship between the territory map data and the sound spectrogram data and how is it represented, (b) what aspects of the territory map support the claim that allopatric speciation has taken place, and (c) what aspects of the sound spectrogram data support the claim. In this scenario, which would ideally include scaffolding on the part of the instructor and interaction among the students, the students would have had the opportunity to *interact with* the data with the goal of figuring out its potential significance rather than *hear about* the data and its significance as the instructor put all the pieces together.

It is interesting to note here that use of figures from primary sources like the journal *Nature* in a non-majors introductory science course is quite uncommon, yet this slide accompanied one of the few episodes that we observed *in toto* involving reasoning about evidence. This suggests that a more global move that instructors could take toward incorporating disciplinary practice into lectures would be to rely less on textbook inscriptions while increasing their use of inscriptions from primary literature.

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<sup>15</sup> Dillon had already covered gene flow in a previous lecture, but it is possible that students did not recall its meaning as she reasoned about the evidence in the figure.

## V. Discussion: Realigning pedagogy and practice.

The preceding analysis starts from the assumption that honing in on undergraduates' access to, and understandings of fundamental disciplinary practices like inscription and argument provides a fruitful means of conceptualizing the pathway from undergraduate science coursework to pedagogy of elementary science grounded in disciplinary practice. The episodes presented above indicate several distinct challenges to be addressed in conceiving of how more typical forms of undergraduate science instruction could afford candidates a view of inscriptional practice as enacted in the figured world of science-in-the-making, and so contribute to their "reform science" content knowledge for teaching at the elementary level.

The first is the task of understanding inscriptions as acts of practice. In scientific practice, inscriptions are a form of content that requires unpacking, i.e., analysis of significant features and the relationships they express (Bowen and Roth, 1998). During most biology lectures, however, instructors projected inscriptions as if they were transparent: interpretation was presumed to be a relatively simple act. Hence, while instructors interpreted inscriptions for students in the course of explaining phenomena, we found very few instances when instructors assisted students in understanding the basis of that interpretation, i.e., how he/she moved from inscription to referent to significance, much less made explicit reference to inscriptional convention.

In contrast, the acts of "seeing" and denoting were highly problematized in the geology course; the instructor referred to challenges of visualizing three and four dimensional phenomena given one's position on the surface of the earth, or presented with two dimensional inscriptions during each of the lectures we observed (including those not analyzed here).<sup>16</sup> The geology episodes thus served to surface two other challenges to an undergraduate pedagogy of scientific practice. The first, highlighted in the "Amazonia in Appalachia" episode, concerns instructors' conceptions of the legitimacy of offering beginning students more than a glimpse of their "outside" work as a scientists. Clearly, we think it worth encouraging faculty to draw upon their experiences in "doing science" to make more transparent the practice (rather than just the products) of science. However, if instructors signal that these ventures into the "real" world of science are interesting but of marginal relevance to beginning students, then most students will not take them seriously, knowing or assuming that the contents of these forays will not be on the test. The second problem, exemplified in the Strike and Dip episode, is how to move from recognizing problems of "seeing" and inscribing to enabling students to attend to the affordances *and* constraints of various inscriptional "solutions".

The divide we found between the instructors' treatment of inscriptions during undergraduate lectures and their inscriptional practices beyond the lecture hall is consistent with the findings of Bowen and Roth (1998) in their study of the use and interpretation of graphs in undergraduate ecology lectures. In their analysis, Bowen and Roth focused on components of the figured world of the *ecologist* that remained hidden in the figured world of the *ecology lecturer*, and the impact that the lack of explication of these components might have on student learning. Bowen and Roth concluded that "it is difficult to claim that lectures are an effective format for students learning about the conceptual material of a domain, especially that supported by the representation practices of that domain" (p.87) and suggest that students would be better served

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<sup>16</sup> The degree to which these differences are a reflection of the instructor's fields of practice vs. pedagogical style is an interesting question.

by participating in seminar type courses that would require them to generate, use, and present inscriptions based on more authentic investigative work.

We do not disagree with this conclusion. However, given the virtual certainty that lectures will continue to be the primary format of introductory science courses for some time, it is important to consider ways in which instructors might capitalize on their dual membership in the figured worlds of scientific practice and undergraduate introductory science, making inscriptions and inscriptional practice objects of instruction in the lecture context. As suggested in our “what-if the instructor had ...” questions, we believe that even in the context of an introductory lecture course, instructors might help make disciplinary practices more salient and accessible by altering the instructional mode in deliberate and focused ways. Specifically, they might offer more invitations for students to reason about and practice inscriptional conventions, to invent means of representing data, and to examine the affordances and constraints of different inscriptional choices.<sup>17</sup> In providing students with opportunities to see inscriptions as tools and to practice with them, instructors take a step toward making new identities and practices available – for their students and themselves – within the figured world of undergraduate introductory science.

For prospective teachers, these experiences are crucial. As argued at the outset of this paper, helping students to recognize inscriptional practice is a crucial step toward providing them access to science as a dynamic, multi-faceted human endeavor as opposed to a rhetoric of conclusions. Without opportunities to engage critically with practices of representation themselves, teachers are unlikely to know how to help their students participate in this key dimension of science.

Finally, while we have a particular stake in supporting the development of prospective teachers’ content knowledge for teaching, we believe that an emphasis on inscriptional practice is relevant also to students who do not seek careers in teaching. Specifically, such an emphasis supports a broader goal of preparing prospective “consumers” of science, an aspect of scientific literacy mentioned by all four of the instructors we observed. The ability to weigh the credibility of scientific argument presumes the ability to think critically about the inscriptions through which evidence is presented, to see inscriptions not simply as conveyors of information, but rather as representations of particular forms of analysis. If our graduates lack experience reasoning about the relationships assumed in the inscriptions they confront and so simply take them as “given”, then we have fallen short of our goals.

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<sup>17</sup> Instructors might argue that some, if not all, of these aspects of disciplinary practice are covered in the labs that accompany many introductory non-majors science courses. However, it has been our experience that this is not the case. For example, especially in more “cookbook”-type labs, students are rarely, if ever, asked to collect data and then display it in a meaningful form. They may indeed collect data according to a scripted protocol but the lab manual typically provides a table to be filled in or the axes of a graph to be completed thus denying students the opportunity to think about *how* to construct a meaningful display. Even if labs do provide this kind of opportunity, confining inscriptional practice to the lab downplays its rightful place as an object of instruction and still leaves students more often than not confused by the multitude of opaque, problematic inscriptions that are part and parcel of introductory science lectures.

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## ESL student perspectives on university classroom testing practices

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*Abstract: ESL students struggle to represent accurately on tests what they know. Understanding what constitutes equitable testing practices in university settings for ESL students poses a significant challenge to educators. This study reports on the content analysis of semi-structured interview data obtained from 13 university-level ESL students on their opinions, concerns, strategies, and preferences in testing. ESL students provide evidence that language proficiency, test anxiety, and preferences for particular test formats, such as multiple-choice over essay questions, affect their ability to demonstrate content knowledge. Students describe context, culture, and seven language-related problems in testing, and show awareness of various test-taking strategies. The results suggest practical implications for making testing outcomes more equitable for ESL students.*

*Keywords: English as a second language, testing, higher education reform, international students, learner preferences*

The number of English-as-a-Second-Language (ESL) students from international and immigrant backgrounds continue to grow rapidly and impact teaching and learning in colleges and universities (Erisman and Looney, 2007; Gray, Rolph, and Melamid, 1996; Institute of International Education, 2009; Steward, 1991; Walker, 2000). While all schools "are being required to respond to the challenge of . . . making schooling equal and equitable for all" (Grant, 1992, p. 1), one persistent area of concern is valid and equitable assessment (e.g., Ewell, 2004; Solano-Flores and Trumbull, 2003). Assessment practices, in particular, are a growing concern in higher education because of mounting pressure to create a "culture of evidence" that accounts for student learning (Shavelson, 2009, p. 1). Indeed, Ewell (2004, p. 2) argues that "assessment linked to accountability is being advanced . . . as a recipe for 'fixing' education at all levels."

It is in this context that I sought to understand the assessment challenges faced by ESL university students—those I teach and those I advocate for—in content-area classes. It is widely acknowledged that ESL students struggle to represent accurately what they know on tests. In the act of test taking, language knowledge and content knowledge merge and are often confounded. According to LaCelle-Peterson and Rivera (1994, p. 69), current testing practices fail to "capture" what ESL students really know in terms of content knowledge. This gap between students' actual knowledge and their test performance is often ignored or unrecognized by university faculty. Schneider and Shulman (cited in Shavelson, 2007, p. viii), however, argue that university faculty must "know what to make of" and "how to act on" valid evidence of student learning. The purpose of this qualitative study is to a) make visible ESL students' perspectives on classroom testing practices; and b) to highlight practical implications for how university faculty can address ESL students' testing concerns.

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## I. Relevant Literature.

Research and theory from the fields of second language acquisition (SLA), psychology, and psychometrics are important to understanding ESL students' perspective on testing. From the SLA literature, Bernhardt, Destino, Kamil, and Rodriguez-Muñoz (1995) believe that ESL students "are in double jeopardy when confronted with assessment of any type" because they are "forced into demonstrating knowledge in a language over which they have only partial ... control" (p. 6). Short (1993) explains this complexity as follows:

Because language and content are intricately intertwined, it is difficult to isolate one feature from the other in the assessment process. Thus, teachers may not be sure whether a student is simply unable to demonstrate knowledge because of a language barrier or whether, indeed, the student does not know the content material being assessed. Yet a distinction needs to be drawn, especially if a student is not succeeding in a course. (p. 629)

Clearly, language proficiency is one factor that influences academic success, but SLA research also shows that it is only one factor among many influencing student performance on classroom exams (e.g., Graham, 1987).

Research in psychology suggests another factor that influences test performance—test anxiety: a situation-specific form of general anxiety experienced in association with examinations (e.g., Sapp, 1993). Research has shown that test anxiety can be both facilitating or debilitating (Alpert and Haber, 1960); however, Spielberger and Vagg (1995) have identified worry (i.e., negative thinking and self-doubts regarding testing outcomes) as being strongly associated with poor test performance, since worry diverts attention from the test-taking task. Test anxiety affects minority students to a greater degree than it does majority students (e.g., Phillips, Pitcher, Worsham, and Miller, 1980) due to issues of language, culture, and familiarity with test formats and characteristics (e.g., Anderson and Saucer, 1995; Solano-Flores and Trumbull, 2003; Scott, 1986). Consequently, ESL students who are ill-prepared for a testing situation may reduce their "access to educational and occupational opportunities" by testing poorly (Spielberger and Vagg, 1995, p. xiii).

A third factor influencing ESL students' test performance is test format. Lemke (1990, p. 80) charges that present testing practices in the U.S. undeniably "favor" students from middle-class, standard-dialect, individualistic, and Protestant backgrounds. According to Alexander and Parsons (1991), current testing practices continue to be a "highly ethnocentric" phenomenon, which "is particularly distant to the experiences and goals of minority populations" (p. 245). Salamonson, Everett, Koch, Andrew, and Davidson (2008) have exploratory evidence that the higher the degree of English-language acculturation predicts ESL students' academic performance. Solano-Flores and Trumbull (2003, p. 3) argue such concerns for "valid and equitable assessment" of students from "non-mainstream backgrounds are longstanding."

Because much of the literature in educational measurement and research addresses the reliability and validity of various examinations, the opinions, concerns, and preferences of test-takers themselves have often been ignored (Gellman and Berkowitz, 1993; Nield and Wintre, 1986; Zeidner, 1987). Although research with native English speakers demonstrates that test-takers have clear preferences in testing, ESL students' preferences in testing have not been investigated in content-area classes.

ESL students pose a significant challenge to educators, who must grapple with understanding what constitutes equitable testing practices in university or college settings for language-diverse student populations. This study sets out to document the experience of ESL students in testing when they are required to express content knowledge in a second language. The following research question guides this qualitative investigation of university-level classroom testing: What are ESL students' opinions, concerns, strategies, and preferences related to being tested in content-area courses?

## **II. Methodology.**

The present study theoretically adheres to qualitative methods. Qualitative research relies on non-numerical data to describe and understand human experience (Glesne and Peshkin, 1992). Qualitative inquiry relies on descriptions, processes, natural settings, the emic construction of personal meaning, data collection via human researchers, and inductive theory building (Creswell, 1994; Guba and Lincoln, 1989). In this study, the use of semi-structured interviewing techniques with open-ended questions allowed access to a wide variety of information, with the possibility of follow-up and clarification (Marshall and Rossman, 1995), and collection of “comparable data across subjects” (Bogdan and Biklen, 1992, p. 97).

### *A. Subjects.*

The 13 subjects selected for participation in the semi-structured interviews were ESL students enrolled in four-year university programs. Subjects were selected on the purposeful criterion of typicality. Interviews were between 35 and 50 minutes, and interviews ended when no new information was obtained. Redundancy was the primary criterion for ending subject selection (Lincoln and Guba cited in Patton, 1990). Subjects (females=6; males=7) represented different language backgrounds (i.e., Belorussian, Russian, Portuguese, Spanish, Korean, Chinese, and Arabic), and various majors. Two of the thirteen subjects were graduate students. Subjects had lived in the U.S.A. between seven months and seventeen years and had been university students between one month and two-and-a-half years.

### *B. Interview Protocol.*

The interviewing protocol developed for this study began with basic background information (i.e., country of origin, length of U.S. stay, university experience, and major), and then focused on open-ended questions about students' experience, concerns, and preferences regarding testing. Preferences in testing included focus on five test formats: true/false, multiple choice, short-answer/completion, restricted response (i.e., questions asking students to list, define, give reasons, etc.), and extended essays.

### *C. Data Analysis.*

Data analysis entailed transcribing the tape-recorded interviews, checking transcriptions for accuracy, and conducting a content analysis of the interview data across subjects using *Hyperqual 2* (Version 1.2) software. Content analysis consists of descriptive data reduction, that is, identification, coding, and categorization of significant patterns of response across ESL

subjects (Patton, 1990). The semi-structured interview questions provided the analytical framework, focusing on testing experiences, perceived differences, strategies employed, testing preferences, language skills, and opinions on how professors could assist them. Coding categories emerged from student responses. For example, students responses may be coded as “testing differences,” “vocabulary,” or “strategy.” Once coded, dominate patterns of response were synthesized under the broader categories of: a) problems in testing, b) testing preferences, and c) testing strategies. The limitations of the data collection procedures are recognized, in that time spent interviewing and building relationships with interviewees was limited (Glesne and Peshkin, 1992). The interview data have been preserved as an indication of authenticity (Guba and Lincoln, 1989).

### III. Results.

The interview questions provide the structure for presenting the results of the content analysis; that is, three main issues are addressed: a) problems in testing, b) testing preferences, and c) testing strategies. These findings provide university faculty both test-taker and second-language perspectives on testing practices in university classrooms.

#### *A. Problems in Testing.*

ESL students were asked to respond to several questions focusing on problems in testing. For example, students were asked to describe their first experiences in testing, to note American and home-country differences in testing, and to identify the problems they encounter when taking tests at the university level. They were also asked whether they believed their grades on tests accurately reflected their content knowledge. From these questions, interviewed ESL students identified problems in testing related to context, culture, and language.

*The Context.* As a minority population in universities, the ESL students were aware that they compete with native English speakers for grades, and two-thirds of these students felt that their grades did not accurately reflect their content knowledge and ability. According to these ESL students, grading in university courses was an issue in which students and professors shared responsibility. For example, one student accepts that academic success depends on her own efforts: “We have to study harder ... twice as hard” as native speakers. Another student’s test performance fluctuates and he feels it almost beyond his own control: “My life depends on midterms, homework due. I am absolutely unsure about myself right now. Sometimes I do good; sometimes I have to retake [a class] one more time. The first time I received a D, and then the second time I received B. I don't know.”

