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# STIMULATING CURIOSITY TO ENHANCE LEARNING

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***Abstract:***
*Curiosity is an aspect of intrinsic motivation that has great potential to enhance student learning. Theory and evidence describing curiosity are discussed, focusing on psychological and pedagogical literature relating to adult education. In particular, the concept of 'information gaps' as a source of academic curiosity is explored. In addition, the concept of curiosity in two disparate sample disciplines; second language learning and medical education are considered. The role of inquiry based learning approaches are also discussed as potential modes of stimulating student curiosity, as well as simple classroom techniques, which could be applied to almost any academic discipline and based on the theories should act to enhance student curiosity.*

***Keywords:*** *Curiosity, motivation, information gap, exploration*

In his influential book "The World is Flat", Thomas Friedman has postulated that, in regard to educational achievement, curiosity combined with motivation to learn are more important than intelligence [1]. Furthermore, his suggestions have generated great interest among educators [2]. However, emphasizing curiosity in educational achievement is not as recent as it may appear. There is a long but erratic history of the study of the role of curiosity in learning and education. Due to its behavioral and mental nature, the concept of curiosity has received the most attention from psychologists, particularly educational psychologists. In addition to the corpus of psychological theory and data, there is therefore also a partially overlapping corpus of pedagogical research.

## Curiosity and Psychology

To understand the relationship of curiosity to learning and education it is useful to examine the various approaches to the topic that have come from the field of psychology, for it is this theoretical background that has generally provided the foundations for the pedagogy. As previously noted, Friedman's emphasis of curiosity as being of primary importance in learning is not as new as may be assumed. The philosopher and early psychologist William James was discussing similar topics, including 'scientific curiosity' in the late nineteenth century [3]. Later in the early twentieth century the eminent child psychologist Jean Piaget was emphasizing the importance of curiosity in childhood cognitive development. He used various terms to refer to curiosity and exploratory behavior, linking them particularly to the process of assimilation, which along with accommodation refer to the two ways in which children adapt or learn about the world [4].

In addition, the Russian psychologist Lev Vygotsky has emphasized the role that adults play in encouraging exploratory behavior of children [5]. Vygotsky suggested that children's cognitive abilities are not set, but exist on a continuum from independent performance to that which is possible in collaboration with adults. Thus cognitive abilities can be extended through exploration and stimulation of childhood curiosity [6]. The influence of both Vygotsky and Piaget has been huge in the field of child psychology and applied aspects in education. However, their theories exist primarily to explain development of cognitive processes in the early years of life, it is of less use in understanding adult curiosity for academic information, such as may be evoked by university study. Nevertheless, it is of interest to note the importance of curiosity and exploration as topics of investigation by two of the great names in the history of psychology.

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Despite this early acknowledgment of the importance of curiosity in human behavior, research into the topic has been slow to develop. The main reason for this was the predominant theme that developed across Western psychology, including educational psychology, in the early to mid twentieth century - behaviorism. This psychological paradigm attempted to explain all human behavior comparatively to principles of learning in non-human animals, in particular rats and pigeons [7]. This was based strictly on observations of behavior with no need for mental terminology such as 'thinking' or 'curiosity'. Nevertheless, behaviorist principles where frequently applied to educational settings [8]. However, this was limited to the science and technology of behaviorism, such as devices to automatically test learners, and reward them in ways thought to enhance learning. The idea of considering the inner mental experiences of the learner, such as their motivation to learn or their curiosity, was thus neglected.

The concept of motivation did exist within such behaviorist models of learning. It was thought that motivation enhanced learning; however, this was strictly linked to biological drives, such as hunger and thirst. Indeed, it was argued that for learning to take place an organism must be motivated by being in a state of deprivation, such as being hungry or thirsty [9]. It can therefore be seen why such ephemeral ideas of learner curiosity were not compatible with theories of learning that concentrated on universal and biological features of the learning process. The behaviorist approach relied on dogmatic theory, supported by information that could be discovered by the observation of the behavior of rats or pigeons. It is an irony therefore, that it was in fact observed animal behavior which was one of the reasons that behaviorist approaches were generally abandoned, in order to allow for psychologically based interpretations of human behavior and learning.

It is a fact, for example, that people (and other animals) are motivated to acquire information, something that cannot be directly linked to a primary drive such as thirst. This type of behavior is demonstrated by a wide range of species. For example, rats will 'patrol' their usual environment, even if they are very familiar with it and they will repeatedly explore areas that have not been associated with finding food etc, so cannot have been learnt [10]. Such behavior is a problem for behaviorist explanations of learning and motivation.

Terms such as 'exploratory behavior' retain the scientific air, when talking about non-human behavior, however within psychology, it is common to link such behavior, when it involves people, to personality traits. Indeed, it can be argued that 'novelty seeking' is the equivalent in humans of exploratory behavior in other animals, and hence what we may consider human curiosity [11].Attempts have been made to classify curiosity as an individual difference feature, which can be considered as either a trait (i.e. individuals have a set level which is more or less the same across situations) or as a state feature (which varies by situation) [12]. However, one can question the usefulness of considering curiosity as both a trait and state. Indeed, it has been argued that there is no such thing as curiosity as a stable personality trait that is equal across contexts [13]. Furthermore, focusing on individual differences may be of academic interest, but in applied situations such as teaching, it would be more useful to understand the ways in which curiosity is stimulated in order to enhance the probability of meaningful learning occurring.

