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## OUTSIDE THE LINES: EXPLORING STUDENT USE OF WEB-BASED VICARIOUS LEARNING ABOUT FINANCIAL MARKETS

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*This study considers web-based expert commentary as a mechanism for college student learning about financial markets. Social cognitive theory suggests that students may learn vicariously by observing the thought processes expressed in the writings of well chosen web-based role models and adopting similar patterns of thought over time. An exploratory study using undergraduate business school students investigated the change in measures of financial market awareness after exposure to web-based commentary. Significant learning effects were evident, particularly when exposure was augmented by structure that guided the learning experience. Although more research is required, these findings suggest the utility of web-based expert commentary for learning vicariously at the collegiate level.*

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### INTRODUCTION

Although my professorial discipline is management rather than finance, I believe that business school graduates, regardless of career path, will be more effective in their professional and personal lives if they possess working knowledge and awareness about financial markets. Grasp of environmental context is important for cognition and decision-making (Aguilar, 1967; Bazerman & Tenbrunsel, 1998; Endsley, 1995; Simon, 1960). Moreover, many organizational and personal decisions possess economic components that require financial acumen.

Although little research has investigated collegiate-level financial market knowledge and awareness directly, studies do suggest that general levels of student financial literacy are low with marginal improvement trends (Mandell, 2004; Volpe et al., 1996). Most programs designed to improve financial competence in secondary and post secondary institutions rely on classroom approaches led by academically grounded instructors (Financial Literacy & Education Commission, 2006). While conventional approaches may be useful for conveying some concepts, traditional classroom formats may be rather ineffective for developing many financial market-related skills (Siam, 2005). Instead, transferring knowledge about socially complex domains is often better achieved by immersing students in reality-based learning environments (Leonard & Swap, 2005).

My focus has been on facilitating ways to help students learn about financial markets via reality-based venues. In this article, I share an approach that, while certainly a work in progress, has generated promising results in exploratory investigations. Grounded in social cognitive theory (Bandura, 1977; 1986), the approach involves learning about markets vicariously by reading

expert commentary posted on financial market websites. It is posited that by reading the thought processes of well-chosen role models, students will adopt similar patterns of thought over time. I share results of exposing a group of students to expert commentary from a single financial website over a ten-week period. Findings suggest that students may indeed develop financial market awareness through web-based vicarious learning mechanisms. Introducing the notion of web-based vicarious learning to programs aimed at increasing reality-based skill development constitutes the primary contribution of this study.

### Background and Hypothesis Development

Effective decision-making in many organizational environments requires tacit, deep-seated intelligence grounded in social context (Leonard & Swap, 2005). Given the complex nature of markets (Peters, 2003), many financial decisions require such acumen. Successful traders, for instance, often draw from a tacit "feel" of market conditions when making buying and selling decisions (Schwager, 1989). In corporate settings, capital allocation decisions often stem from complex, difficult to describe thought processes (Brealey & Myers, 1991). When complexity of a knowledge domain is high, lecture-based training is often an ineffective knowledge transfer mechanism (Boh et al., 2001). Instead, deep-seated intelligence is often better conveyed by approaches that immerse students in the social context of the knowledge domain (Bandura, 1977, 1986).

One approach that facilitates social learning is hands-on experience. Although general economic frameworks for learning by doing have been well established (e.g., Arrow, 1962), business schools have varied widely in their use of experiential learning in programs of study

(Kolb & Kolb, 2005). Recent advances in technology have facilitated the injection of more experiential learning mechanisms into financially-oriented curricula. Computer-based market games and simulations (e.g., Ball & Holt, 1998), investment clubs (Grinder et al., 1999), and trading labs (Siam, 2005) offer learning environments more closely connected to the realities of financial markets than lecture-based approaches.

Another mechanism for knowledge transfer in a social setting is vicarious learning. Also known as observational learning or mastery modeling, vicarious learning stems from the notion that much of the intelligence gained from direct experience can be obtained by observing the behavior of others (Manz & Sims, 1981; Rosenthal & Zimmerman, 1978). Applied in a suitable context, vicarious learning mechanisms can effectively develop behavioral, social, and intellectual competences (Bandura, 1988).