Some ESL students, however, also perceived grading practices of professors as being unfair to them. For example, one student said poor grades were not “because we don't understand, or we don't study. We might spend twice as much time as others, but we didn't get a better grade as others.” Another student described a lack of fairness in grading this way:

In physics we wrote a paper. He [the professor] didn't look exactly at the content. He just looked at vocabulary words, grammar, ... [but] you have to look at what's inside -- just not look at the outside. Maybe some people aren't good in it [i.e., writing]. They have the best content out of all American students, but they don't know how to write it ... I think that's not fair.

These ESL students also seemed to recognize the difficulty faculty face in meeting the differing needs of native and nonnative speakers in the same class. They neither expected professors to "talk in a special way for foreign people" or alter testing practices on their behalf. One student said, "I'm afraid [of tests] ... because it's not my language ... Teachers must take care that we are internationals ... I don't want a different test for native speakers and international students, but like simple questions, and simple answers."

Another student speaks candidly of the frustration she experiences when she is placed in the position of having to help her professors to work with ESL students:

I try to understand why some teacher will understand me better than the other. And then you will find that this teacher never have this kind of student before. And then, you mark yourself as 'Test Student Number One.' You've got to ... let him know what you are, what kind of problems you [have], and then he knows that he get result ... [Who]ever comes after [me], he knows how to handle it.

These interview excerpts reveal that in the U.S. university context, minority ESL students are in the uncomfortable position of competing with native speakers for grades. They also felt they were taught by faculty who are not prepared to work with or accommodate ESL students with unique learning and testing needs. These aspects of context are problematic and contribute to the disadvantage ESL students perceive themselves as having in some university classes.

*The Testing Culture.* Two-thirds of the ESL students interviewed felt that the U.S. system of testing differed from their home-country systems. These students appeared to have experienced a gradual shift to what one subject described as "American ways." Five characteristics typify the cultural differences in testing that ESL students perceived between U.S. and home-country testing systems.

First, tests are given more frequently in the U.S. than in the students' home countries. Multiple midterms and comprehensive finals seem to pressure ESL students: "I take a lot of tests for one subject, at least, three or four times a semester. That was quite a lot for me, and that is kind of a stress for me. That's why I don't like a lot of tests."

Second, students were surprised that they are expected on tests to express their personal opinions as well as to know facts. For example, one student said that in his home country, "It's more like you have to answer this because you read that ... [But in an architecture class] here you have to be yourself, and you have to [write] what you think."

Third, these ESL students felt U.S. professors were more caring than expected. A student was surprised when her professor permitted her to use a dictionary for her second music history test following poor spelling and vocabulary use on her first exam. She reacted to this adjustment by saying, "Professors ... thought about me, about my problems and they ... go to meet my problems, and to relief it. I got used to 'My problems are my problems. I have difficulties with English ... It's my difficulties.'" Another student said, "Here, the teacher more involved with students ... They explain everything." Another student observed that faculty "make sure everybody understand, ... then give you the test."

Fourth, several of these ESL students perceive the U.S. testing system as being easier than their home-country systems. The Russian, French, Taiwanese, and British (for an Arabic student) testing systems, for example, were each named as being more demanding than the U.S. system.

A Taiwanese student explained this difference in testing rigor as follows:

In Taiwan, they try to make things difficult because we are small. We don't have enough space for everybody to come to college, so they make everything hard ... to pick the best out of those people [to] go to colleges. [In the U.S.] we have a chance to come to college. We have a better education chance, and they try to make you really understand the courses ... I like it better here.

Several students also mentioned that grading in their home countries was more subjective than in the U.S. system. Students explained that in their home countries grades are based on one final exam, often in the form of an oral exam, during which a professor can decide on grades subjectively: "If he likes you, it's A, or A-, or B. If he doesn't like you, it can be a B-."

Fifth, the U.S. system has alternatives in testing formats that are unfamiliar to ESL students. While some students were comfortable with multiple-choice and essay formats, other students were not. Test format expectations clearly depended on each student's previous home-country experience; however, the use of a testing center to administer tests, class presentations as tests, or the idea of take-home tests was each mentioned as a unique testing alternative in the U.S. system.

Concerning take-home tests, one student seemed surprised at the trust professors had in their students: "Such a trust to students ... You are alone in the room. They trust you to use nothing. I tried to be honest. I used only my own brain, but it is just impossible in every other university I was studying [in]." According to another student, the expectation of honesty takes effort, because in his school culture, "Cheating ... is kind of acceptable."

For ESL students, the differences in testing practices that characterize the U.S. culture of testing are both positive and negative. While they struggle with the number, format, and alternatives in testing practices, they also seem to perceive the system as easier for them when compared to their home-country alternatives.

*The Language.* ESL students also describe language-related problems that interfere in the process and products of testing. Various students mentioned individual problems in testing, such as finding time to study with work responsibilities, not using adequate preparation strategies, or drawing a blank when confronted with a test. More significantly, however, these ESL students' responses revealed language problems in testing that were common to the majority of students interviewed. In order of salience in the data, seven language-related problems were identified: a) vocabulary, b) understanding test questions, c) memorizing in English, d) knowing how to write, e) time constraints, f) "trapped" content knowledge, and g) keeping pace in the classroom. Each of these issues is discussed below.

First, the most frequently identified problem in testing for ESL students is a limited receptive and productive English vocabulary. From the perspective of these ESL students, their failure in testing situations can be attributed, in many cases, to one word, or the one word they did not know. Students said they felt lost in a flood of terminology--"big words"--in such classes as accounting, anthropology, geography, or computer programming. One student said, "The teacher was like speaking another language [not English]. What is he saying? I was too lost, even though I read before the lesson in the book."

When ESL students discussed their vocabulary knowledge and its connection to testing, they spoke in terms of lacks, limitations, and need for improvement. One student said, "My vocabulary is too short. I need to improve it. I need to write the same word in different way,"



(i.e., use synonyms). Another student said, “Sometimes I can't find the right word I'm thinking.” Another student worried that in writing test answers, “If you don't know some word, you have to change the whole sentence because it doesn't make sense. You lose a lot of time.”

Several student comments demonstrated that representing content knowledge on tests is hampered by not recognizing or being able to produce one important word. For example, one student described this one-word phenomenon as follows: “Prevail--I don't know what prevail is, still don't know. That was in my midterm. I know the answer ... but they word them out like college words, ... so I don't know if I know the answer.” Another student reinforced this idea that a single vocabulary item can stop ESL students from even attempting to demonstrate their content knowledge:

I don't have this big vocabulary, so I'm limited to ... certain amount of words I know. If there comes a question with maybe a word that means the same thing, but I don't know that word, even when I actually know the answer ... I just can't answer the question because I don't know what that word means.

These students seem to concur with this student's sentiments: “If I don't know [that word], maybe I'm going to answer something wrong.” Another student highlighted knowing a word linguistically and from a sociocultural perspective as a potential challenge. For example, in a linguistics class, one student explained how the entire lecture hinged on understanding what Black English was. From her perspective, “It seems to me that everybody know, but I don't. And it was essential because if I know I could understand what was going on.”

The second language-related problem ESL students have in testing situations is understanding the questions they are asked on tests. One student explains, “Will I understand what the professor is asking? Most of the time, that's the problem I have.”

Several students mentioned that they often misunderstand test questions because of the professor's wording. These ESL students said they reread questions, analyze questions word by word, and struggle with difficult vocabulary in order to understand test questions. One student explained that in classes such as history or chemistry, she specifically tries to remember from lectures and readings “how they ask those questions.”

A third problem in testing for ESL students is the amount of memorization required for most tests. Memorizing content for tests is complicated by the fact that they are memorizing in their second language. One student said, “It is hard [to] memorize in Portuguese, imagine in English.” Other students described memorizing content-area information as a “double effort” or “harder” because it is “my second language.” One student even suggested that her ability to memorize is different in her two languages: “In Korea, I think I really good at memorizing, and some how in U.S.A., I forget how to memorize.”

A fourth language problem is expressing knowledge in writing, in an appropriate western style. One student said she used to just speak “Russian by English words,” and she has had to struggle to learn to use “English rules in English structures” when writing English. ESL students also seem to worry that some professors unfairly want them to write like native English speakers: “They can't expect you have perfect grammar.”

Time limits in testing are the fifth identified language problem. Specifically, these students felt that time restraints led to both language and content errors in testing. Students pointed out that in writing on tests, they “have to think, to organize, and to check grammar,” and that their ideas often come to them first in their native language and need to be rephrased in

English. These language-related processes require time. One student's comment typifies this ESL language concern:

Time is sometimes a factor in my performance on an exam. Honestly, it takes me a little bit more time to read and actually understand clearly ... Most of the time, I know the answer, [but] I do something wrong because I did it really quick ... Sometimes I would like to have more time.

Sixth, ESL students described having content knowledge “trapped” in their native language in such a way that they could not adequately access that knowledge to demonstrate mastery in test situations. This phenomenon is described as knowing some content or word in their native language, but not knowing it in English. A Korean student registered for an anthropology class, when he first arrived to study in the U.S., because he had already taken a similar anthropology class in his native language. He had hoped that this background knowledge would give him an advantage; nevertheless, he reported, “I know the answer of the question, but the problem is I cannot describe in English.”

Finally, the seventh problem mentioned frequently by ESL students was their difficulty in keeping pace, from a language perspective, with the teacher in the classroom. This problem was described as becoming accustomed to American expressions and accents, taking notes and listening at the same time, or producing university-level work. One student described her professor's pace as follows: “One class about 200 people ... He doesn't know who has the questions or not. He write fast. Talk fast. [You] write down everything, and you have to go home and figure out the rest of it.”

When asked what teaching practices their professors could use that would help them perform better on tests, these ESL students had in-class and test preparation requests. Students felt faculty helped ESL students by speaking more deliberately, explaining difficult concepts twice, providing study guides, previewing tests, and meeting with struggling students. When preparing tests, ESL students hoped faculty would write clearly, use simple vocabulary, plan more time for tests, allow dictionary use, and answer students' questions during tests. These accommodations would help diminish the language-related problems ESL students had in testing. One student said, “The same test form, but use different words. Try to make the question clear, same answers, same question to make people like us really understand the questions ... Take out all those big words.”

These ESL students were also asked to reflect on which language skill—reading, writing, listening, speaking, grammar, vocabulary, or pronunciation—was most important in helping them show their content knowledge on tests. They felt that improving their reading skills would be most helpful to their academic success. They also felt that improving writing skills, followed in turn by improving vocabulary and grammar, would be important for testing situations. Students felt that ESL programs, charged with preparing students for the regular university classroom, should focus more on such topics as understanding university expectations, writing timed essay responses, increasing the rigor of reading components of ESL classes, and developing study skills (e.g., note-taking and memorization strategies).

In summary, ESL students experience problems in testing on the university level from context, culture, and language perspectives. Specifically, these seven language-related problems in testing are unique to second-language students and jeopardize their ability to demonstrate content-area knowledge on tests.

### *B. Testing Preferences.*

ESL students were asked about their general testing preferences in content-area courses. They were also specifically asked about five format alternatives: true/false, multiple choice, short answer/completion, restricted response, and essay.

ESL students' general testing preferences were first a preference for oral tests, because that was what they were accustomed to in their home country. Second, students felt that their format preferences would depend on the subject matter of the course. In physics or math, one student preferred multiple-choice tests because "you can take out [answers] that don't make sense, ... so that helps you out." Another student felt that it is better to be tested "chapter by chapter" in a math class. For another student, multiple-choice formats were more appropriate for "technical" material, such as chemistry elements, and essays would be more suitable for "theory" courses, such as political science.

When asked about their specific test format preferences (e.g., true/false, multiple choice, etc.), ESL students most often preferred a multiple-choice test format. Multiple-choice tests were the easiest for them to do well on. Essay exams and short answer/completion test formats were considered the most difficult. When asked if these format preferences would be the same in both their native and second languages, these students responded either that all formats would be easier in their native languages or their preferences would be the same for both languages.

When asked why certain test formats were or were not preferred, these students had very little to say about true/false, or short-answer/completion test formats. Generally, they reported that true/false items were confusing, tricky, or picky but provided a good chance of getting a correct answer. Short-answer/completion items were disliked because the format required memorizing a specific word. No positive comments were offered about short-answer/completion questions.

Multiple-choice items were preferred by these ESL students and generated commentary from 12 of the 13 students. Although considered the easiest format, students offered strong criticisms of the format as well. For example, students felt that multiple-choice questions were tricky, ambiguous, and difficult to understand when time was limited. They also felt that some professors gave too many options to choose among. The main strength of multiple-choice items, according to these ESL students, is that the correct answer is in front of them. As one student said, "We have all answers. If I know materials, I can figure it out."

Most students felt positive about restricted-response test items, which require them to briefly list, define, or give reasons. While two students felt it was "difficult to explain something very short," other students felt that it was a good opportunity to give "simple definitions or simple answer[s]" or "gain a lot of points on test[s]," by at least writing something down.

Finally, ESL students were the most negative about essay-format tests. Most students echoed the sentiment of the following student regarding essay questions: "My native language is not English, so to write extended essay will be tough on me ... When you tell me to use the limit[ed] amount of words I have learned in English, and try to make a coherent academic essay, it will be quite tough." These students mentioned grammar, punctuation, syntax, vocabulary, the challenge of developing a topic, and difficulty in expressing their own opinions as some of the reasons they did not like essay questions on exams.

Overall, these ESL students showed strong preference for multiple-choice questions, which rely more on reading skills than writing skills. Restricted-response and essay items,

however, were still preferred over short-answer/completion items. From these students' feedback, it appears that they have strong opinions concerning which test formats help and which hinder their test performance in university classes. It also appears that a students' level of language proficiency as well as level of familiarity with testing formats mitigates ESL students' preferences.

### *C. Testing Strategies.*

Students approach testing situations idiosyncratically. Strategies that work for one student may not fit with another student's study habits. Nevertheless, several of the ESL students interviewed appeared to relate to the following student's struggle in university classes:

It's hard to memorize for me. I can read this, and I can understand, but if you make me a question of this, I can't do it. I don't know how to explain it, but I can't take a test based on what I read ... I read like [I'm reading] a magazine, not like I need to study. Sometimes there are few words I can't understand. Is it important? And I don't know how to take notes. I'm just copying what the teacher [does] in the blackboard.

This student identified his lack of study skills, specifically academic reading, note-taking, and vocabulary skills, as obstacles to his academic success.

Students identified various test-preparation and test-taking strategies they used related to testing in university courses. The test-preparation strategies discussed reflect three components: a) principles that holistically guide students' study efforts; b) use of various resources; and c) specific study techniques. In terms of study principles, students seemed to recognize the need to adjust study skills to the demands of different classes:

Each class has a different format. One of the key components is the syllabus ... I read the syllabus carefully and prepare for the first test. After the first test, I know what will be there in the second exam or what kind it will be.

These ESL students also acknowledged that each class, subject-area, and department has a structure that needs to be mastered for academic success. For one student, these structures guide his study priorities:

If I go to business school, they're going to watch particular classes, especially math. So I'm going to put some pressure on me on math class. I'm not going to worry about American Heritage and English 115. I know at the same time that GPA is really important if I want to get scholarship or something.

In terms of resources, ESL students recognized professors, teaching assistants, syllabi, study guides, textbooks, and classmates as important sources of information. Connecting effectively with these resources is at times challenging for ESL students. One student who is orally fluent in English complained that:

Those teachers won't believe me when I say I have a problem: I can't understand them. My English TA once say, 'I don't think you [have] any problems. As long as you read

the books, you come to see me, you'll be okay.' I have problems understanding the literature. When I ask for help, you tell me I'll be fine. It's not the answer I'm looking for here.

