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Managing the Curiosity Gap Does Matter: What Do We Need to Do About It?

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ABSTRACT

This paper investigates Loewenstein's Curiosity Gap Model systematically, using data from five universities in three countries and from a U.S. middle school and a high school as well. The data provide support for the model; specifically the results indicate that those with large curiosity gaps (who we assert are more prone to learned helplessness) are more likely to perform poorly in classes. Recommendations are made concerning how those using experiential exercises can attempt to narrow the curiosity gap for these students.

INTRODUCTION

At last year's ABSEL conference, Gentry et al. (2001) presented a preliminary study operationalizing Loewenstein's (1994) Curiosity Gap Model (CGM). Their operationalization extended research on the CGM by Burns and Gentry 1998; Gentry and Burns 1996, 1997; and Yakonich, Cannon, and Ternan 1997, among others. Gentry et al.'s (2001) pilot study analyzed a small sample of students, a precursor to the analysis of the much more substantial sample presented here. This more substantial sample represents three countries (Canada, China, and the US) and three levels of education (undergraduate, high school, and middle school). This paper presents a more comprehensive analysis, leading to the conclusion that concern about the magnitude of the curiosity gap is merited. Based on these empirical results, strategies for managing the student's curiosity gap are suggested.

THE CURIOSITY GAP MODEL

In the domain of education, curiosity is almost universally viewed in a positive light because it motivates students to learn. Loewenstein (1994) bases his definition of curiosity largely on the natural human need for understanding one's environment. Interestingly, humans actively seek uncertain situations in which they can solve problems, as evidenced by the popularity of puzzles and mysteries. The key, as noted by Hebb (1949), is that humans seek moderate levels of uncertainty, which are more pleasurable and less averse than either high or low levels of uncertainty.

Loewenstein's model (1994) of curiosity is based on the notion of manageable gaps in one's knowledge. Motivation tends to increase as an individual realizes that a gap exists between the current knowledge level and a desired knowledge state. Furthermore, Loewenstein (1994) notes that the key to understanding curiosity seeking "lies in recognizing that the process of satisfying curiosity is itself pleasurable" (p. 90). Thus, students should find learning fun because closing manageable gaps is pleasurable. However, the operant term is *manageable*. "To stimulate curiosity, it is necessary to make students aware of manageable gaps in their knowledge" (Loewenstein 1994, p. 94). Gaps that are too great discourage learning: Students who consider the new learning level to be unattainable will be deterred from attempting to gain the new level. Similarly, when gaps are too small, learners are apathetic to the challenge. A failure to appreciate what one does not know would constitute an absolute barrier to curiosity (Loewenstein 1994, p. 91). The enlightened individual is one who knows what he or she does not know, a cognitive trait. A curious person is motivated to close the knowledge gap, a conative trait. Loewenstein's information gap perspective implies a wonderful circularity that curiosity should be related to one's knowledge in a particular domain. The more curious one is, the more knowledge one acquires, making other information gaps more manageable and thus creating higher levels of curiosity.

OPERATIONALIZING THE "GAP"

We attempted to measure the gap in terms of two constructs: "Confidence" and "Importance." Further, these issues were measured in the context of specific issues deemed to be those that the instructor wants students to take from the course.

Confidence. "Confidence" captures the lower end of the gap, as it deals with what the student brings to the course. At the same time, it also captures some aspects of the "gap" itself, as awareness of the amount to be understood should restrict one's estimate of confidence.

Importance. On the other hand, "Importance" would seem to capture the upper end of the gap, with "greater importance" being logically associated with more "need to know." Rather than "low importance" being associated with little knowledge coming in, it might be that prior knowledge would be represented by greater variance in the importance ratings. For example, the student who sees every topic as being extremely important may have no clue as to what is relevant to his/her personal growth.

Difference Variable. A third operationalization of the "gap" is the difference in our proxy for what the student knows ("Confidence") and our proxy for what the student wants to know ("Importance"). As discussed earlier, neither operationalization deals solely with the particular end of the gap that it was intended to measure. Still, it is intuitive that the person who has high confidence in his/her knowledge and also sees the material as being somewhat important will have relatively less incentive to close that gap than someone with less confidence. On the other hand, the individual with relatively low confidence but high perceptions of importance may be prone to learned helplessness.