Vicarious learning processes offer benefits sometimes unavailable in purely experiential instruction. When learning vicariously, observers study the behavior of experts who serve as models (Gioia & Manz, 1985). Instead of relying primarily on the direct and potentially costly consequences of their own behavior to tell them what to do, learners observe effective models in action to gain a sense of the behavior needed to produce effective outcomes (Bandura, 1977). Rather than pure mimicry, robust competence development is necessary since learners must adapt their knowledge and skills to particular contexts (Wood & Bandura, 1989). Vicarious learning processes may facilitate richer capability development in a more efficient manner than instructional venues grounded in trial and error-based experiential processes (Manz & Sims, 1981).

Effective role models must possess a master's stock of knowledge usually gained from long periods of practical experience, as well as credibility, motivation, and skill for transferring practical wisdom to novices (Gioia & Manz, 1985). In addition to knowing more about a subject than novices, experts usually exhibit superior skills in pattern recognition, frequently utilize intuition when making decisions, and possess large stores of tacit knowledge (Leonard & Swap, 2005). Prospective students must recognize and respect these qualifications to be motivated to learn from experts who possess these traits. Experts must also be willing, effective teachers. For instance, an expert instructor may need to adjust content and delivery depending on student knowledge level (Leonard & Swap, 2005). An effective expert instructor essentially provides a role model for students to emulate. Studies in professional settings suggest that

aspects of financial decision-making can be learned in this manner (Chakrabarti & Roll, 1999).

Traditionally, implementing vicarious learning programs in a university setting has been difficult due to lack of available role models. While some college faculty possess experiential knowledge and wisdom, many fall short of the industry qualifications necessary for achieving legitimacy as practical experts in the eyes of students. However, advances in information technology can help connect students to role models from remote locations. Specifically in the context of financial education, expertise for vicarious learning purposes might reside in the plethora of websites that dispense financial market advice and commentary. Individuals who provide commentary on these sites have often been involved in financial markets for many years and have accumulated large stores of knowledge. While quality of financial website commentary varies greatly and care would be required to locate credible role models, it is plausible that novices could observe the thought processes of market experts as expressed in website commentary and, over time, adopt similar patterns of thought.

Because of the time necessary to develop true expertise in many disciplines (Simon, 1987), it is unrealistic to expect college students to develop expert level knowledge and decision-making skill from relatively short periods of exposure to web-based commentary. Instead, initial exposure to web-based commentary more likely manifests in establishing core mental frameworks upon which students can build more sophisticated competence in the future. In particular, exposing novices to financial expert commentary should help develop situational awareness of financial market context. Situational awareness is a state of knowledge that precedes decision-making and performance that involves perceiving critical factors in an environment, understanding their meaning, and projecting what can happen to a system in the near future (Endsley, 1995). Accounts of expert financial decision-makers suggest that these individuals often possess acute situational awareness of markets (e.g., Lefevre, 1923; Soros, 1987; Steinhardt, 2001). Although situational awareness may be developed by various means (Bedney & Meister, 1999), permitting novices to observe experts at work in real-life conditions should advance situational knowledge development through vicarious mechanisms. Stated formally:

**Hypothesis 1:** Exposure to website expert commentary will be positively related to increases

in situational financial market awareness among college students.

One potential impediment to learning vicariously is that, because of the large proficiency gap that often exists between teacher and student, sophisticated knowledge expressed by the expert may be too advanced for learners to grasp (Leonard & Swap, 2005). As such, structure that guides the vicarious experience might help focus efforts to learn from web-based financial expert commentary. Higher quality knowledge transfer often occurs when entry-level students receive guidance as they engage in learning processes (Hickman, 1994). When learning from web-based market commentary, guidance could come from various sources. Highlighting particular commentary for novice readers, archiving seminal "learning moments" for instructional reference, and establishing interactive web-based sessions with student readers are some examples of structure that might guide novices in vicarious study. Guided study is likely to result in more knowledge transfer than what occurs when novices are provided little direction (Leonard & Swap, 2005). Therefore, it is posited that:

**Hypothesis 2:** Use of guided learning structure will be more strongly related to increases in situational financial market awareness than unguided study of website commentary.

In a university setting, instructors must be concerned with motivating students to engage in vicarious learning processes. Of course, a common incentive for motivating student behavior is to require the activity as a condition for achieving a graded level of performance. Student interest should also drive vicarious learning. Interest is an experiential state characterized by focused attention on an issue and accompanied by feelings of pleasure and concentration (Krapp & Renninger, 1992). Interest can be a powerful motivator and a key determinant in intrinsic motivation, self-determination, and learning (Steinmetz & Patten, 1967).