Despite the challenges associated with getting the help they need, several ESL students noted that various people, teacher handouts, or offered resources help them sort through what content is important for a particular test.

These ESL students identified several test-taking strategies they had in common. For example, skipping difficult questions, reading questions carefully, guessing, asking for help, brainstorming, and using dictionaries typify more common strategies. Although students' comments revealed awareness of test-taking strategies, how effectively strategies are applied in content-area test situations by ESL students is unclear from this study.

#### **IV. Discussion.**

These data provide an insider's view of the problems, preferences, strategies, and preferred teacher practices associated with classroom testing for ESL students. Their responses demonstrate the importance of context, testing culture, and language in understanding testing from a second-language perspective; however, they also suggest that format, strategies, and faculty practices potentially impact ESL student performance in various test situations. The implications of these findings are addressed through a focus on issues of second-language acquisition, test anxiety, and testing.

##### *A. Language Proficiency.*

Two findings stand out regarding the role of language proficiency in testing. First, university faculty benefit from knowing that ESL students require more time than native English speakers to process, learn, and remember concepts from academic texts. ESL students describe their language-related problems in testing in terms of their academic language skills, or what Cummins (1980) calls *cognitive/academic language proficiency*. This distinction between conversational and academic language proficiency is well supported in the second-language literature (e.g., Cummins, 2000; Kinsella, 1992; Snow and Brinton, 1988). Conversational fluency, in highly contextualized everyday contexts, develops faster than more abstract academic language skills for ESL students (Cummins, 2000).

Cummins (1980) further argues that academic language abilities are interdependent in learners' first and second languages. Although these students have obtained a level of second-language proficiency that gained them university entrance, their comments reveal that they do not assess themselves to be adequately proficient in academic language use—below a threshold of adequate academic language proficiency—to demonstrate accurately or consistently their content knowledge on tests.

Second, these students identified reading and writing as the language skills that would help them most in testing; however, they spoke most frequently about how their limited vocabulary—a sub-skill in the language learning process—jeopardized their test performance. Through their examples and elaboration, these ESL students demonstrated that vocabulary knowledge is of great importance in testing. DeCapua and Wintergerst (2004) research supports this contention that both wording and poor word choice on questionnaires present a major

challenge to ESL students. Indeed, Leki and Carson (1994) also argue that vocabulary is key in academic achievement. If a student lacks the strategic competence to paraphrase, he or she may not be able to compensate for a limited vocabulary. This, of course, does not deny the role of vocabulary in learning to read, write, comprehend, or speak in the academic context. These findings do, however, lend support to Matthews' (1990) argument that the sub-skills of language proficiency not be awarded equal weight in the language proficiency equation. When comprehension is in question, using a wrong word or not knowing a word is more serious an error than using poor grammar (e.g., Bolinger, 1979).

Several practical implications emerge for reducing the language jeopardy in testing situations for ESL students. For example, faculty can include a note on ESL testing accommodations in their syllabi, including a willingness to meet with students, provide study guides, provide vocabulary lists for tests, allow dictionaries, or additional time for completing tests, especially when extended writing is required.

Faculty can also make a concerted effort to use familiar, high frequency words when writing test items rather than sophisticated, low frequency academic language. On tests, faculty should be willing to allow access to dictionaries when ESL students encounter unknown words, especially when those words merely impede comprehension of the question rather than reveal lack of content learning. Gaps in ESL students' vocabulary knowledge can be unpredictable. For example, a student should not be penalized for not knowing the word "initiated" in the following question: "Mitotic cell division is initiated in the \_\_\_\_." It is entirely possible for a student to know how to "compare" mitosis and meiosis and for the same student to be confused by being asked to "contrast" processes. In grading, faculty should focus on the quality of ideas and content over issues of grammaticality. Attending to such accommodations demonstrates faculty willingness to share responsibility for mitigating language issues on tests of academic content. In an era of growing linguistic and cultural diversity on American campuses, such voluntary faculty accommodations for ESL students demonstrate greater responsibility and accountability (Ewell, 2004; Shavelson, 2007) for ESL students' learning outcomes.

### *B. Test Anxiety.*

The ESL students interviewed provided anecdotal evidence of test anxiety. Their anxiety was evident when they described their cognitive processing being impeded by difficulties in memorizing, accessing content knowledge, or applying appropriate test-taking or metacognitive strategies. In addition, these students reacted emotionally to various test formats: Several students had aversions to one particular test format or another (e.g., multiple choice or essays). Student expectations in testing and strategy use were clearly culturally framed, as researchers like Scott (1986), Diaz-Guerrero (1976), and DeCapua and Wintergerst (2005) suggest.

These findings qualitatively corroborate what the psychology literature predicts concerning test anxiety for minority populations. Perceived poor performance, insecurity, and fear of negative evaluation—which were each expressed in these interviews—are evidence of test anxiety (Anderson and Sauser, 1995). Concerns raised related to language, culture, and testing preference are potential explanations for test anxiety among ESL students. Faculty can help alleviate some of this type of test anxiety by being more deliberate in their descriptions of classroom testing procedures and formats and by having written accommodation policies in syllabi. When faculty share responsibility for equitable testing outcomes, students benefit.

### *C. Testing Preferences.*

The ESL students interviewed preferred multiple-choice test formats over true/false, short-answer/completion, restricted-response, and extended-essay formats. Multiple-choice, restricted-response, and extended-essay formats elicited strong opinions from ESL students.

These findings support previous descriptive work related to ESL students' preferences in testing. Qualitative studies by Leki and Carson (1994), Horowitz (1986), Kinsella (1992), and Leki (1995) describe writing as a problem when test items require language production, and time limits as a problem for objective test items. Knoch's and Elder's (2010, p. 72) findings also suggest that ESL students clearly prefer having longer time frames for writing extended responses/essays (i.e., 50 minutes compared to 30 minutes) even when the impact on the quality of writing is "negligible." A quantitative pilot study by Madsen and Murray (1984) suggests that ESL students prefer an objective test format.

The testing preferences of ESL students also appear to be similar to those of native speakers of English. Native speakers show preferences for restricted-response and essay items over multiple-choice formats on the criteria of "value, fairness, and validity in assessing content knowledge" (Zeidner, 1987, p. 357); however, they believe that multiple-choice tests are easier to do well on (e.g., Gellman and Berkowitz, 1993; In'nami and Koizumi, 2009). Although ESL learners have language, anxiety, and format obstacles to overcome in testing, it is uncertain if multiple-choice test formats create more or fewer problems in testing for ESL students than other format alternatives.

### *D. Conclusion.*

As university faculty continue to teach growing numbers of linguistically diverse students, they will be required to measure their classroom practices, especially their testing practices, against the standard of equity. This study documents the common concerns, problems, and preferences ESL students have when demonstrating their content knowledge on tests. While every preference and perception of students cannot and should not be acted upon, the findings identify simple actions university faculty can take to acknowledge the complexity of representing learning in a second language for ESL students while removing simple sources of language or culture bias in assessment practices. There is a need for further research, both qualitative and quantitative, to clarify the degree of importance such factors as language proficiency, test anxiety, and format preferences play in ESL students' test performance. Although the results of this study must be interpreted cautiously, the findings begin to describe the issues faculty should consider in making testing more equitable for ESL students they teach and test.

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## **Supporting student learning: improving performance on short-essay exams using realistic practice opportunities**

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*The present manuscript reports an attempt to support students in learning to apply knowledge from class to novel situations on course exams. Students took short-essay exams at the end of each unit. Students were offered two practice opportunities during each unit: answering practice questions and participating in a mock exam study session. On average, exam performance improved when students completed more practice questions accurately and when they took mock exams. The improved performance suggests that efforts to support student learning succeeded in helping them develop a deeper, application-based understanding of course materials.*

*Keywords:* exam performance, practice exam, mock exam, developing understanding

### **I. Introduction.**

Many undergraduates struggle with applying knowledge from lectures to novel exam situations. The students in the reported undergraduate behavior modification and therapy course faced that challenge every semester because all of the course exams contained primarily essay and short-essay questions which required them to apply class material to novel, application-based situations. In an effort to better support the students in successfully applying their knowledge on exams, we developed two realistic practice opportunities that the students could take advantage of: online practice questions and a mock exam study session. This manuscript reports the outcome of our inquiry into how successful those supports have been for our students.

The challenge of helping students learn to apply their knowledge is not new. We based our inquiry in the tradition of viewing application as a type of understanding; that a student who is able to use their knowledge to address a novel situation has a different understanding of the material than a student who simply memorizes the steps in some problem-solving procedure. This philosophy has been well-articulated in several places (McKeough, Lupart, and Marini, 1995; Wiggins and McTighe, 1998; Wiske, 1998), and views the ability of a student to use their knowledge in novel ways or in novel situations as one performance indicator that the student has achieved a deeper understanding of course material than just a basic knowledge of facts. As articulated by Perkins, evidence of understanding is found in performance, and understanding is a “flexible performance capability;” the ability of people to “think and act flexibly around what they know” (Perkins, 1998).

Such performance capabilities generally do not appear in the absence of instructional techniques, which encourage them, however, and we undertook this inquiry into our course design in an effort to recognize and tailor supports for students in order to achieve an

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application-based understanding of the course material. As recommended by Perkins, we saw the provision of opportunities for students to interact with course materials in a way which was challenging, engaging, active, and which required reflection on their performance as vitally important to helping them reach the level of understanding we desired for them (Perkins, 1998).

The desire for students to learn to use the knowledge gained in our course was also rooted in the deeper context of our field of study and practice: applied behavior analysis. A defining characteristic of applied behavior analysis is a focus on studying and intervening to solve applied, socially significant problems such as drug dependency and the education of people with developmental disabilities (Baer, Wolf, and Risley, 1968). Thus, a goal of our field is to produce socially meaningful change in the lives of people with whom we work. Producing desirable outcomes in diverse areas and under many different conditions in the community requires practitioners who can take a simple procedure or principle (say, that behavior which is reinforced happens more frequently in the future) and be able to apply that knowledge to different circumstances (e.g. providing praise to a child for engaging in desirable play behaviors or delivering a thank-you card to a teacher who made an extra effort to accommodate a student's needs on a difficult exam).

The course in which this inquiry was conducted is the first course students encounter in the major which asks them to address such important social issues by designing and describing actual interventions they might use. It requires them to develop an application-based understanding of the principles and procedures of behavior analysis to solve problems rather than just to become familiar with our approach to intervention. It is also often the first course students encounter which relies entirely on short-answer and essay-based evaluation of their knowledge. Students struggle with the unfamiliar format and performance requirements, and our goal has been to explore ways to facilitate their development of a deeper, application-based understanding.

We already conducted study sessions and offered optional practice exam questions in the course, so we began by looking to the literature for suggestions about how to make those two activities more effective. Given the ubiquitous presence of review activities on college campuses, we were surprised to find that few empirical studies had evaluated the effects of study sessions (Aamodt, 1982a; Aamodt, 1982b; Neef, Cihon, Kettering, Guld, Axe, Itoi, and DeBar, 2007; Rust, Price, and O'Donovan 2003) or practice exams (Balch, 1998; Bol and Hacker, 2001; Oliver and Williams, 2005; Simon, 2005) on student exam performance. Within the studies we found, however, there were some useful trends.

Student performance on exams improved more when review activities more closely resembled the actual exam in form (e.g. it asked questions in the same style, such as multiple choice) and content (e.g. the review activity contained materials which would be on the exam and did not contain materials which would not be on the exam) than when the review opportunities did not resemble the actual exam (Balch, 1998; Bol and Hacker, 2001; Oliver and Williams, 2005; Simon, 2005). For example, Balch (1998) compared student performance on multiple-choice exams in an introductory psychology course across two groups: students completing a practice exam during a review session, and students who only reviewed the same course material. Students who completed the practice exam (formatted like the actual exam, and covering the same material) scored higher on the actual exam than the students who only reviewed the material with the instructor.

Additionally, study sessions that included a review of performance expectations and realistic practice were the most effective, followed by the sessions involving only a review of

performance expectations (Aamodt, 1982a, 1982b; Balch, 1998; Rust, Price, and O'Donovan, 2003). Study sessions that included only question and answer opportunities (Aamodt, 1982b) or less realistic practice opportunities (Neef, et al., 2007) did not produce large improvements in exam performance. For example, Aamodt (1982b) conducted a study comparing the effects of two different study sessions: one involving a review of key course material and performance expectations for the exam guided by a course teaching assistant and another where no review was given, but students had the opportunity to ask the teaching assistant questions about the exam. Both sessions were held a couple of days before a comprehensive final exam in the course. Not surprisingly, students attending the study session with the active review of material and performance expectations scored higher on the final exam than students attending the question and answer only session.

Of most interest to us was a study by Rust and colleagues (2003) reporting the results of a study session designed to improve the application ability of business students on an essay-based final exam. Across two years of a large-enrollment, first-year, undergraduate business course, the authors offered a 90-minute study session. Four weeks before the final, open-ended assessments were turned in by students, every student in the course received a set of grading criteria and two sets of sample answers to the assessment questions they would be completing at the end of the course. One week later the instructors offered a 90-minute study session. Students attending the session were asked to evaluate the sample answers according to the grading criteria and bring the completed evaluations to the optional study session. Once at the session, students worked in small groups to discuss their grading, shared their grading with the larger group, listened to an instructor/grader describe how the question would be graded, discussed their grading again in light of that description, and then finally viewed and discussed the instructor/grader's specific evaluation of the same sample answer.

A baseline measure of student ability was established by looking at the performance of all students participating in the study in a course taken prior to the business module in which the study session was offered. There were no significant differences between the two groups of students (those attending and those not attending the study session) on the baseline measure, suggesting there were not differences in ability and motivation between the two groups even though they were self-selected. Following the study session, however, there were significant differences in course performance between the two groups, with those attending the study session scoring higher in the business course than those who did not attend the study session. Those differences in performance persisted in a third business course students took a year later, with students who had attended the study sessions in the second course scoring higher on average than those who did not attend the session.

We modeled our review sessions (described in more detail below) on the study sessions conducted by Rust and colleagues (2003) because we felt our goals were similar, we had capabilities to offer similar opportunities, and because the results were compelling. We also wanted to see if already existing practice opportunities in our course were comparable in effect.

The overarching goal of our inquiry was to identify ways to better support students in meeting the course performance expectations; to help them, as Perkins (1998) conceived, "put their understanding to work" in solving difficult and novel problems. The purpose of this specific inquiry was to examine the effectiveness of two realistic review opportunities (practice questions and a mock exam study session) at improving performance on short-essay exams requiring the students to apply knowledge learned in class to novel situations. Both review activities involved offering students multiple opportunities to engage with and apply course materials during

activities and settings designed to be similar to what they would see when they took actual unit exams.

## **II. Method of Inquiry.**

### *A. Background of Course and Participants.*

We conducted our inquiry within a course entitled Principles and Procedures of Behavior Modification and Therapy. The course introduces students to many of the guiding ideas, philosophies, and methods of the field of Behavior Analysis, and it is a required course within the department curriculum. It is a prerequisite course for most other upper-division courses, including the required, year-long senior practicum for majors. Most students take the course during their sophomore or junior years as part of either a major or minor in Applied Behavioral Science. All students enrolled in the course during two semesters (182 students: 90 in spring, 92 in fall) participated in the investigation.