The context in which these constructs were measured was that of specific knowledge. The instrument required the researcher to contemplate just what was desired in terms of what the student was to take away from the course. Twenty concepts were incorporated into "Confidence" and "Importance" contexts. For example, one item in a Consumer Behavior class was "How confident are you that you understand the relationship between one's social class and one's price consciousness?" whereas the item dealing with the upper end of the gap was "How important to you is it that you understand the relationship between one's social class and one's price consciousness?"

Dependent Variables. One obvious problem with a diverse sample of classes is that an extremely wide variety of measures is used to evaluate student performance. The most common was overall grade. We view this as a stringent criterion in that a great deal can happen between the measurement of the individual's curiosity at the beginning of the semester and the final determination of the student's course grade. Clearly class dynamics can play a huge role in the motivation of the student during the intervening three or four months. Thus, we also chose to use the grades on the first exams in the classes and on the first non-exam assignment as dependent variables as well.

SAMPLE

Data were collected in a variety of classes across the United States, as well as at universities in Canada and the People's Republic of China. The university samples were all undergraduate classes, whereas data were also collected among ninth grade science classes at a high school and among seventh grade English classes at a middle school.

DATA COLLECTION IN FALL OF 2000

University of Nebraska	n=16
University of Nebraska	n=17
University of Nebraska	n=38
Louisiana State University	n=18
Brock University	n=23
Jilin University	n=53
Louisiana Tech University	n=45
Lincoln East HS	n=74
Scott Middle School	n=113
Total	N=397

RESULTS

Relationships between Performance and the "Difference" Gap Measure. The primary operationalization of the curiosity gap was the difference between the Importance and Confidence ratings. No relationship was found between this measure of the gap and the performance on the first exam or on the first assignment. However, for the total class grade, a relationship (chi-square (1 df) = 3.77, $p < .06$) was found when those with a large curiosity gap were compared to those with moderate and small gaps. Those with large curiosity gaps were much more likely to be low performers (as can be seen in Table 1) than those with small or moderate curiosity gaps. [The sample sizes for the first exam and the first assignment are smaller because some instructors did not provide that level of detail.]

Relationships between Confidence and Performance. The pattern of results (see Table 2) for the total class grade, the first test, and the first assignment were as expected by the CGM. In each case, the majority of the moderately confident group were high performers (55%, 56%, and 53%, respectively) whereas the majority of the low and high confidence groups were low performers in most instances. For the first assignment, the chi square statistic (6.54, $p < .05$) is significant, with those moderately confident more likely to be high

TABLE ONE
CROSS-TABULATIONS OF DIFFERENCE SCORE AND PERFORMANCE

Performance Construct	Difference Score Level	Low	Moderate	High	Low/mod	High	ChiSquare
First Test	Low	38	40	39			
	High	44	44	44			
First Assgnmt	Low	31	33	40			
	High	40	38	34			
Overall Grade	Low	61	60	76	121	76	3.77
	High	63	67	52	130	52	p<.06

performers while those with high and low confidence being more likely to be low performers. The results for the first exam are interesting in that the majority of those in both the low and moderate confidence groups were high performers, while the majority of those initially very confident were low performers. Apparently, this high level of confidence was not an incentive to study very hard for the first exam. However, by the end of the semester, those initially high in confidence were just as likely to be high performers as those with moderate confidence, whereas those with low confidence were more likely to be low performers.