A more novel factor to consider in the context of learning vicariously from website commentary relates to student perceptions about the web venue itself. Since effective vicarious learning processes must capture the learner's attention, permit mental rehearsals and comparisons, and motivate subsequent use of the observed behavior (Wood & Bandura, 1989), a venue that does not engage students in the process will likely produce few gains. A student's attitude towards a website may be shaped by such factors as the venue's perceived entertainment value, informativeness, and organization (Chen & Wells, 1999).

Indeed, given the growth in Internet usage among college students and sophisticated expectations many students possess concerning on-line media, attitudes toward the website may be more important in driving engagement in web-based learning processes than conventional factors such as interest in the subject matter itself. It follows that:

**Hypothesis 3:** Favorable attitude about a financial website will be positively related to student engagement in web-based vicarious learning projects.

## METHOD AND MEASURES

### Method

A single financial website was chosen for this exploratory study. It was selected because of its focus on financial market education and because of the expert-like qualifications of the website contributors. The website is the central operation of a for-profit venture founded by a former Wall Street trader and hedge fund manager who perceived entrepreneurial opportunity in establishing a web-based platform for real-time learning about financial markets. More than two-dozen contributing writers, labeled "professors," provide website commentary while working their careers. The founder interviews all potential contributors and seeks professionals who have demonstrated career success as well as instructional capacity. A stated goal of the venture is to help readers develop thought processes that encourage financial literacy and informed decision-making. Access to most of the website is free although there is some premium content. Subscriptions at the time of the study numbered about 2500.

Website commentary is delivered through two primary venues. In one section, contributors post daily columns that address market topics, issues, and questions posed by the readership. In a second more dynamic venue, contributors post less structured commentary centered on what they are seeing, thinking, and experiencing in their market activities each day. Contributors also use this medium to answer additional questions that arise from the readership during the trading day. News flow from major financial media outlets is integrated into this venue as well. The blog-like output resembles a stream of consciousness flowing from a group of working professionals to the reader in close to real time. During a typical market day the website generates considerable reading material. A random sample of six days drawn from a recent three-month

period found an average of more than ten feature-length columns and over 100 streaming comments posted daily.

**Table 1: Guided Lessons Developed for Study**

Core Concept	Lesson Number	Lesson Topic
Website orientation	1	Intro to the website
Balanced perspective	2	Seeing all sides of the trade
	3	The financial media
Market categories	4	Various financial markets and their interrelationships
	5	Historical market snapshots
Technical analysis	6	Price levels and trends
	7	Identifying time horizons
Psychology	8	Market psychology and sentiment
Risk	9	Risk: Definition and management
	10	Tail risk and linear thinking
Structural issues	11	Money, credit, and asset prices: The liquidity effect
Fundamental analysis	12	Trading versus investing
Alternative asset classes	13	The case for gold

Conscious of the knowledge gap between expert and novice that often retards vicarious learning (Leonard & Swap, 2005), this researcher worked with website contributors to develop structure for enhancing the online learning process. After a comprehensive review of historical commentary housed in the website's archives, a list of concepts thought to reflect the core body of knowledge (BOK) collectively expressed by website content was developed. Then, using representative postings from the website archives, the researcher assembled a series of online lessons meant to introduce novice students to BOK concepts in a controlled fashion. For example, a lesson titled "Seeing Both Sides of the Trade" (i.e., seeking to understand both the buyer's and seller's viewpoint in a financial transaction) was developed to operationalize the BOK concept related to maintaining a balanced perspective when participating in financial markets. Each lesson was designed to be completed in 30-45 minutes and contained hyperlinks to seminal website postings as well as a quiz at the end of the tutorial. Therefore, when completing lessons students were still being exposed to expert commentary. However, the lessons sought to establish a facilitating tone so that students could ease into expert thought streams at a guided, controlled pace. In all, 13 online lessons covering a range of financial market topics linked to the BOK were developed (see table 1).

To gain insight into the potential value of a web-based vicarious learning approach, an exploratory study was conducted using a sample of undergraduate business school students enrolled at a regional public university. Using extra credit as incentive, volunteers were recruited from three of this researcher's classes. Two classes were sections of a junior-level core operations management course required for all undergraduate business majors.