### *B. Structure of Course.*

The course contained five units, each exploring a facet of solving applied problems, such as: defining and measuring behaviors of interest, teaching new behaviors, reducing problem behaviors, writing behavioral contracts to help families in need, designing token economies, and addressing legal and ethical issues in the treatment of people with disabilities. At the beginning of each, an outline of the content of the unit was made available to students online. At the end of each unit, students took an exam over the material covered in the preceding unit. Unit exams were worth thirty points apiece (150 total points in the course) and consisted of essay and short-answer questions. The majority of questions (80-90%) required students to apply the principles of behavior and the techniques described in the textbook (Martin and Pear, 2007) and discussed in lectures to address novel applied problems which they had not seen before. For example, a man with disabilities might be described, and students asked to explain how they would teach him a self-care behavior. Short-answer questions from the textbook and lectures accounted for 10-20% of the questions on each exam.

### *C. Identifying Areas of Difficulty and Developing Supports.*

In considering how to support the students in the present course, the first step was identifying what the students should be able to do as a result of taking the course. At the most basic level, we wanted students to become critical consumers of behavioral interventions and to develop a foundational set of skills in the design and use of relatively simple behavioral techniques and procedures. Table 1 presents a representative sample of both general performance goals and also some specific examples of more detailed performance targets within each goal for several units of the course. In addition, Table 1 also contains information about how student performance was assessed on unit exams.

**Table 1. Examples of General Course Expectations and Specific Goals within Each.**

Expectations	How assessed
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Unit 1:

Students will label, define, and measure behavior. Students will also describe basic experimental designs and social validity measures

Specific expectation:

Students will accurately describe how to use a frequency recording system to measure the amount of some behavior

Short-essay question on exam which describes a situation and asks students to identify behaviors of concern and then describe how those behaviors and interventions designed to address them should be measured and evaluated

Unit 2:

Students will describe how to teach Both non-verbal and verbal behaviors

Specific expectation:

Students will accurately describe how they will shape a new behavior including identifying specific steps in the shaping process

Short-essay question on exam which describes a client who is both non-verbal and who lacks basic self-care skills and asks students to describe the teaching procedures they would use to address the deficits of the client

Unit 5:

Students will describe how to design a token economy for a population of dependent people

Specific expectation:

Students will accurately describe how they will assign values to backup reinforcers used in the token economy

Short-essay question on exam which describes a group of people who are served in some group setting such as a classroom or residential care facility and who have behavior problems. Students asked to address concerns related to setting up a token economy to provide reinforcement and support for the clients

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We also wanted to address the common difficulties students encountered when taking exams. There were both organizational difficulties (i.e., struggles with writing clear and organized answers, misunderstanding grading criteria), and application-based difficulties (i.e., failing to identify relevant details from exam questions, engaging in rote memorization of sample answers to practice situations rather than learning how to use a procedure) for students. These difficulties became the targets for support and for additional practice opportunities. Because an informal, TA-led study session already occurred before each exam and optional practice questions for students to answer throughout the semester were an established part of the course, a modification of those review activities became the means of providing the additional support students needed.

*Practice Questions.* For each unit of the course, there was a practice exam that was posted online on the first day of the unit. It contained a description of one or more clinical



situations and a set of questions. Each question required students to use the information presented in the unit to develop behavioral solutions to the clinical situations described.

The questions asked on the practice exams and the actual exams were similar in structure and format. Both the practice exam and actual exam questions requires students to apply the course material to a novel situation. What was different between the practice exams and the actual exams were the situations to which the unit materials needed to be applied. For example, a question on both exams in the third unit was, "Describe how to use extinction to reduce the client's problem behavior." The client described in the practice exam might be a child who tantrumed whenever his parents did not pay attention to him, while on the actual exam, the client might be a junior-high student who became aggressive when asked to work. Students had to apply what they had learned about extinction to the different situations. For the first case, a correct answer involved not paying any attention to the child when he tantrumed. For the second, a correct answer involved continuing to present requests to work even if the student became aggressive.

Questions from the practice exam were assigned 4-6 times during each unit, and students could turn in written answers online on specified dates prior to the unit exam. Students who submitted answers received feedback (a copy of the grading key for those questions with their score for each answer submitted) within a week, and could earn up to three extra-credit points for each unit of the course for answering the questions. Extra credit points counted toward the final course grade, and the amount of extra credit earned depended on the correctness of the answers submitted. Thus, a student who turned in all of the assignments and was 50% correct received 1.5 extra credit points for the unit. A student who turned in all of the assignments and was 100% correct earned 3 extra credit points for the unit. Because course grades were assigned based on the percentage of 150 points the students earned, the students could earn up to 10% additional credit on their final grade (15 points) by completing the practice questions accurately and on time.

*Mock Exams.* During each unit, students could also participate in a mock exam study session led by the course graduate teaching assistant (GTA). Each mock exam session lasted two to three hours and was usually held two days before the unit exam. The mock exam sessions took place in a classroom on campus –often the same classroom in which students attended the course meetings. Students earned no extra credit for participating in mock exam sessions.

Mock exam sessions contained three parts: an introduction, the administration of the mock exam, and the grading and discussion of answers. During the introduction, a general description of the session was given. Next, students were given a copy of the mock exam, and were asked to complete it within 45 minutes under "test-like" conditions (without notes and working independently). The mock exam included the same situations and questions as posted online in the practice exam, but the document was re-formatted to resemble the actual exam by spacing out questions on the pages to give students room to write on the document and rewording and shortening some questions so students could more likely finish the mock exam in the allotted time. Finally, the GTA handed out a grading key and discussed the grading criteria question by question. Students were asked to evaluate their answers and were also encouraged to volunteer answers for discussion and analysis. After discussion of answers for each question, the GTA briefly displayed a correct sample answer to clarify the expectations for that question. This lasted 60-90 min, and the students were allowed to take their answers and grading criteria home. The discussion portion of the mock exam study session was designed to promote a deeper

understanding of both the grading criteria and of issues to be addressed when applying procedures across different situations.

#### *D. Evaluation Measures.*

The primary measure in this analysis was student performance on the unit exams. Student attendance at mock exam sessions and completion of practice questions were also recorded to determine whether they were correlated with exam performance. At the end of the semester, students were also given a brief survey about the two review activities.

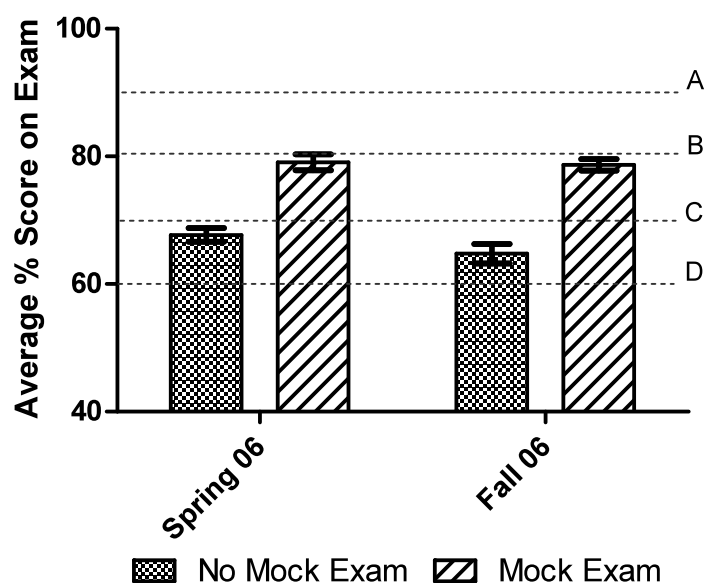
### **III. Results.**

Overall, both review activities were associated with improved performance on unit exams. The mock exam study sessions appeared to have the biggest impact on student performance. Additionally, students preferred attending the mock exam study sessions to completing the practice questions.

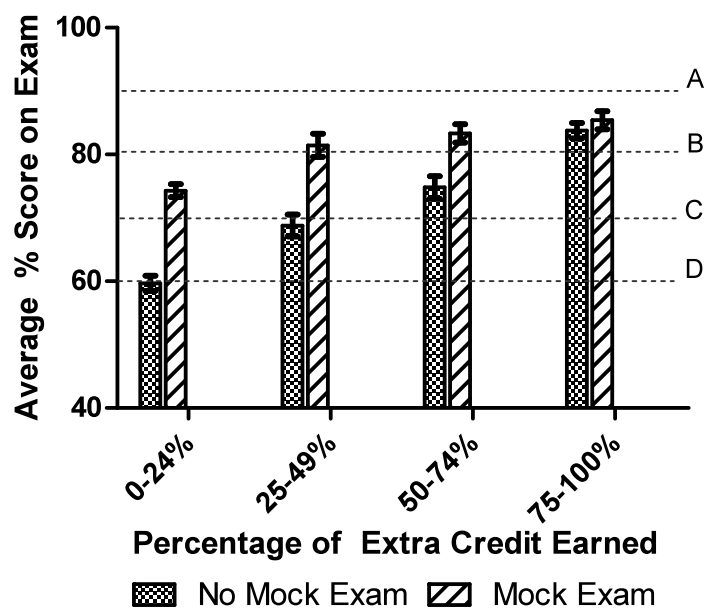
Average scores on the section exams during the spring and fall semesters of 2006 are shown in Figures 1 and 2. These scores do not include any extra credit students earned. As shown in Figure 1, across all exams ( $N=874$ ), students who attended the mock exam study sessions scored higher on the actual exam than students who did not attend the mock exam study sessions for the same unit. A two-tailed t-test confirmed that the differences between groups were significant, with  $t(2) = 8.558, p = 0.013$ .

Students also scored higher, on average, on unit exams as they earned more extra credit for the same unit. A correlation analysis of extra credit earned and exam score indicated a highly significant positive correlation between the two:  $r = 0.41, p = <0.0001$ . Figure 2 shows that for both students who did and did not attend the mock exam study sessions, as they earned more extra credit, their average exam score also increased (divided into 4 groups to allow easier visual analysis). The effect was most pronounced for students not attending the mock exam study sessions. Figure 2 also shows that even when matched for the amount of extra credit earned, students performed better on the actual exam if they attended the mock exam study session. The effect of attending the mock exam study session on test performance was the most pronounced for those students who earned the least amount of extra credit on the practice questions. The students who performed the best on exams, however, were those who both attended the mock exam study session and also earned at least 75% of the available extra credit for the unit.

A four-question survey handed out during both semesters asked students to indicate if they participated in each review activity, and if they did participate, to rate the helpfulness of the activity on a scale of 1-5 (1= waste of time, 5=vital). Nearly all of the students who completed the survey participated in at least one type of review activity. Students rated both the practice questions (mean: 3.85) and the mock exam study sessions (mean: 4.70) as being helpful, with the mock exams receiving the higher rating.



**Figure 1. Average performance on section exams of students who did and did not take the mock exam for that section.** Exam score does not include any extra credit points, and error bars represent standard error.



**Figure 2. Average performance on section exams of students across both semesters by the amount of extra credit they earned.** (Extra credit based on accurate completion of practice questions) and by attendance or non-attendance at the mock exam session. Exam score does not include any extra credit points, and error bars represent standard error.

Student attendance at mock exam study sessions also suggested student preference for, and perceived helpfulness of, the mock exam study session. Figure 3 shows the percentage of

students who participated in each review activity across both semesters. The percentage of students earning at least 50% of the available extra credit for each of the five units across both semesters of the course shows no clear trend, but the number of students doing so decreased in the fall semester compared to the spring and was markedly lower than the percentage of students attending the mock exam study sessions.

An increasing percentage of students participated in the mock exam sessions across both semesters. With no contingency on attendance such as extra credit points, it was assumed students came because they found the sessions helpful. Also, as student attendance at the mock exam study sessions increased across the two semesters (see figure 3) so too did the overall GPA of the students finishing the course. Table 2 presents the cumulative GPA (earned in the course) of the students for each semester.

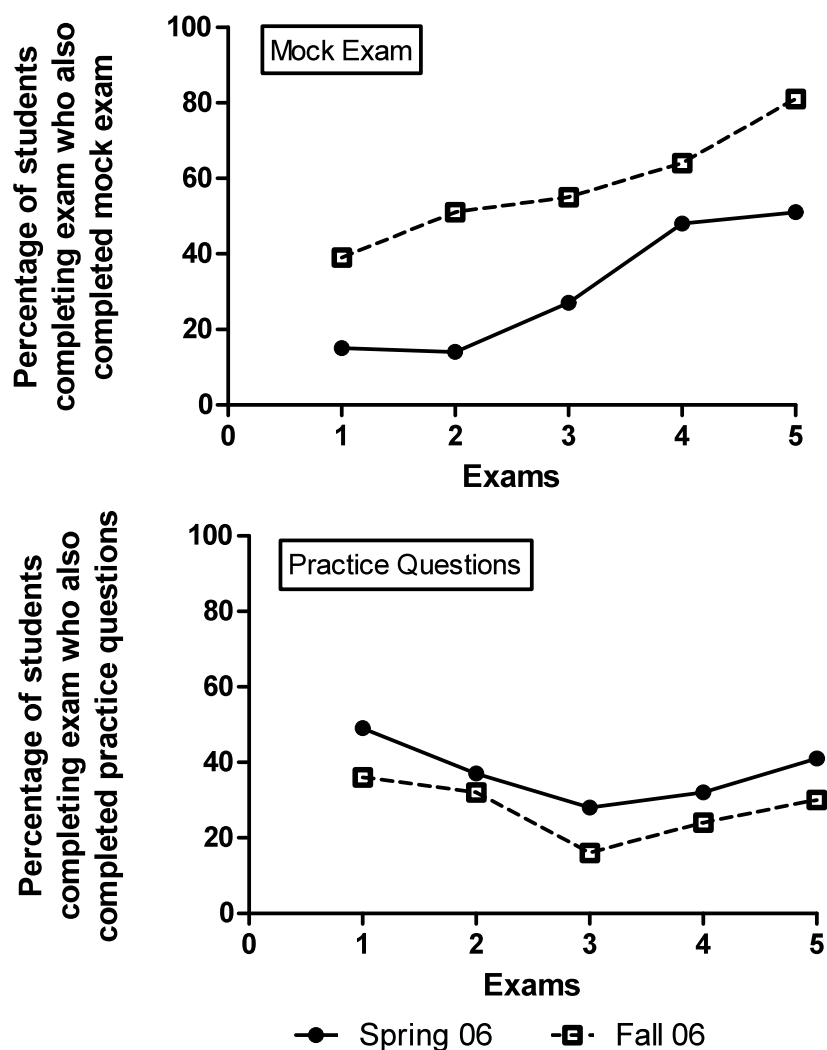
**Table 2. Cumulative Class GPA Across Semesters.**

	FL 05	SP 06	FL 06
Cumulative final GPA of each class	2.06	2.13	2.21

#### **IV. Discussion.**

The results from this investigation indicate that both completion of practice questions and participation in a mock exam study session were associated with positive effects on student performance on section exams in our course. Students who answered more practice questions correctly scored higher on unit exams than students who answered fewer or none. Students who participated in the mock exam for a unit scored, on average, 12% higher on the unit exam than those who did not. The students who performed the best on the exams were those who earned at least 75% of the extra credit points and also attended the mock exam for the unit. The students who performed worst were the ones who neither completed practice questions nor attended the mock exam session. Additionally, the overall performance of students in the course improved as more students attended the mock exam study sessions. These results suggest that both of the review activities provided the additional support students needed in order to demonstrate a deeper understanding of the course material by writing better answers to essay and short-essay questions requiring application of knowledge to novel situations.