TABLE TWO
CROSS-TABULATIONS OF CONFIDENCE AND PERFORMANCE

Performance Construct	Confidence Level Level	Low	Moderate	High			
					Low/Mod	High	ChiSquare
First	Low	36	35	45	71	45	1.92
Test	High	37	44	35	81	35	p<.20
					ChiSquare		
First	Low	65	43	65	6.54		
Assgnmt	High	43	56	49	p<.05		
					Low	Mod/High	ChiSquare
Overall	Low	72	59	69	72	128	2.97
Grade	High	52	67	68	52	137	p<.10

Relationships between Importance and Performance. The patterns of results (see Table 3) are consistent with that theorized by the CGM. In each case, the majority of those rating the course topics as moderately important were high performers in the class (55%, 62%, 59%). For the total grade, the results are significant (chi-square (2df)=7.6, p<.05). Those seeing the material as being more important were more likely to be low performers on the first exam (chi-square (1 df)=2.95, p<.10). One explanation might be that the higher perceived importance results in greater anxiety.

Relationships between the Variance in Importance Ratings and Performance. As noted earlier, those possibly "clueless" about the course's content might well rate all content as being very important; thus those with limited variation in the importance ratings might be expected to perform less well. For the first assignment (see Table 4), this pattern of results occurred. For both the first test and the first assignment, the majority of those with moderate variation in their importance ratings were more likely to be high performers. That no relationship was found with the total class grade may indicate that the "cluelessness" originally demonstrated may disappear over time.

TABLE THREE
CROSS-TABULATIONS OF IMPORTANCE AND PERFORMANCE

Performance Construct	Importance Level Level	Low	Moderate	High			
					Low/Mod	High	ChiSquare
First	Low	41	43	52	84	52	2.95
Test	High	47	55	41	92	41	p<.10
First	Low	34	34	44			
Assgnmt	High	41	56	48			
					ChiSquare		
Overall	Low	72	51	71	7.58		
Grade	High	54	72	56	p<.05		

TABLE FOUR
CROSS-TABULATIONS OF STD. DEV. OF IMPORTANCE AND PERFORMANCE

Performance	Std. Dev. of Importance Level				
Construct	Level	Low	Moderate	High	ChiSquare
First	Low	49	29	42	7.71
Test	High	50	50	33	$p<.05$
First	Low	48	19	35	12.3
Assgnmt	High	35	45	32	$p<.005$
Overall	Low	74	74	66	
Grade	High	55	52	63	

WHAT TO DO

Our results indicate that there is strong need to be concerned about those students who have large gaps between what they know and what they want to know. It is somewhat surprising that a pencil and paper instrument administered early in the semester on issues largely unknown to the students could predict low overall class performance for students with large gaps. Clearly these students do not merely display false modesty about what they know and exceptionally high levels of interest in the course material. Our results suggest that students with very little curiosity, the underachievers, need not be the primary focus of educators. They will perform nearly as well as those with manageable gaps, although they may do more poorly on the first exam. But those with very large gaps, who are more prone to learned helplessness, consistently underperform.

This finding is especially disconcerting for those who use experiential exercises, as these pedagogies often serve, in the short run at least, to increase the curiosity gap. What one knows is of less relevance in the simulation framework and the value of what can be learned from the experience is more fuzzy. Golden, Burns, and Gentry (1984), in a study involving the communication barriers associated with a wide variety of pedagogies, found that simulation games and other forms of experiential exercises are seen as threatening by students accustomed to lecture-style classes. While those in ABSEL may tend to be overly positive about the benefits of hands-on learning, it is important to note that many out there, including many of our students, may be intimidated by experiential learning.

Following is a discussion of strategies for managing the curiosity gap, focusing on moving the two extremes to the middle. The basic issues are familiar to experiential pedagogues. Here, though, strategies are derived from the theoretically-based and empirically-supported framework of the CGM.

Raising the Lower End of the Gap. As noted earlier, all students can be expected to encounter reduction in what one knows as the experiential exercise (for ease of presentation and visualization, we will use the context of a simulation game to represent the larger domain of experiential exercises from here on) presents new frameworks that must be learned. The simulated world and the real will have limited overlap and, to the extent that the student has a representation of the real world fixed in memory, deviation from the real world may cause high levels of frustration (Gentry and Brown 1973). Before the student can learn what is intended to be learned, s/he must first learn the game's rules. This barrier is a material one. From their own perspective, educators might consider the sometimes prohibitive learning curve and other start-up costs of adopting a new simulation game.