The other class was a senior level quality management elective consisting primarily of management majors. All participants completed an initial questionnaire that included measures of financial market awareness and background demographic information.

After a brief orientation, the group was granted open access to the financial website and associated learning structure. Students were also provided a log for recording time spent on the project and number of guided lessons completed. A good faith effort towards spending at least one hour per week on the project was requested, although participants were told that they would not be penalized for putting in less time. It was felt that penalizing students for low exposure levels would tempt some participants to inflate their reported project times. At the outset of the project, it was suggested that those who considered themselves novices to financial markets should focus on the structured lessons rather than on reading website commentary directly. However, no formal requirement was established along these lines and students were free to elect the amount of guidance they wished. After a ten week period, participants submitted their timesheets and completed a second questionnaire that included measures of financial market awareness similar to the first survey as well as some attitudinal measures about the website. A total of 54 students successfully completed the study.

The demographic profile of the respondents appears in table 2. The sample was evenly split between males and females averaging 24 years of age. Participants were juniors and seniors. At the time of the study, students had taken approximately four finance and economics classes. The sample was weighted towards management majors since one of the class sections was a management elective. On average, participants reported spending

about 400 minutes on the project (about 40 minutes per week) and completing about five structured lessons.

**Table 2: Demographic Breakdown of Respondents (n = 54)**

	Mean	SDev	Min	Max
Age	24.3	5.22	20	46
Gender	0.5	0.50	1	2
Class	3.7	0.46	3	4
Econ/Fin Classes	4.0	2.37	0	15
Experience	3.4	0.87	1.9	5.0
Exposure	399.1	413.69	0	2730
Lessons	5.2	3.57	0	13
Major	Count	Percent		
Accounting	4	7.4		
Bus Admin	6	11.1		
Finance	7	13.0		
Info Systems	5	9.3		
Management	21	38.9		
Marketing	7	13.0		
Other	4	7.4		
Total	54	100.0		

## MEASURES

### Main Study Variables

**Financial Market Awareness.** Since reality-based financial learning venues are aimed at developing practical competence rather than textbook knowledge (Siam, 2005), original, practically-oriented scales for measuring situational financial market awareness were developed. These scales were developed with the assistance of contributors from the study website and other financial industry professionals. Practitioner involvement in scale development helped establish face validity of the measures. Due to their length, the full scales are omitted here but can be obtained from the author upon request.

Five scales were developed to measure financial market awareness. One scale asked respondents to rate familiarity (1 = Not Familiar At All; 5 = Very Familiar) with 16 market terms such as price-to-earnings ratio and volatility. Familiarity with terms constitutes a fundamental level of understanding upon which more sophisticated knowledge can be built (Bloom et al., 1956). Ratings for the 16 items were summed for each individual. A second scale reflected understanding of market terms. Using a multiple-choice format, respondents were asked to match market terms with definitions for 14 terms such as the Dow Jones Industrial Average and bearish market behavior. The number of correct responses was summed for each individual.

A third scale reflected understanding of current market context. Grasp of environmental context is an important element of cognition and decision-making (Aguilar, 1967; Bazerman & Tenbrunsel, 1998; Endsley, 1995; Simon, 1960). As such, an 18-item multiple choice scale assessed student understanding of contextual factors such as current price levels and trends of various financial market indicators (e.g., stock market indices, interest rates, crude oil). Correct responses were summed for each respondent. Each of the 18 context items included a "Don't Know" response choice. A count of respondent "Don't Know" selections comprised a fourth scale. The premise of this scale was that even if a student did not select the correct answer, a decrease in the number of "Don't Know" choices might reflect more cognitive awareness.

A fifth multiple choice scale required students to interpret market signals and relationships, such as the relationship between corporate bond spreads and investor concerns about a company's creditworthiness. In many ways, this was the most intellectually challenging scale since it assessed capacity for integrating concepts in a manner reflective of a higher level of knowledge in Bloom et al's (1956) taxonomy. Correct responses to the 10-item scale were summed for each respondent.

For each of the market awareness scales, respondent scores on the second questionnaire were subtracted from the score on the first questionnaire. The resulting "delta scores" captured changes in each dimension of market



awareness during the study and were employed as the primary measures of learning in the analysis.

**Exposure Time.** Students in the website group recorded the number of minutes they spent on the project each week. At the end of the ten week period, minutes were summed.