One of the most exciting aspects of the results for us involves the effects of attending the mock exam sessions for students who did not complete any practice questions. Those students have historically been at the highest risk of failing our course (over 60% of students who complete no practice questions earn an F on exams), and are often the students who struggle the most with the material. We were encouraged to see that if those students attended the mock exam session, then their exam performance, and presumably their understanding of the course material, was dramatically improved (less than 10% of students who earned no extra credit, but attended a mock exam, earned an F on the exam). The mock exam sessions appeared to be most helpful for the group of students who needed it the most. The attendance figures also show that more of those students attended mock exam sessions across the two semesters. These results are in contrast to the results reported by Balch (1998) and Aamodt (1982a), who found that students



**Figure 3. Percentage of students completing practice activities (attending mock exam or earning at least 50% of available extra credit) for each section of the course across both semesters.**

with higher GPA's entering the course were helped more by the review activities than students with lower entering GPAs. We did not measure our students' entering GPA in this course, but we plan to in future semesters in order to more carefully determine if the effect of the mock exam sessions is more pronounced for the weaker students entering the course. If future research confirms that the mock exam does improve the learning of students entering the course with lower GPAs, then it has implications for how to design effective supports in other application-based courses across disciplines that have historically high failure rates (e.g. physics, laboratory-based biological sciences).

These results also replicate and extend the results of earlier studies on review activities. First, it replicates the positive effects previously reported for realistic practice (e.g. Balch, 1998; Rust, et al., 2003) and review of performance expectations (e.g., Aamodt, 1982b; Rust, et al.

2003). Second, this study extends the literature on review activities to application-based essay exams in a behavioral psychology course. It will be important for future research to continue to evaluate methods to support students in mastering more advanced, application-based demonstrations of their understanding, and this study represents an early step in empirically evaluating procedures designed to do so.

There were several aspects of the practice questions and the mock exam study sessions which might have accounted for the results. One is the active nature of the activities. In the mock exam study sessions students wrote answers to questions, offered answers to the group for discussion, and received feedback on their answers both from a provided grading key and from discussions with peers and the facilitating graduate teaching assistant. Students completing practice questions wrote answers to novel situations and also received feedback and a grading key online. Such discussion and feedback might have facilitated more effective reflection by the students by helping them realize what course information they had not mastered, thus helping them focus their studying on those areas.

Another aspect of the review activities, which may have accounted for the large effect were the permanent products students received which might have guided further study. Students were able to take both their completed mock exams and the provided grading keys home with them for further study at the conclusion of the mock exam study sessions, and for each practice question assignment students could access their completed grading key at any time. Such products provided concrete records of the important information they needed to know and how well they knew it which could be referred to in future, independent study sessions. It may also be that the mock exam study sessions and practice questions allowed students to prepare in more productive ways by offering them the chance to interact with review materials in the same way they would have to interact with actual exam questions. Students may also have studied and prepared more knowing they had to write answers in the mock exam session.

Another interesting finding of the present study was the different rates of student participation in answering practice questions and attending mock exam study sessions. Neef and colleagues (2007) suggest that students might participate in study sessions more if they are more effective. Both the practice questions and the mock exam study sessions appeared to have beneficial effects on exam performance, and yet more students attended mock exam sessions as the two semesters progressed, while the number of students writing answers to practice questions dropped across semesters. It may be that the mock exams, while intense, were seen by students as easier because all they had to do was show up for a single session, while answering practice questions required students to spend time preparing and submitting answers on multiple occasions throughout the unit to receive the highest benefit from the activity. Since even beneficial review activities do not positively influence students' grades if the students do not complete them, it is important that future research identify what characteristics of such activities (such as proximity in time to the exam and the effort required to attend) make it more likely that students will participate.

A potential limitation of this approach to supporting student learning relates to the amount of time required to conduct review activities. Conducting five mock exam sessions of two and a half hours each and grading 15-20 practice question assignments across a semester requires a large investment of time that some instructors may feel they do not have. While the up-front time requirements are large, anecdotally, the timesavings in grading more than offset this concern within the reported course. With increased participation, especially in mock exam sessions, more students wrote more well-organized and correct answers. Since it took less time to

grade correct and clearly written answers, the GTA spent much less time overall grading each set of unit exams.

In a further effort to make the review activities more efficient, ongoing work in the same course has involved efforts to identify which specific components of the review activities might be most responsible for improvements in student learning. We want to explore questions about which components are needed or redundant. For example, perhaps requiring students to write answers and requiring them to evaluate and correct sample answers are both helpful, but do not produce summative improvements in exam performance. It may only be necessary to do one or the other in a session and still see a positive effect on exam performance. Future studies will report the results of these additional component analyses. Also, the effect of the review activities, and especially the mock exams, have led to the incorporation of aspects of the review sessions into the daily course activities; for example, by spending time in class asking students to work in small groups to answer applied questions at several points during a lecture in an effort to increase engagement during a class period.

This investigation was undertaken to identify ways in which students could be better supported in learning to apply course materials to novel situations by revising existing practice opportunities. The two review activities appeared to do so. The results suggest that both completing practice questions and attending mock exam study sessions improved student understanding of the course material, as indicated by performance on short-essay exams and also in the course overall. This improved performance suggests that students write better answers on exams when they take advantage of course activities designed to support their learning by offering realistic, engaging, practice opportunities which have been aligned with the expectations and assessments of the course.

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## **Validating the differences between Associate and Bachelor students by comparing performances in a combined class setting**

**Dean Porr<sup>1</sup> and William Acar<sup>2</sup>**

*Abstract: Observed differences between Associate and Bachelor students are often justified by citing the comparative poorer performance of 2-year students that continue into 4-year programs. This research offers a different approach by investigating introductory-level management courses taught as a combined class at a regional campus of a state university. Results indicated noted differences between the two groups in regard to exam grades, peer reviews and attendance. This analysis of combined sophomore-level management courses supports prior findings of transfer student performance in upper-level courses.*

*Keywords: Associate students, Bachelor students, combined courses*

The growth of 2-year Associate programs has been accompanied by studies that reveal inherent differences between the students in these programs and the more traditional students in 4-year institutions. The qualitative findings about differences in social background, preparation level, commitment level, reason for enrollment, etc. (Monk-Turner, 1995; Alfonso, 2006; Whitfield, 2005) were often supported by more quantitative research revealing comparative poorer performance by 2-year students who continued their education into the 4-year programs (Smith, Opp, Armstrong, Stewart and Isaacson, 1999; Strauss and Volkwein, 2002). These students were referred to as transfer students, while traditional Bachelor students were referred to as native students.

Few studies have been done on the performance differences seen in combined classes of 2-year Associate and 4-year Bachelor students (Etzkorn, Weisskop, and Gholston, 2004). This study investigates the consequences of enrolling 2-year Associate and 4-year Bachelor students in a combined introductory management course. This felicitous research opportunity thus poses the question: if Associate students who transfer to Bachelor programs have been found to perform at a lower level in junior and senior level courses than native Bachelor students, does a similar performance differentiation exist at the sophomore level in a combined class setting? The method differs from existing comparative analyses in two ways: 1) the students are at the sophomore level of their academic career, and 2) the study includes all of the Associate students, not just the select students who continue their education.

### **I. Literature Review.**

The inherently different and changing missions of 2-year and 4-year colleges are to be considered in trying to teach students from both institutions in the same classroom. At their outset, the primary function of junior colleges, now referred to as “community colleges”, was to provide two years of course work suitable for transfer to 4-year institutions (Wilson, 1983). This

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philosophy has now changed as many 2-year programs are considered self-sufficient and a logical path to certain types of employment. Still, research indicates that community college students have a lower social class background (Monk-Turner, 1995) and are more likely to attend part-time (Alfonso, 2006). A study of over 7,000 students in 51 New York State University institutions concluded that 2-year students received higher grades while 4-year students experienced more growth (Strauss and Volkwein, 2002). The study also indicated that the different missions of 2-year and 4-year campuses exerted significantly different influences on undergraduate grade point average (GPA) and intellectual growth.

Nonetheless, the academic concern for growth and retention has created interest in the issue of 2-year students transferring into 4-year programs. The concept of “transfer shock” was an important milestone in early community college research, becoming an easy write-off of the responsibility for student performance (Hills, 1965; Boswell, 1992). Whitfield (2005) expanded this concept by describing a “transfer achievement gap” between transfer and native students that did not decline as students spent more time in the university (4-year) environment. Rather than portraying transfer shock as a temporary and recoverable effect, Whitfield referred to the ongoing effect as a “transfer coma.” Within this research is a perception that community college students are less academically talented than their university counterparts, feeding into the claim that community colleges do not adequately prepare students for upper-division study (Whitfield, 2005).

So it came to pass that the demands placed on higher education to be cost effective and meet the timetable expectations of students have caused some universities to combine apparently similar courses. Students from different majors register for a course specific to their degree requirements and find themselves in a classroom with students registered for a course with a different designation. Such combined courses have the potential for student performance considerations due to the inherent differences in the distinct populations. The question of student performance within combined courses has been addressed by researchers with various results.

Early research on the topic of combined courses indicated that the practice was logical for various reasons. Patterson (1974) compiled a list of seven principles that, in his opinion, should be agreed upon and assumed before an institution considered combining courses. One is the principle that the institution should minimize duplication of education programs and redundancy of facilities by striving for complementary academic programs. Research data concerning combined courses are traditionally averaged over numerous academic departments, so the reported results provide little incentive or direction for course-specific curricular change (Quanty, Dixon and Ridley, 1999).

Although academic researchers have found numerous differences between 2-year and 4-year programs, efforts to combine apparently similar courses into a rather seamless transition are apparent. Whitfield (2005) found that academic institutions have made great efforts to reach agreements about course equivalencies in order to ensure that students do not lose credits upon transfer from Associate to Bachelor programs. In a sample collecting data from 1,172 two-year college presidents, there were over 9,000 partnerships between 2-year and 4-year colleges (Smith, Opp, Armstrong, Stewart and Isaacson, 1999). In Washington State, 30% of students who earn a Bachelor’s degree begin their education at one of the state’s 33 community colleges. This “two plus two” system is used to help alleviate the facility problems that would otherwise overburden the state university system (SBCTC, 2003).

A commonly-used determinant of whether a student should be enrolled in associate or bachelor level coursework is the student’s scores on college entrance exams such as the ACT

from the American College Testing Program. The ACT measures subject-specific knowledge on a variety of subjects such as social studies, mathematics, natural sciences and English. A criticism of the ACT tests is that they are based on the judgment of high school and college instructors about the academic knowledge and skills students need to succeed in typical first-year college courses (Aggarwal, Vaidyanathan and Rochford, 2004). Nonetheless, ACT scores were found to be good predictors of first-year business students' grade point averages (Aggarwal, Vaidyanathan and Rockford, 2004) and predictors of transfer students being able to obtain a higher-level Bachelor degree (Dickerson, 1993).

The study of transfer student performance also strengthened the argument that such research was course-specific. A study involving 11 community colleges from the period of 1996 through 2002 found that examining transfer student performance at the course-specific level is essentially worthwhile when a course or sequence of courses is an important gateway to an academic or professional program (Whitfield, 2005). Quaint, Dixon and Ridley (1999) agreed, indicating that the success of transferring from community college to the university setting is course-specific and should not be generalized.

Moreover, another area that may distinguish the performance of students within the classroom is attendance. Numerous researchers have found a direct relationship between class attendance and course grades: it has been found in economics (Cohn and Johnson, 2006), in psychology (Gunn, 1993), and in finance (Park and Kerr, 1990). If students who attend class regularly are more likely to receive higher grades in these courses, the same findings may apply to management students, regardless of whether they are pursuing 2-year or 4-year diplomas.

## **II. Method.**

The Associate degree program of the regional campus in the study contains a course entitled Introduction to Management Technology. This course is described as a study of management principles and represents the capstone management course for management majors in the 2-year degree program. There is one prerequisite business course, Introduction to Business, which concentrates on the social, economic and consumer environments of business in general.

Within the same regional campus all 4-year students in the College of Business, regardless of major, are required to take an initial management course entitled Principles of Management. This course is described as an introductory course in management and organizational design. The only prerequisite for the course is a sophomore standing; however it serves as the prerequisite for numerous management courses that logically build on it.

Due to the logistic concerns of a regional campus that offers both Associate and Bachelor programs on a relatively small scale, these two introductory management courses have been combined for many years. This study is an analysis of the results of the combined course, taught by the same instructor at the same campus 11 times over 4 years. One hundred seventy Associate and 117 Bachelor students were involved in the study. There was no differentiation of course requirements between the two groups of students. All students were required to take four exams based primarily on a popular management textbook and participate in a group project requiring work outside the classroom. For this reason, we adopted the average of the four exam grades as the main individual performance indicator of each student.

The demographic data collected on each student included their major (2-year Associate or 4-year Bachelor), gender and class meeting time (day or evening). Two additional variables were also available: the student's classroom attendance percentage and ACT score. The specific

ethnicity of the students in the study was not available; however current school records indicate that the campus student body is 95% white, 2% black, 1% other, and 2% unreported. The age of the students in the study was not available, but the sophomore standing requirement for the course would mirror the campus average of 25 years.

An additional performance metric was the average score on a peer review conducted by fellow group members. The peer review requirement is done in a manner consistent with other course assignments. The students are placed into groups of four to six by the instructor to insure diversity as far as gender, work experience, personal interest and field of study. This method of group formation was used to avoid any tendency for students to voluntarily group themselves into social cliques or differentiate themselves into groups according to major. The specific topic of the group project was left to the discretion of the team within the framework of the course and approval by the instructor.

The group assignments were completed at the end of the regular semester, requiring a paper and corresponding presentation. The peer review process was conducted during finals' week. The peer review form was passed out to each student individually and the atmosphere was that of a typical test. The students knew the form was being graded and the only person viewing it was the instructor. The form required the student to evaluate all members of the group on 12 common group assignment criteria. The student was then required to give an overall assessment of the performance of each group member as Excellent, Good, Acceptable or Needs Improvement. An area for comments was provided on the form. A four-point scale was attached to the overall summary performance choices. The resultant peer evaluation grade for each individual used in the study was the average of the scores they received from all fellow group members.

In an effort to encourage students to give serious consideration to completing the form accurately, 20% of their group grade was the thoroughness of completing the form and 20% was the aggregate score of how they were assessed by their peers. Because the group assignment constituted 20% of the final grade, the net effect was 4% of each student's final grade was determined by how he or she reviewed their peers and 4% was determined by how he or she was reviewed by their peers. The students were reminded throughout the semester about the importance of this activity, and the resultant atmosphere associated with it was as serious as the other course testing.

### **III. Results.**

Gender and age issues were not found substantially relevant to the exam grades and are not reported here. The exam grades for the Associate students averaged noticeably lower than the Bachelor students (73.1% vs. 82.6%). Based on a grading scale of ten percentage points per letter grade (90s = A, 80s = B, etc.), 2-year students' exam grades were one full letter grade lower than their 4-year counterparts.

On the basis of the four-point peer evaluation rating scale, Associate students were rated an average of 3.04 and Bachelor students were rated an average 3.49. As to the issue of attendance, Associate students were in class an average of 83.2% of the time, as compared to the Bachelor students' attendance rate of 85.9%.

Regarding prior-preparation test scores, the regional college campus system operates under an open enrollment policy that requires only a high school diploma for initial admission. The result of this policy is that 189 of the 287 students involved in the study had ACT scores in

their personal files. The remaining students were admitted to the university by taking an internal test designed to reveal initial course placement needs or through transfer from another institution. So, as far as could be determined, Associate student ACT scores averaged 20.0 and Bachelor students averaged 21.4.

A t-test was conducted to determine whether the means of the two groups of students were significantly different in each of the four measurables. As shown in Table 1, the resultant t-values came to 2.21 to 7.46. The corresponding level of significance for these values exceed the accepted alpha level for social research of .05, indicating that the differences between the means were not simply due to chance. The average, median, standard deviation and standard error of the mean, for exam grades, peer reviews, attendance and ACT scores, as broken down by program, can be found in Table 1. The t-values and levels of significance (two-tailed) comparing the 2-year and 4-year means for the four measurables are also provided.