Nevertheless, there are standard procedures that are useful in moving the lower end of the gap in the desired direction. While the students will have a well-written player's manual that they have all read carefully, lectures on the key aspects of the game still serve to crystallize their perceptions of the simulated world. Further, a quiz over the game prior to the start of play does increase greatly the likelihood that they will read the manual. Finally, the often recommended trial run of period one (a "just for fun" decision) provides students with experience in the decision making process without having to dig their way out of a hole created by possible unpreparedness to play the game. The overriding message here is to make certain that students are prepared to begin game play. Some will read the manual and get it; others will be clueless. The results of this study suggest that alienating the former group is of modest consequence compared to enhancing the latter group.

Lowering the High End of the Gap. While it is not clear where students are starting from, even more vague is what they want to obtain. As instructors, we have a goal in terms of their learning, though most of us would have some difficulty in articulating that to an educated third party. Lecturing has the advantage of allowing the instructor the perception that a set amount of material will be learned; in reality, a set amount is taught and who knows what is learned. When using a simulation game, there is more ambiguity as to what is being taught, as well as much ambiguity as to what is being learned. The most common advice concerning the use of any experiential exercise is to debrief students very systematically after the exercise is over. Hopefully, debriefing will help the students crystallize what they have learned. Some at ABSEL have suggested that debriefing should also be done midstream during the game play. We support that recommendation strongly, as we believe there is need for directional guidance during a fairly free-form learning experience.

A second issue deals with the exercise's reward structure. How much weight should be placed on an exercise is a much-discussed but little-settled issue. Clearly, though, some grade weight needs to be assigned to the exercise in order to get the students' attention. The basis for the grade is also a bone of contention. There are those who argue that game performance represents learning, just as there are many who argue that, in many cases, it is the student who digs himself/herself out of a hole (though very rarely all the way to the top of the competition) who learns the most in the experience. At the first ABSEL conference, Ralph Day made the observation that simulation games are the only approach that makes students live with their decisions. A student can do a poor job on one case, and then start over fresh on the next one. A poor simulation decision leaves the student facing an extremely different (and more difficult) set of conditions. The learning experience across students in the context of a simulation game is not controlled nor is it at all constant. Good first decisions may be the result of good planning, but they can also have random elements as well as carryover (from previous classes) effects. For instance, Smead (1979) noted that the selection of a nearly optimal component mix for the soft drink in the Day and Ness *Marketing in Action* game put students in a commanding position that few would relinquish. Students with poor early decisions may not have a chance to win the game, yet turning the firm around may be a wonderful learning experience.

The question becomes "How should we reward students for game play?" Business focuses on the "bottom line," so those who support performance as the proper criterion have a real-world analog to rely on. However, using simulation games in class is not done to instill competitiveness (our culture already has more than its share of that), but rather as a vehicle for learning. The bottom-line orientation may provide strong disincentive to learn among those getting off to a rocky start. Or, in terms of the curiosity gap model, the upper level may change such that the gap is not manageable.

Dickinson (2001a, 2001b) and Thavikulwat (2001) have provided much thought as to alternative reward systems, including methods based on period-to-period change. Dickinson's work has been empirically based using data based on hypothetical simulation play in a game with a bottom-line reward system. Had a learning-oriented reward system actually been used, very different performances might have been observed. The logic of the curiosity gap model argues for such a learning-based reward system.

More work is needed to interface between reward systems and the size of the curiosity gap. Anecdotal evidence certainly supports the existence of a relationship. Dick Teach years ago discussed a reward system in which only the losing team each week had to contribute to a pot that went for a keg of beer at the end of the semester. Students played in such a way as to avoid losing, rather than attempting to win. Performance levels differed greatly when Dick succumbed to political correctness and dropped the end of the semester keg party.

SUMMARY

This paper completes the story that was presented partially at last year's conference. We report a more systematic analysis of the data obtained from a broad-scale study, and then discuss approaches that we recommend to reduce the magnitude of the curiosity gap, a goal which our results indicate will help improve student performance.

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