**Use of Structured Guidance.** To estimate use of the learning structure developed for the study, students were asked to record the number of lessons that they completed each week on their timesheets. At the end of the ten week period, the number of completed lessons was summed.

**Attitude Towards the Website.** A six-item scale that reflected user attitudes towards a website was adopted from Chen and Wells (1999). Representative items read "I would like to visit this website again in the future." and "Reading this website is a good way for me to spend my time" (1 = Strongly Disagree; 5 = Strongly Agree). Cronbach's alpha for this scale of .88 suggested high inter-item reliability. For each student, responses to the individual items were combined into an average score.

### Control Variables

**Age.** Since market interest and awareness might vary with age, respondents indicated their age on the questionnaire.

**Gender.** Response to market-related phenomena may depend on gender, as suggested by research on risk taking and financial decision-making (e.g., Byrnes & Miller, 1999; Chen & Volpe, 2002). Gender of each respondent

was obtained and coded as dummy variables (0 = male; 1 = female)

**Class Standing.** Class standing (1 = freshman; 4 = senior) was obtained for each respondent.

**Experience.** Deep-seated intelligence is often grounded in experience (Leonard & Swap, 2005). Measures of both academic and practical experience at the beginning of the study were employed. Participants reported the number of college level finance and economics classes they had completed or were in the process of completing. Respondents also completed an eight-item scale that reflected their practical experience with financial markets. An example item read, "I've invested money in financial markets before." (1 = Strongly Disagree; 5 = Strongly Agree). Cronbach's alpha of .77 suggested acceptable inter-item reliability. For each student, responses to the individual items were combined into an average score.

**Interest.** Interest can be a powerful motivator and a key determinant in intrinsic motivation, self-determination, and learning (Steinmetz & Patten, 1967). Interest in financial markets was measured at the end of the study using a five-item scale. A representative item read, "I have interest in how markets work" (1 = Strongly Disagree; 5 = Strongly Agree). Cronbach's alpha of .94 for this scale suggested high inter-item reliability. For each student, responses to the individual items were combined into an average score. Descriptive statistics and bivariate correlations for all study variables appear in table 3.

**Table 3: Descriptive Statistics and Bivariate Correlations of Study Variables**

	Mean	SD	1	2	3	4	5	6	7	8	9	10	11	12	13
1 Age	24.26	5.220													
2 Gender	1.50	.505	-.03												
3 Class	3.70	.461	-.07	.08											
4 Classes	3.99	2.368	-.14	-.02	.03										
5 Experience	3.44	.865	.11	**-.38	.04	-.01									
6 Website	3.86	.602	.02	-.01	.12	.07	t.24								
7 Exposure	399.06	413.7	.21	-.19	.15	-.08	**-.35	**-.39							
8 Lessons	5.22	3.570	.17	.13	.13	-.20	.21	**-.40	***.45						
9 Interest	4.01	.599	.10	-.12	.22	.10	**-.38	***.49	**-.40	t.23					
10 ΔFamiliar	13.28	10.201	*.27	*.32	.09	-.08	*.30	.18	.01	**-.38	.12				
11 ΔDefinition	.96	2.163	.16	.07	.12	t-.24	.03	.05	*.31	.12	*.29	.05			
12 ΔContext	1.93	2.027	.19	-.11	-.08	-.06	.02	.18	.20	.04	.22	.13	*.28		
13 ΔDontKnow	-4.09	3.944	-.02	*.29	-.15	.13	.04	-.20	-.01	*.33	t-.24	**-.36	-.15	***-.47	
14 ΔIntegrate	.70	1.487	-.12	.03	.03	.00	.04	-.10	.06	.06	-.14	-.07	-.12	-.18	.02

t p < .10, \* p < .05, \*\* p < .01, \*\*\* p < .001

### Results

To assess the general relationship between website exposure and development of market awareness, paired t-

tests were conducted on respondent delta scores of the five measures of market awareness (table 4). All the differences were not dramatic, all were found statistically significant. These findings suggest a general relationship

between website exposure and improvement in financial market awareness as proposed by hypothesis 1.