**Table 1. Demographic measurables.**

<b>Demographic (n)</b>	<b>Exam Grade %</b>	<b>Peer Review</b>	<b>Attendance %</b>	<b>ACT Score</b>
<i>2-year (170)</i>				
Average	73.1	3.04	83.2	20.0
Median	75.0	3.00	88.0	20.0
Std Dev	10.7	0.75	14.8	3.0
Std Err of Mean	0.80	0.06	1.11	0.28
<i>4-year (117)</i>				
Average	82.6	3.49	89.8	21.4
Median	84.0	3.50	92.0	21.0
Std Dev	7.7	0.55	10.3	3.4
Std Err of Mean	0.79	0.05	1.0	0.41
<i>Total (287)</i>				
Average	77.0	3.22	85.9	20.5
Median	79.0	3.30	90.0	21.0
Std Dev	10.6	0.71	13.6	3.2
Std Err of Mean	0.63	0.04	0.80	0.24
<i>2-year vs. 4-year t-test</i>				
t-value	7.46	5.77	3.97	2.21
Significance	0.001	0.001	0.001	0.025

Class records provided various demographics, allowing for these measurables to be analyzed according to gender and scheduled class time (day versus evening). There were no significant performance differences between male and female students for any of the four measurables. This supported similar findings of upper-level economics courses (Williams, Waldauer and Duggal, 1992). An analysis of performance differences between day and evening students revealed almost identical average and median scores for all four measurables.

As displayed in Table 2, the correlation analysis between the four measurables of the study revealed that exam grades, peer reviews and attendance are all good predictors of each other. Social science guidelines consider Pearson correlation sizes of 0.37 or larger as evidence of

substantial correlation effects. This is how we interpret the Pearson correlations numbers of 0.358 and 0.466, with a two-tailed significance level of 0.000 between attendance and exam grades and peer reviews respectively. It is useful to note that, in this particular case, the corresponding r-squared values indicated that 13% to 22% of the variance of either variable is shared by the other variable.

ACT scores proved to be a good indicator of exam grades, with a Pearson correlation of 0.455, a two-tailed significance of 0.000, and an r-squared value of 0.207. On the other hand, ACT scores were not significantly correlated to either peer reviews or attendance. The correlation, significance, and r-squared values of the four measurables can be found in Table 2.

**Table 2. Correlation between measurables.**

	Exam Grade	Peer Review	Attendance	ACT Score
<i>Exam Grade</i>				
Correlation	1.00			
Significance	X			
r-squared	X			
<i>Peer Review</i>				
Correlation	0.428**	1.00		
Significance	0.000	X		
r-squared	0.183	X		
<i>Attendance</i>				
Correlation	0.358**	0.466**	1.00	
Significance	0.000	0.000	X	
r-squared	0.128	0.217	X	
<i>ACT Score</i>				
Correlation	0.455**	0.000	0.049	1.00
Significance	0.000	0.998	0.508	X
r-squared	0.207	0.000	0.002	X

\*\* Correlation is significant at the 0.01 level (two-tailed test)

#### IV. Limitations.

This study was limited to one combined course taught 11 times on one campus. The combined course setting is ideal for testing performance differences of 2-year and 4-year students; so expanding this research method to other Associate/Bachelor combined courses and other locations would give greater credibility to the findings.

Another limitation was the inability to compare these findings of distinct group performance in the combined class setting to performance from similar courses that remained separated for Associate or Bachelor students. The relatively small size of the campus in the study prohibited offering the course exclusively to each group. Reproducing this research method in a larger academic setting with more scheduling options might provide new research opportunities.

## V. Conclusions and Recommendations.

The significant positive correlation between exam grades and peer reviews found in this study raises interest in the area of multi-source assessment. This is an area in which practice is considered well ahead of empirical research (London and Smither, 1995), indicating a clear need for additional research on 360-degree feedback systems (Dunnette, 1993; London and Beatty, 1993; London and Wohlers, 1991). The application of the peer review research methods used in this study to other management courses could contribute to these expressed needs.

This study revealed that, at the sophomore level, Associate management students attended class less often, contributed less to group projects, and scored lower on coursework exams than their Bachelor student counterparts in the same classroom setting. The independent samples t-test values indicate that these differences were not due to chance. These findings support existing research about performance differences between the two groups conducted under the different circumstances of upper-level courses involving only Associate-to-Bachelor transfer students.

Decisions concerning combined courses are often made for administrative reasons without sufficient regard to appropriate scholarly research concerning the impact that such decisions have on students. While some scholars have hypothesized that combined courses may increase the learning experience for the 2-year students, this study indicate marked differences in exam performance, team performance, and classroom attendance exist between the groups. Curricular decisions to combine Associate and Bachelor students in the same class should be carefully considered if a goal of the institution is to maintain the highest standards in its baccalaureate program.

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## **Students' perspectives on problem-based learning in a transitional Doctorate of Physical Therapy Program**

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*Abstract: Doctor of physical therapy (DPT) graduates are expected to be competent in professional behaviors, communication, critical inquiry, clinical decision making, and evidence-based practice. The purpose of this qualitative study was to describe the experience of students enrolled in a single, problem-based learning (PBL) course within a conventional lecture-based transitional DPT (tDPT) program. Students wrote weekly entries in a reflective journal. Three investigators identified significant statements in the journal entries, clustered the statements, and developed themes. Five themes were identified: 1) accessing and applying information, 2) value of giving and receiving feedback, 3) value of and commitment to the group, 4) awareness and appreciation of the PBL process, and 5) personal and professional growth. A single PBL course within a tDPT conventional curriculum was well accepted by students in this study. Students appreciated the benefits of learning in a group, and gained knowledge, skills, and attitudes consistent with characteristics desired of DPT graduates.*

*Keywords: problem-based learning (PBL), transitional doctorate in Physical Therapy (tDPT), reflective journals, qualitative study*

### **I. Background and purpose.**

#### *A. Professional Competencies.*

A doctoral degree has been or is becoming the entry-level requirement for many health professions. In the field of physical therapy, the emphasis in the clinical doctorate programs has been on providing students with advanced knowledge, skills and attitudes to promote the development of reflective, evidence-based practitioners (American Physical Therapy Association, 2006). Although a specific method of education has not been recommended, several authors (Feingold, 2008; Foord-May, 2006; Kelly and Haidet, 2005; Savery, 2006; Springer, Stanne, and Donovan, 1999; van der Meer and Scott, 2008) have suggested that student-centered programs are more likely to produce the desired characteristics in the new graduate. Problem-based learning (PBL) is one student-centered method that has been utilized extensively in health science education, and may help students acquire the professional knowledge, skills and attitudes desired in doctoral education.

Health professionals must be able to reflect on their personal and professional development (Donaghy and Morss, 2007; Fraser and Greenhalgh, 2001). According to Boud, Keogh, and Walker (1985) reflection is “a generic term for those intellectual and affective

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activities in which individuals engage to explore their experiences in order to lead to new understandings and appreciations” (p. 19). Kuiper and Pesut (2004) argue that both cognition (critical thinking, reasoning) and metacognition [reflection on one’s own cognitive and learning processes (Cheong, 2008)] are essential and integrated parts of clinical reasoning. Educators seek to incorporate instructional strategies that will help their students develop clinical reasoning and reflection.

### *B. The Problem-Based Learning Approach.*

Problem-based learning has been suggested as one of the educational methods that facilitate both cognition and metacognition skills (Foord-May, 2006; Lusardi, Levangie, and Fein, 2002; Uhlin, Johannesson, and Silén, 2007; Williams, 2001). In a PBL course, learning is structured around a realistic case scenario that provides context to facilitate reflection and critical thinking (Kuiper and Pesut, 2004). Students learn in groups with guidance from a tutor. They define individual and group learning needs, and search for and critically apply findings to the case scenario (Dolmans et al, 2005). Students must select and organize relevant information and communicate effectively with their peers. The ability to apply information clinically is dependent, in part, on how one organizes and accesses knowledge (Norman and Eva, 2003). In PBL courses, students are practicing organizational and retrieval skills that will be useful for making and applying clinical decisions, interacting with patients and colleagues, and becoming lifelong learners (Lusardi, Levangie, and Fein, 2002).

Self- and peer-assessments are components of PBL that may be particularly useful for promoting reflection in physical therapy students. In a PBL course, students are required to evaluate themselves, their peers and tutors during tutorial sessions. This weekly oral feedback may cover any of the expected tasks of PBL, e.g., defining learning objectives, accessing, organizing and applying relevant information, and professional behavior, such as punctuality, communication and respect for others. Students are expected to modify their behavior in response to feedback, and to note and suggest change in others. Williams (2001) articulates that the feedback component of a PBL course promotes students’ reflections on their actions and facilitates development of strategies for improved performance.

### *C. Problem-Based Learning Literature.*

Authors conducting reviews of the literature over the past 20 years (Norman and Schmidt, 1992; Albanese and Mitchell, 1993; Dochy et al, 2003; Koh et al, 2008), have reported that PBL sustained self-directed learning, and improved resource use, collaborative skills, retention of knowledge, knowledge application, and transfer of concepts to new problems. In their recent systematic review, Koh and colleagues (2008) reported positive effects of PBL on physician competencies after graduation especially in the social and cognitive areas. The authors indicated that there was strong evidence to support the positive effect of PBL on several observed competencies of medical graduates: diagnostic skills or accuracy, communication skills, appreciation of cultural, legal and ethical aspects of health care, coping with uncertainty, responsibility and reliability, and self- or peer appraisal. Ozturk et al (2008) reported evidence that PBL encouraged critical thinking in nursing students; and, Richards et al (1996) and Distlehorst and Robbs (1998) noted the superior clinical performance of PBL students. Finally,

from their meta-synthesis of meta-analyses, Strobel and van Barneveld (2009) concluded that “PBL is significantly more effective than traditional instruction to train competent and skilled practitioners and to promote long-term retention of knowledge and skills acquired during the learning experience or training session” (p. 55). These studies have provided evidence that PBL fosters many of the characteristics desired in doctoral level PT graduates.

Some authors (Colliver, 2000; Dochy et al, 2003; Albanese and Mitchell, 1993; Albanese, 2000; Saarinen-Rahiika and Binkley, 1998; Mann and Kaufman, 1999; Jefferson, 2001; Solomon, 2005; Rideout et al, 2002; Koh et al, 2008) have reported that PBL is not superior to conventional educational approaches in all aspects of learning. For example, students who studied in a PBL curriculum demonstrated lower levels of content-specific knowledge and basic sciences and scored the same or lower on examinations compared to students in conventional programs (Dochy et al, 2003; Albanese and Mitchell, 1993). Students in PBL also perceived themselves as having lower knowledge even when they had performed as well as students from conventional programs on board examinations (Koh et al, 2008; Mann and Kaufman, 1999). Jefferson (2001) concluded from his review that PBL did not improve students’ problem-solving skills and Colliver (2000) found no convincing evidence that PBL improves knowledge and clinical performance.

#### *D. Problem-Based Learning and Physical Therapy.*

Studies of physical therapy students have provided support for the suggested effects of PBL on professional skills and behaviors. These have included investigations on students in fully integrated PBL curricula, and those in stand-alone PBL courses. Van Langenberghe (1988) reported that students in PBL have more desirable personal study habits. Physical therapy students during the first term of a fully integrated PBL program described an improved ability to access appropriate information, an appreciation of giving and receiving feedback, and an increased awareness of group process and group methods of learning (Williams, MacDermid, and Wessel, 2003). Students in a first year PBL ethics course felt they improved their critical thinking and problem-solving skills and their ability to speak in front of others (Uhlir, Johannesson, and Silén, 2007). In an attempt to evaluate the effect of a PBL course on lifelong learning, Wiegand, Gillette, and Brosky (2005) surveyed physical therapists two to four years after graduation. Those that had taken a PBL course on professional issues felt more prepared to develop and implement continuing education courses than those who had covered the same curricular content in a conventional course.

A thorough review of the literature revealed only one study examining the reactions of students to a single, PBL course within a 3-year DPT program (Santasier and Plack, 2007). The Case Study I course was full time for one week, held between semesters of conventional curricula and incorporated cycles of action and reflection. The authors analyzed qualitative data from the individual, reflective essays of 25 students who answered the question on whether the course objectives addressing professional behaviors were met, and from graphic metaphors created by groups of 3 or 4 students to depict what the course was like for them. Students reported enhanced critical thinking, commitment to learning, interaction skills, stress management, and professional identity. The authors noted that the graphic metaphors “further supported the integration, synthesis, and personal growth in professional behaviors” (Santasier and Plack, 2007, p. 35).

Several authors (Dolmans et al., 2005; Lusardi, Levangie, and Fein, 2002) have called for further research to better understand the theoretical concepts underlying PBL, and the impact of PBL on students' transition to clinical practice and lifelong learning. No studies have reported the reactions of students to a single PBL course within a conventional, lecture-based curriculum designed for transition to a DPT. The response of students to a single PBL course near the end of their professional education may be different from that of students who participated in PBL style courses throughout their program. The purpose of this qualitative study was to describe physical therapy students' perceptions of their experience and learning during participation in a single PBL course within a transitional DPT (tDPT) lecture-based curriculum.

## **II. Methods.**

### *A. Design.*

This study followed a phenomenological, qualitative approach (Creswell, 2007). Researchers use this method when they wish to describe the lived experiences of people involved with the topic being studied. We chose this design to capture the PBL experience from the personal perspective of the students. Students wrote weekly reflections over the 10-week time period of a single PBL course. The three investigators read the journal entries and developed themes.

### *B. Participants.*

Sixty-three physical therapy students (15 male and 48 female, mean age 23.6 years, range 22.1-27.7 years) enrolled in a PBL Case Study Seminar course within a lecture-based tDPT curriculum were invited to participate in the study. All students had completed an entry-level Master of Science in Physical Therapy (MSPT) degree with 30 weeks of clinical education course work. Sixty-one of these students had not yet been employed as physical therapists. Two students were alumni who had graduated within the past 5 years and had been in clinical practice prior to enrolling in the course. The study was approved by the All College Review Board for Human Subjects Research of Ithaca College, and participants provided written informed consent.

### *C. Educational Program and PBL Course.*

The tDPT program was solely available to Ithaca College graduates holding a MSPT degree. The 10-week, on-site, tDPT curriculum consisted of 6 intensive courses, one of which was Case Study Seminar, the only PBL course offered in the entire physical therapy curriculum (MSPT and tDPT). The course was designed to help students integrate previous academic and clinical coursework, expand professional knowledge, develop skills in communication and reflection, and design treatments based on evidence. Groups of six to seven students, facilitated by a tutor, met for two hours weekly to discuss a series of written health care scenarios. Students were required to work together to identify weekly learning issues. They individually located, accessed, evaluated and organized evidence relevant to the case. Knowledge was discussed and applied to the client scenario during the next tutorial session. The cases covered a broad scope of physical therapy practice, were complex and multidisciplinary in nature, and included patients of various age groups and cultural backgrounds. Peer, tutor and self-assessments occurred orally at each tutorial session, and in written and oral format at midterm and at the end of the course.

All tutors attended eight hours of PBL training workshops, had a minimum of two years experience with the PBL approach, and had been involved in the tDPT program for the past three years. The course coordinator provided the course syllabus and a tutors' guide which included the learning objectives and relevant literature for each case scenario. Tutors attended weekly meetings with the course coordinator to discuss the progression of the course, student performance and facilitation strategies to enhance students' learning.

#### *D. Data Collection and Analysis.*

Reflective journal writing was used as a means of gathering students' perceptions on their first experience with PBL. Previous investigators have used this method to study the process of transitional adjustment of adult learners in their first year of higher education (Risquez, Moore, and Morley, 2007-2008), and of physical therapy students entering a PBL curricular program (Uhlín, Johannesson, and Silén, 2007; Williams, MacDermid, and Wessel, 2003). Both students and faculty in previous studies have commented on the value of journal writing to better understand the students' experience with PBL (Uhlín, Johannesson, and Silén, 2007; Williams, MacDermid, and Wessel, 2003).

As part of the Case Study Seminar course, each student was required to complete and submit a reflective journal about their experience and their understanding of the process of problem-based, self-directed learning. They were to include observations, impressions, and reactions to what and how they were learning, and to relate these to previous learning and potential future behavior. Students were awarded 1% for each completed weekly journal entry for a total of 10% of the course grade. At mid-course and in the final week, the course coordinator reminded students to write in their reflective journals.

On the first day of the last week of the course, the principal investigator sent an e-mail to the students inviting their participation in the study. The students were assured that their decision to participate or not participate would have no impact on the course grade. The investigators would access the reflective journals for qualitative analysis of content only after the students' graduation date. Students received no incentives to participate and were offered a summary of the results at the end of the study upon request. At the end of the course, all students submitted their journals to an administrative assistant. To protect the anonymity of the students, a research assistant removed the names from the journals of all participants, replaced names with code numbers, and delivered the coded journals to the investigators.

Three investigators were involved in the qualitative analysis of the journals. One investigator was the Case Study Seminar course coordinator and a tutor, the second, a tutor in the course, and the third, a faculty member from another university with no involvement in this tDPT program. All three investigators were experienced educators and scholars in the profession of physical therapy. Their combined clinical and research expertise included pediatric neurology, orthopedics, rheumatology, moral judgment and clinical education. Two of the investigators had extensive experience in teaching in PBL curricula and had utilized reflective journals in previous research (Larin, Wessel, and Al-Shamlan, 2005; Williams, MacDermid and Wessel, 2003; Williams et al, 2002). Each investigator brought to the analysis of the reflective journals a different awareness based on their respective experiences in physical therapy.

Initially, the three investigators independently read five randomly selected journals and highlighted significant statements representative of how the participants experienced the PBL course. They then began to group the statements into large units of information or categories and

met to revise and establish agreement on the categories. They then reread and searched for the agreed categories, and identified significant statements outside of these categories, in the same five journals and into two entries from each of six additional journals. For the latter six journals, the investigators were paired (3 possible pair combinations), so that each journal was read by two evaluators. This analysis was followed by a second meeting to further establish agreement on the categories. In case of disagreement between the paired investigators, the third evaluator participated in the discussion until the issue was clarified and a consensus reached. The remaining journals were randomly assigned to one of the three pairs of investigators. The three investigators met again to establish agreement on the interpretation of the categories of the weekly entries. Afterwards, they independently developed and organized clusters of meaning into themes that would lead to a composite description of the essence of the students' experience (Cresswell, 2007). They then met several times to refine and come to agreement on the final themes. All decisions made throughout the analytic process were recorded.

Member checking was performed to validate interpretation of the journals. Eight study participants volunteered to provide feedback on the themes developed by the authors. They were provided with descriptions of the themes and asked if information accurately represented their experience in the PBL course. They were to indicate any themes that did not reflect their experience, as well as experiences that were not reflected in the themes. The information was gathered through a research assistant to maintain the anonymity of the respondents.

### **III. Results.**

Fifty-one students (81% of the class, 11/15 male, 40/48 female, mean age 23.5 years, range 22.9-26.7 years) participated in the study. All participants completed 10 journal entries, each approximately one page in length. The first entry typically described the students' expectations for the course, and the last entry was generally a summary of their experience over the 10 weeks of the course. The remaining entries focused on the tutorial sessions or preparation for them. Some students provided recommendations for changes in the course.

Qualitative analysis revealed five themes: 1) Accessing and applying information, 2) Value of giving and receiving feedback, 3) Value of and commitment to the group, 4) Awareness and appreciation of the PBL process, and 5) Personal and professional growth. The themes are presented below and illustrated with quotes from the journals. Each quote is identified by participant number and week of entry in parentheses.

#### *A. Theme 1: Accessing and Applying Information.*

The students discussed their individual efforts and resultant learning in accessing and 'filtering' information that they shared with their peers and applied to the case during the tutorial sessions. Students learned that they needed to ask specific, focused research questions in order to narrow the search to a reasonable number of relevant articles and to have better group discussions. They began to use search engines more efficiently, and to critically appraise articles, selecting those with higher levels of evidence to limit the volume of information without compromising quality. In order to share the research findings with the group, students learned to organize their information for prompt access and to supplement, but not repeat, the contributions of others in the tutorial discussion. As the course progressed, they became more aware of communication skills, particularly the ability to present, listen, and facilitate. Students noted more effective participation

of all members as they became more comfortable with their group. The students recognized the value of ‘information management’ skills for clinical practice.

*“...I was able to focus my search this week to include only really relevant articles about the treatment approach. I think that this week I was finally able to get into a groove where I spent just enough time looking for articles so that I found all of the relevant ones that I could but I still had time to really read them and critically appraise them.” (18-9)*

*"This week I also tried a new organizational strategy. Before the group meeting I made a single document that contained the title of the article I found, a brief summary of the study design and results, the level of evidence, and the components of each model to which the evidence was applicable. I found that this method not only prepared me for the discussion more thoroughly, however it made me learn and pay attention to the material much more than I would have by just reading the articles alone." (41-7)*

*“I am putting more emphasis on evidence that is more current...by relying on more current data it will be easier to keep up with the rapid pace of healthcare discovery. If I continue to do this once I am in the clinic, hopefully I will be able to stay on top of current evidence.” (49-8)*

#### *B. Theme 2: Value of Giving and Receiving Feedback.*

A large focus of the journal entries was dedicated to the students’ feelings about feedback and their use of feedback to guide change in performance. Initially, most were concerned about the newness of giving feedback to their peers and tutors in a small group, face-to-face format. Students voiced various levels of comfort with giving and receiving feedback, and differed in their expressed opinions on the frequency of feedback needed. Some felt that frequent feedback became redundant, while others noted that ongoing feedback facilitated performance changes and led to the development of useful clinical skills. Students actively sought and utilized feedback to develop strategies to improve individually and as a group. They commented on the success of their new strategies and liked to have confirmation from others that a positive change in behavior had been observed. All acknowledged that the ability to give and receive feedback was an important skill for clinical practice.

*Providing constructive feedback to other members of the group was a challenge especially on the first day. I understand this will be useful when we get out into the professional world especially during staff meetings. It allows us to learn how to professionally and appropriately provide feedback. However, I do not feel that weekly constructive feedback is necessary...It will take time until I become more comfortable with the process. (12-1)*

*Providing feedback in past courses has always been private and quick...always positive. For me, feedback had always been something I did not take seriously or learn from...feedback in PBL is quite the opposite...Surprisingly, I actually enjoyed this aspect of our class...I now realize how valuable it is to receive and provide feedback and will now continue to take this process sincerely. (46-2)*



*I find the weekly feedback very beneficial. I feel that the advice I get from my peers on how I can contribute more to the group helps in my speaking skills, organizational skills, and improves my ability to be an effective team member... I try to take the feedback and apply it to the following week. (14-3)*

*When it came time to give constructive feedback, I felt good about myself and I think group members observed an improvement in myself as well... I am more excited for next week now that my enhanced performance has been acknowledged. (48-8)*

### *C. Theme 3: Value of and Commitment to the Group.*

The students noted many positive aspects of working in a group. Students described a greater breadth of learning because group members brought different resources, past experiences and perspectives to the cases. Students acknowledged that group discussions led to a better understanding of concepts and deeper learning than individual study. Students felt that as a result, they would provide more effective patient care. Individuals reflected on their ability to model the effective behaviors of other group members. The group provided support, allowing students to try new roles or voice their opinions in a safe environment. Quieter students might be encouraged to contribute, while more vocal students modified their involvement to a facilitatory role. The students revealed an acute consciousness of their individual responsibility towards the group. Students felt a strong need to be present and punctual at all tutorial sessions, to come well prepared, to contribute actively to the discussion, and to take on new roles to improve group function. The students appreciated working with classmates that they had not been involved with previously. They wanted the group and all its members to succeed, and they recognized the importance of their individual contributions to this end.

*Despite reading the same articles, we all picked out different information and were able to collaborate as a team to draw conclusions from our research. I believe that this shows that in the clinic if a team receives the same information you still need to collaborate because people get different things out of the same research. This emphasizes the need for communication and collaboration. (45-9)*

*The critical thinking and problem solving as a group helped me see beyond what I was thinking and directed me to what I was missing... I felt I had delved deeper in the case study with the group compared to as if I would have just looked at it alone. (48-1)*

*The conversation reached a new level of intensity. I don't think it would have been possible to have such a serious, deep-thinking conversation early on in the semester before our group had learned the ins and outs of group process and had become comfortable with each other. (19-9)*

*I would feel terrible if [a group member] failed the class...this class is a group effort and as a group we need to help each other achieve. (16-8)*

*I was a bit lost... I learned that it is not fun to miss a meeting. I felt really left out and lost leaving today and hope that I can get back on track. I will definitely not miss or be late to anymore group sessions....I will be understanding of others in the future as well. (48-5)*

*D. Theme 4: Awareness and Appreciation of the PBL Process.*

Throughout the weekly journal entries, the students discussed their interactions in the tutorial sessions. They noted whether the group functioned well or not in sharing information and applying it to the case. They analyzed what went right or wrong, and how they might improve the group process. They were aware of the different roles taken on by themselves, by other group members and by the tutor, and whether these were effective in helping the group. Early on students were more tentative in their participation, particularly feeling discomfort if they moved away from traditional, comfortable behaviors. They progressed to being interactively engaged in an enjoyable, smooth and balanced flow of group discussion. They were pleased when their group ran like an effective health team discussing the needs and treatment of a patient. Students realized that when the group functioned well, they learned more. Some students noted each week that the group improved from the previous week. Others reported ups and downs, and described what the group or individual was going to do to improve performance.

Several students enjoyed the high level of self-directed learning in the PBL-based course. They provided various examples of situations where independent learning and logistical decisions were made by the group members (with little or no influence from the tutor). Students developed individual as well as group goals to enhance their learning and improve group function. Some students acknowledged the relevance of self-directed learning to future professional practice and lifelong learning.

All students commented on the value of the course and the PBL method of learning. Several students noted and agreed with the gradual increase in demands as the course progressed. While acknowledging that the course was more challenging than expected, the majority of the students felt PBL should have been introduced earlier in their physical therapy studies.

*Our meeting was more of a discussion and we asked each other questions about our articles. We gave our own opinion on what we would do based on the articles and we gave ideas from past experiences on our clinical affiliations. I think we listened to each other better and didn't shift through our notes as much when other people were talking. I also felt like I learned a lot more this session than any other session because of how well we discussed. (27-7)*

*I really don't know why this regression in group dynamics and group process occurred... I think that we were doing so well over the past weeks that we slacked on what we were trying to achieve... I'm personally going to really try to facilitate next week. Hopefully I can improve my facilitation role if I actively listen to others and then challenge the more quiet people in the group to talk more. (16-7)*

*This week marked a transformation in comfort zone. I felt much more free to express my evidence and my clinical opinions this week. I have no idea what caused this sudden shift in attitude. I guess I am really becoming comfortable with problem-based learning and discussing case information with my peers as if they were colleagues and/or fellow*

*clinicians...Our weekly meetings are becoming more efficient and less about spurting out random fragments of evidence. (41-6)*

*Prior to this doctorate program I always disliked group work...finding the quickest and most efficient way to complete the task. PBL seems so different than that. We all actually spent time to teach each other. I know I learned things about myself through the feedback sessions...now I feel I can be a strong member within a group. This course has changed my view on group work. I now know how valuable it is to meet with colleagues especially in the healthcare setting. There is always something to learn even as an expert. (12-10)*

*I now realize the critical balance between sharing, active listening and facilitating, amongst other roles... I have strengthened my active listening skills and skills of facilitation... The process of PBL has reinforced and further strengthened my abilities to accept and provide concrete constructive feedback....made me more of a motivated self-directed learner...I look forward to returning to the workplace and starting a weekly review of research with my team. (17-10)*

*During the beginning of the course I fostered negative feelings towards my tutor. I realize now that [he/she] has pushed us continuously to the next level and at the time I did not feel appreciated for my personal, as well as my group's accomplishments. Our tutor brought a different... perspective to our group that raised multiple questions that we otherwise would not have considered. (13-10)*

#### *E. Theme 5: Personal and Professional Growth.*

Personal and professional growth was noted in the change in the weekly comments of the students and in their final summaries. Students discussed their emerging ability to take on different group roles, to be more (or less) outspoken, to use their communication and active listening skills to facilitate others, and to be more efficient and effective in managing information. They began to 'internalize' these skills, allowing effective group functioning without having to concentrate on group process. Individuals were proud of their own improvements and happy when they could contribute to the growth of the group or its members. The students noted that the skills they gained from the PBL course would be valuable in communicating with patients and healthcare teams, in finding information pertinent to 'best practice', and providing and responding to feedback in a clinical setting.

*I think this course taught me that you can work as a team, even though they may be people that you do not know very well. I also learned the importance of being respectful of others in a working communication setting. If you want people to listen, you also have to listen to what others have to say and interact appropriately with them. In summary, I head into the clinic as a stronger team member with new invaluable skills. (45-10)*

*This course had a huge impact on focusing my skills.... Really made me use the knowledge I have gained from the past two research courses solidifying my ability to search for high levels of evidence....I am more confident in my ability to research specific patient characteristics and justify my decisions using evidence from the research. (49-10)*

*I really enjoyed the problem based learning approach to this class. I think it helped us to become familiar with some harder case studies and researching for these patients with evidence-based practice. I also believe it helped us to learn how to work efficiently in group process... and enable us to defend our positions on the different subjects. In the future, I think that this skill will help us to defend our research and opinion when approaching doctors of medicine or other health care professionals regarding treatment and advocacy for our patients. (30-10)*

*Overall, this class was extremely beneficial to me. Going in I was very nervous and doubted the benefits of learning group process. I think this class really made a difference in my life. I learned strategies that would benefit me throughout life, not only inside the classroom. I think I took away lessons that will help me in clinical practice, as well as everyday life. I really learned lessons on how to improve communication with others as well as how to accept constructive criticism well. The feedback portion was difficult to come to terms with at first, but toward the end I really saw the benefit of delivering as well as receiving it. (19-10)*

All eight tDPT graduates who participated in member checking indicated that the themes were accurate representations of their experience in the PBL course. They did not suggest the addition or omission of any themes. Two individuals emphasized the clinical relevance of the skills gained in the PBL groups. Another would have liked more direction with providing feedback in the tutorial sessions.

#### **IV. Discussion.**

This qualitative study demonstrated that students in a discrete PBL course within a tDPT conventional curriculum valued the PBL method of learning, gained knowledge and skills relevant to future practice, and were committed to the tutorial group and improving the group process. By the end of the course, all students reported that their learning in the course had been a positive experience. Many of the skills that the students gained were those that the profession considers necessary for its members, particularly for graduates at the doctoral level. Students described improved skills in professional behavior, communication, critical inquiry, clinical decision making, reflection, and evidence-based practice. Students wrote in their reflective journals that they had learned how to access, evaluate and apply appropriate information to practice, communicate effectively with colleagues and clients, and reflect on their actions and decisions. These skills are consistent with the American Physical Therapy Association (APTA) Vision 2020 statement and the APTA document on the competencies of the tDPT graduate (American Physical Therapy Association, 2000; Brosky and Scott, 2007; American Physical Therapy Association, *Coalition for consensus*.).