Table 4: Mean Comparisons of Market Awareness<sup>a</sup> (n = 54)

	Pre Exposure	Post Exposure	Diff (Post-Pre)
Familiar w Mkt Terms	37.59	50.87	***13.28
Mkt Definitions	6.83	7.80	** .96
Knows Mkt Context	3.02	4.09	***1.93
Don't Know Mkt Context	12.19	8.09	***4.09
Mkt Relationships	3.80	4.50	** .70
t p < .10, * p < .05, ** p < .01, *** p < .001			

<sup>a</sup>Paired t-tests

To evaluate the relationship between website attitudes and project engagement, two groups of regression models were estimated (see table 5 below). Model 1 employed exposure time as the dependent variable while model 2 employed number of lessons completed as the dependent variable. In both models, control variables were added first in order to show the progressive effect of adding the website attitude variable.

The beta coefficient associated with website attitude was found significant in both models. The relationship appeared stronger in model 2, suggesting perhaps that attitude towards the website plays a particularly important role in facilitating guided study. Overall, findings in table 5 support a relationship between website attitudes and project engagement as posited by hypothesis 3.

Table 5: Regression Analysis Using Measures of Website Engagement as Dependent Variable (Standardized Beta Coefficients)

Variable	Model 1a	Model 1b	Model 2a	Model 2b
Age	.153	.162	.116	.129
Gender	-.097	-.117	.219	.190
Class standing	.104	.102	.084	.082
Econ+finance class count	-.095	-.101	-.192	-.201
Market experience	.180	.154	.217	.180
Market interest	*.289	.168	.160	-.012
Attitude towards website		t.262		*.373
R <sup>2</sup>	.253	.304	.178	.282
Adjusted R <sup>2</sup>	.187	.198	.073	.173
F	*2.65	*2.87	1.70	*2.58
t p < .10, * p < .05				

DISCUSSION

While exploratory in nature, findings from this study suggest the utility of web-based expert commentary in facilitating vicarious learning about financial markets in a collegiate setting. Given the vast quantity of financial commentary available online, and the recognized need to inject more reality into university programs of study (e.g., Kolb & Kolb, 2005; Siam, 2005), the merits of this approach should be investigated further. Brokering an introduction between web-based vicarious learning and college programs aimed at improving practical skill development represents the primary contribution of this study.

Findings from this study suggest the merits of structured guidance to help close the gap between expert and novice knowledge in web-based vicarious learning environments. The structure employed here was a series

of lessons grounded in the experimental website's core body of knowledge. Future work should investigate issues related to guided-learning structure in more detail. For example, other approaches for guiding web-based vicarious learning experiences may be as or more effective than the lesson-based mechanism considered here. One idea is for an individual, perhaps the students' university instructor, to serve as a real time interpreter between the expert and student using a blog or chat room format. The interpreter would translate situations expressed by the expert in terms that would augment student sense-making processes. Such structure might offer the added benefit of involving collegiate instructors in the process, which might spill over into richer classroom experiences as well as more firmly grounding business school professors in real life contexts.

The findings and limitations of this study generate many issues for future research. Future work must



expand the nature of the sample used here in order to improve generalizability and statistical power of the findings. Because the student sample for this study was multidisciplinary and obtained in a non-finance course domain, it would be of considerable interest to replicate this study in financial classroom contexts to evaluate learning effects on students with career interests in finance. The learning efficacy of other websites should be evaluated and compared so that factors common to effective web-based vicarious learning can be determined. Exposure time should be expanded to assess learning rates and competence levels over time. Since situational awareness has been found to be an antecedent of performance in other disciplines (Bedney & Meister, 1999), future research should focus on the construct of situational financial market awareness and investigate behavioral and performance consequences of developing this awareness among college students.

Plausibly, web-based vicarious learning approaches might develop competence in other business disciplines as well. Being a management professor, I can envision the pedagogical value of web blogs or chat rooms where content is composed or moderated by practicing managers. In the future, perhaps I will be sending my students to websites where they can peer into the minds of executives on a daily basis. Exposure to commentary from practicing managers might help students of various business disciplines to build a foundation for deep-seated knowledge and skill development.

Calls for developing more practical competence in business school graduates are increasingly common (Sherwood, 2004). The socially complex nature of many business-related competences suggest that improving deep-seated skill development at the collegiate level will likely require approaches not yet explored. One novel approach, using web-based technologies to enable students to observe experts in action, has been considered here. While more research is necessary to fully develop this approach, a vicarious learning mechanism that permits students to peer into the minds of professionals could extend practical skill development in college programs of study.

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