An exceptional finding was that all students found the PBL course to be a positive experience, even though it was the only PBL course the students experienced in their physical therapy education. Several characteristics of the Case Study Seminar course may have contributed to this positive response and should be considered when attempting to implement a unique PBL course in a conventional curriculum. First, tutors and students were well prepared by the course coordinator's orientation sessions. The process, objectives, and outcomes for the

course were clearly outlined for students and tutors. Second, all tutors were committed to the PBL process evidenced by their repeated involvement in the course over three years. Foord-May (2006) emphasized the need for compatibility between the teaching philosophy of the faculty and the educational approach in order for PBL to be successfully implemented. Tutors attended a workshop prior to the beginning of the course and regular meetings during the course. Third, the tutors pushed the students for higher performance in increments. For example, when a student began to feel comfortable in one role, the tutor might suggest he/she try another role. Tutors might help students develop research questions early in the course, and emphasize use of levels of evidence or application of theoretical models later in the course. As the groups progressed, tutors provided less facilitation and encouraged individual and group problem solving.

While some students enjoyed all interactions with their tutor, other students critically evaluated their tutors' performance. The students who wrote critical reflections about their tutor expressed a positive outcome by the end of the course. It would appear that the friction between students and tutor was 'constructive' as described by Vermunt and Verloop (1999). These authors suggested that constructive friction between students and teachers will result in a gradual transfer of the regulation of learning from the tutor to the student group and an improvement in the group process.

Finally, both the reflective journals and the feedback structure of the course allowed the students to continually be aware of their progress. As found by Williams, MacDermid and Wessel (2003), and Cole and Wessel (2008), physical therapy students in a PBL course need confirmation of their change in behavior following the feedback they receive from their peers or tutors. The act of writing in their journals may have facilitated the students' reflection on what they learned, their ability to plan for change, and their adaptation to new situations.

The academic level of the students likely had an influence on their acceptance of PBL. Participants in our study had already completed entry-level academic and clinical education course work. Students noted how the collective clinical experience of the group members contributed to their learning and the clinical decisions about the patient case scenarios. There has been no study examining the effect of students' clinical experience on their acceptance of PBL. However, the participants in this study frequently commented on the clinical relevance of the skills gained in this PBL course.

The findings in this study have similarities to previous studies with physical therapy students. Santasier and Plack (2007) studied DPT students in a PBL course and reported themes of: critical thinking, commitment to learning, interaction skills, stress management, and professional identity. During their first experience with PBL, Canadian (Williams, MacDermid and Wessel, 2003) and Swedish (Uhlén, Johannesson and Silén, 2007) physical therapy students described changes in their approach to learning, their study strategies, and their method of finding and using information. They commented on their increased critical thinking and problem solving skills, use of theories, awareness of learning and group process, self-confidence in group interactions, and personal growth. They also addressed the difficulty and value of feedback.

Our results have some differences from those of Williams, MacDermid, and Wessel (2003) who reported more comments about aspects of the program other than the tutorial, for example, examinations and assignments. The students in their study spent more time discussing stress and time management, and the need to develop a different study/learning framework to cope with the demands of the entire PBL program. Students in our study focused on preparing for and participating in the tutorial sessions and did not expand on other course assignments in their journals. These differences could be related to the curricular structure and the stage the

students were at in their respective programs. Our study addressed one PBL course within a tDPT conventional curriculum whereas Williams and colleagues (2003) studied reactions of students commencing a fully integrated PBL physical therapy program.

The students perceived that they had developed or improved many of the skills outlined by the APTA as being desirable for the graduates of tDPT programs (American Physical Therapy Association, *Coalition for consensus*). These included abilities in communication, peer assessment, critical evaluation and application of information from studies, and use of models and evidence to guide assessment and treatment. The APTA suggests that physical therapists should have a plan for their own professional development and contribute to activities that advance practice. The students in the study reflected on the way their new skills would help them and their colleagues continue their learning in the work environment. In their tutorial groups, the students practiced 'ongoing assessment, goal setting and implementation', competencies described by the APTA for professional development of the tDPT graduate (American Physical Therapy Association, *Coalition for consensus*). Students also developed their clinical reasoning skills through their discussion of the case scenarios.

There are some limitations to this study. Not all students in the PBL course participated in the study, and therefore it is possible that non-participants may have provided different perceptions. However, the number of participants represented 73% of the male and 83% of the female in the sample class, and reflections were very similar across journals. The method of collecting data from journals has limitations. As noted previously, journal writing, itself, can affect the reflections of students. In addition, because the journal was a course requirement, some students might have written what they thought the instructors wanted to read. On the other hand, students knew their grade was based on completion of the journal rather than its content, and that the journals were anonymous. Because of the pairing of the readers, one third of the journals were read only by two investigators who may have been biased because they were tutors in the Case Study Seminar course. However, all three investigators were involved in regular, detailed discussions concerning the qualitative data analysis. Based on this analysis and member checking, we are reasonably confident that the themes are representative of these students' perceptions of PBL.

We did not evaluate the skills that the students perceived as improved nor can we predict, from their level of satisfaction with PBL, that they will demonstrate these skills in their clinical practice. For example, students felt they developed their communication, research and analysis skills, but we did not actually measure whether these had changed. Previous studies have not generally shown an advantage of PBL in terms of gaining knowledge (Albanese, 2000; Saarinen-Rahiika and Binkley, 1998; Solomon, 2005). However, it is possible that particular skills and attitudes might be better developed in a PBL format, particularly at this advanced level of education.

Based on the findings of this study, educators following conventional curricula should consider including at least one PBL course in a tDPT program. PBL is perceived by the students in this study to enhance many skills desired by physical therapists to deliver effective evidence-based patient care.

## V. Conclusions.

This study adds to the existing literature on PBL for health professional programs. A single PBL course within a conventional curriculum was well accepted by the tDPT students in this study.

Students perceived that they had gained skills in accessing and utilizing information, and giving, receiving and acting on feedback. They were aware of group dynamics and their individual contributions to the success of the group. Students appreciated the value of learning from others and noted positive changes in personal and professional growth. Students noted that the communication, critical inquiry, clinical decision-making, reflection, and evidence-based practice skills they gained in this PBL course would be very valuable in clinical practice.

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## **Book Review**

### **The Online Teaching Survival Guide: Simple and Practical Pedagogical Tips**

**Robin Morgan<sup>1</sup>**

Citation: Boettcher, J.V., & Conrad, R.M. (2010). *The Online Teaching Survival Guide: Simple and Practical Pedagogical Tips*. San Francisco, CA: Jossey-Bass. ISBN: 978-0-470-42353-0

Publisher Description: *The Online Teaching Survival Guide* offers faculty a wide array of theory-based techniques designed for online teaching and technology-enhanced courses. Written by two pioneers in distance education, this guidebook presents practical instructional strategies spread out over a four-phase timeline that covers the lifespan of a course. The book includes information on a range of topics such as course management, social presence, community building, and assessment. Based on traditional pedagogical theory, *The Online Teaching Survival Guide* integrates the latest research in cognitive processing and learning outcomes. Faculty with little knowledge of educational theory and those well versed in pedagogy will find this resource essential for developing their online teaching skills.

Increasing numbers of faculty are entering the online teaching arena. Some of these faculty members have prior experience in distance education, some have significant experience in teaching face-to-face courses, and some are new to the teaching enterprise. As a professor with many years of teaching experience who has recently moved to teaching some of my courses in an online environment, *The Online Teaching Survival Guide* offered the promise of improving my online courses.

*The Online Teaching Survival Guide* is directed primarily to those faculty members who are confronted with designing and teaching their first online class. The book is organized into three sections: Part 1 reviews basic teaching and learning concepts and principles, Part 2 is described as the “core” of the book providing practical, theory-based tips, and Part 3 focuses on the reflective process that should occur after teaching an online course. The theoretical basis of the book, that of constructivism, underlies each section of the book, including the pedagogical suggestions provided in Part 2.

Part 1 of the book provides a brief review of constructivism and such theorists as Vygotsky, Dewey, Piaget, Bruner, Brown, and Schank’s schema theory. In essence, constructivist approaches argue that students actively construct or build knowledge by interacting with their environment. Such an approach will not be new to many who have been actively involved in the scholarship of teaching and learning. However, the foundation provided in Part 1 may be extremely useful for new faculty who have not had the opportunity to read the literature on effective pedagogy. Most noteworthy in Chapter 3 of Part 1 is the list of the 10 Best Practices for Teaching Online. This list could easily be used as a checklist for ensuring that an online course has all of the elements required to meet the needs of the students.

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The authors describe Part 2 as the “core” of the book. Within these eight chapters, pedagogical tips are organized into four sections: Course Beginnings, the Early Middle, the Late Middle, and Closing Weeks. Unfortunately, I think only the newest of faculty to online teaching would find much in these chapters that goes beyond common sense. In addition, the pedagogical suggestions or tips are embedded within the text requiring a person to essentially read the entire section or chapter rather than quickly finding a helpful tip. Two gems in this part of the book are the rubric for evaluating weekly postings provided in Table 5.3 and the three part posting guide for encouraging peer dialogue on page 146. One failing of almost all of the pedagogical suggestions is that they lack the clarity that would allow another faculty member to utilize these suggestions. Almost all of these suggestions would be improved by providing details about how to implement these suggestions. Similarly, there is little to no evidence presented that would support the claim of these being pedagogically effective tips.

The last part of the book provides reflection suggestions for a faculty member who has completed teaching their first online class. The authors provide a useful list of common problem areas such as the problem of student assignments being repeatedly submitted late. Unfortunately, the suggestions – “you may decide on a policy of subtracting points for each day that an assignment is late” – may not provide new information for more experienced faculty members.

The Online Teaching Survival Guide provides a solid foundation in understanding constructivist theory and how such theories would apply to student learning. In addition, the book would be most appropriate for faculty members who have only taught in the traditional face-to-face classroom and who may be confronted with teaching an online course for the first time.

## **Mission**

Founded in 2001, the Journal of the Scholarship of Teaching and Learning (JoSoTL) is a forum for the dissemination of the Scholarship of Teaching and Learning in higher education for the community of teacher-scholars. Our peer reviewed Journal promotes SoTL investigations that are theory-based and supported by evidence. JoSoTL's objective is to publish articles that promote effective practices in teaching and learning and add to the knowledge base.

The themes of the Journal reflect the breadth of interest in the pedagogy forum. The themes of articles include:

1. Data-driven studies: formal research projects with appropriate statistical analysis, formal hypotheses and their testing, etc. These studies are either with a quantitative or qualitative emphasis and authors should indicate the appropriate domain. Acceptable articles establish a research rigor that leads to significant new understanding in pedagogy.
2. Reflective essays: integrative evaluations of other work, essays that challenge current practice and encourage experimentation, novel conclusions or perspectives derived from prior work
3. Reviews: Literature reviews illuminating new relationships and understanding, meta-analysis, analytical and integrated reviews, etc.
4. Case studies: These studies illustrate SOTL and its applications, usually generalizable to a wide and multidisciplinary audience.
5. Comments and communications: Primarily, these are comments based on previously published JoSoTL articles, but can also include book reviews, critiques and evaluations of other published results in new contexts or dimensions

## Submissions

Authors are encouraged to submit work in one of the following categories:

- **Traditional Research Reports: data driven studies with either a quantitative or qualitative emphasis**
- **Reflective Essays on SoTL**
- **Reviews of current themes in SoTL research including meta-analysis**
- **Case studies illustrating SoTL and its applications**
- **Comments and Communications on previous Journal articles, or book or software reviews**

In your e-mail with your submission, please indicate which of the above categories most applies to your submission. Despite their differences, all of these types of submissions should include the author's expression of the implications their work has for the teaching-learning process. This reflective critique is central to our mission in furthering understanding of SoTL. Authors are encouraged to review the [Guidelines for Reviewers](#) in order to understand how their submissions will be evaluated. **Authors are strongly encouraged to study the Reviewer's Rubric that reviewers shall apply in evaluating their submitted work.**

Authors should submit their article to [josotl@iupui.edu](mailto:josotl@iupui.edu). Submissions must be prepared in an electronic format using Microsoft Word on either PC or Macintosh platforms. Submissions should be uncompressed files attached to an e-mail, not in the body of an e-mail text. All submissions must be prepared following the guidelines below. While there is no formal page limit, authors should adhere to recent article lengths, typically 20 pages or less. Authors are expected to include proper referencing for their sources, especially URLs for web sites that might contain material of interest to our readership.

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## **Style Sheet for the *Journal of the Scholarship of Teaching and Learning***

**John Dewey<sup>1</sup> and Marie Curie<sup>2</sup>**

*Abstract: This paper provides the style sheet for the Journal of the Scholarship of Teaching and Learning. Manuscripts submitted for publication should adhere to these guidelines.*

*Keywords: radiation, metacognition, identity theory, constructivism, educational philosophy.*

### **I. General Guidelines for the Manuscript.**

The final manuscript should be prepared in 12-point, Times New Roman, and single-spaced. Submissions should be double-spaced. All margins should be 1 inch. The text should be fully left- and right-justified. The title (in 16 point bold) and author's name (in 12 pt. bold) should be at the top of the first page. The author's name should be followed by a footnote reference that provides the author's institutional affiliation and address. The abstract should be indented 0.5" left and right from the margins, and should be in italics.

Except the first paragraph in a section subsequent paragraphs should have a 0.5" first line indent. Use only one space after the period of a sentence (word processors automatically adjust for the additional character spacing between sentences). The keywords should be formatted identically to the abstract with one line space between the abstract and the keywords. Authors should use keywords that are helpful in the description of their articles. Common words found in the journal name or their title article are not helpful.

Pages should be unnumbered since they will be entered by the Journal editorial staff. We will also insert a header on the first page of the article, as above.

References should be incorporated in the text as authors name and date of publication (Coffin, 1993), with a reference section at the end of the manuscript (see below for the desired format for the references). Titles of articles should be included in the references in sentence case. Unless instructed otherwise in this Style Sheet, please use APA style formatting. Footnotes should incorporate material that is relevant, but not in the main text.

### **II. Section and Sub-Section Headings.**

#### *A. Major Sections.*

Major section headings should be flush-left, bold-faced, and roman-numeral numbered. Major section headings should have one-line space before and after. The first paragraph(s) of the article do not require a major heading.

#### *B. Sub-Sections.*

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Sub-section headings should also be flush-left, in italics, and alphabetically numbered. Sub-section headings should have a one-line space before and after. Sub-sub-sections should appear at the beginning of a paragraph (i.e., with an 0.5" indent, followed immediately by the text of the sub-sub-section), with the heading also in italics.

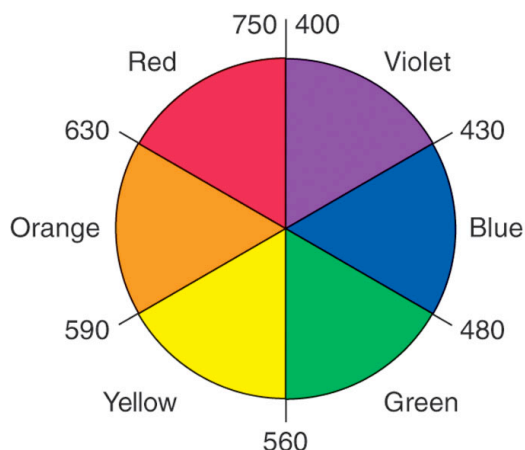
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**Figure 1. Color wheel with wavelengths indicated in millimicrons. Opposite colors are complementary.**

### **Acknowledgements**

Acknowledgements should identify grants or other financial support for this research by agency (source) and number (if appropriate). You may also acknowledge colleagues that have played a significant role in this research.

### **Appendix**

Please insert any appendices after the acknowledgments. They should be labeled as follows:

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### **References**

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