Therefore, cognitive approaches are more informative to applied contexts as they can take into account how individuals construct their individual realities [14]. Such cognitive-constructivist approaches consider the knowledge base of the individual, and have been growing in popularity in recent years. Today, the leading psychological approach to curiosity is based on such premises. However, this approach is not actually very modern at all, as a body of research in this vein was performed in the 1950s and 1960s by the psychologist Daniel Berlyne [15, 16]. He made a theoretical distinction between *'perceptual curiosity'*, involved when a stimulus has some property such as novelty and attracts attention, and *'epistemic curiosity'*. The latter is a term used only for human behavior, and describes a desire for knowledge, which Berlyne described as "*why certain pieces of knowledge are more ardently sought and more readily retained than others"* [15]. Clearly, epistemic curiosity has a particular relevance to learning in an academic setting.

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More recently, Loewenstein (1994) has elaborated on the concept of epistemic curiosity, as proposed by Berlyne, and attempted to define when it occurs. He has theorized that 'information gaps' in an individual's knowledge of a topic are of central importance. A prime example in the classroom would be when a student knows the basic structure of a theory or concept, but lacks specific details. Loewenstein's theory suggests that the student would then be curious about the missing information and be motivated to fill the information gaps [17]. This theory is based on a long standing principle from Gestalt psychology. The principle of closure suggests that there is a motivation to complete items that lack a part [18]. Although traditionally associated with the psychology of perception and illusions, it merges well with the information gap theory of curiosity.

It is further hypothesized that curiosity about a topic will not be invoked when either there are no information gaps identified or if the individual feels that they already know the information. In addition, it is suggested that curiosity becomes stronger, the closer the individual feels that they are to achieving the knowledge, and that there is a pleasant feeling of satisfaction when information gaps are resolved. In support of this theory Lowenstein has analyzed many features of human behavior that on the surface seem counter-productive. For instance, he discusses the interest that many people have in completing puzzles such as crosswords, or why soap operas end on cliff-hangers. According to the theory, the information gaps that people are exposed to act to motivate them to obtain the missing information, either by persevering to complete the puzzle or tuning in to watch the next episode of the soap opera.

Interesting as these arguments may be, they remain anecdotal. However, Loewenstein et al have specifically tested the theory experimentally. In particular, they have provided a demonstration of the 'closeness to knowledge' aspect, which suggests that as people come close to closing gaps in their information, they become increasing curious about it. To examine this, they asked research participants to say words that corresponded to definitions he gave them. In some cases people were relatively confident that they knew the words, in which case they indicated that they did not particularly want to be told the correct answer. Therefore, when they did not think they had knowledge gaps, they were not curious. More interestingly, on some definitions, participants claimed to have the word 'on the tip of their tongues', the feeling of almost, but not quite, knowing. As Loewenstein's theory predicted, in this state they became very curious to discover the word (cited in [17]).

**Curiosity and Pedagogy**

It is almost axiomatic to suggest that curiosity generally enhances academic learning. Indeed two authors have gone as far as to state "*That we take curiosity to be instrumental to and even essential for education, inquiry and knowledge is confirmed by the fact that teachers often prefer techniques of instruction that excite curiosity…Stimulating curiosity is central to education and learning"* [19]. As we have seen, from psychology there have been various approaches to the study of motivated behaviors such as curiosity.

Much of the specifically educational research has historically been associated with curiosity as a psychometric property, and almost always from a developmental perspective, focusing on school age children [12, 13, 20]. Interestingly, it has emerged from this body of research that curiosity as measured as a trait is closely linked to intelligence [13]. Furthermore, despite Friedman's assertion given at the opening of this article, that curiosity is more important than intelligence, the studies of school children suggest that actually IQ is more important in predicting grades [20]. Unfortunately, it appears that there are no similar studies to provide evidence for this relationship in adult learners.

Nevertheless, the focus on curiosity as a trait is currently less popular than cognitive-constructivist approaches such as Lowenstein's information gap theory. To allow testing of this theory in classroom settings, the concept of the information gap proposed by Lowenstein has been further operationalized. It has been suggested that measurements of students' confidence in what they already know about a topic is one important aspect. In addition, how important learning about

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the topic is to the individual is equally important. In fact, these two features define respectively, the lower and upper boundaries of an information gap in academic contexts [21]. By examining the difference in these two aspects, it is argued that students' information gaps can be estimated. Gentry et al supplied data on this operationalized 'information gap' from samples of students from universities, colleges and high schools in the USA, Canada and China. They confirmed that students with large information gaps tended to perform badly on both coursework and final course assessments, a consequence the authors link to low student curiosity about the course material. This makes sense within the information gap theory as it proposes that when individuals are close to resolving the information gap, to achieving closure, their curiosity will be high. When gaps are large, curiosity will be low.

Though preceding the formation of the information gap theory, an older study sheds further light on the role of the perceived value of information. In the context of university continuing education courses, the investigators probed the role of surprise induced curiosity and motivation to learn more about particular topics (epistemic curiosity). They found that the perceived value of the information was the most important aspect underlying curiosity to learn more [22]. This corresponds to the 'upper part' of the information gap as operationalized by Gentry et al.

A more recent test of the information gap theory, and in particular the closeness to closure aspect further supports the theory. A group of university students were given a set of general knowledge questions to answer and several questionnaires related to curiosity and feelings of tension and deprivation. General knowledge questions which the students could not answer, but had a feeling of knowing, were associated with feelings of tension and the most curiosity to find out the answers [23]. Such observations suggest that the way that information is presented can influence curiosity in individuals and has therefore an application to education and training. Indeed, a direct link between curiosity and learning was provided in a study by Berlyne over 50 years ago. He showed that answers to questions that were initially rated as more puzzling by research participants were better recalled later on [15].

Such observations suggest that curiosity may increase learning by motivating individuals to think more about the material being presented, and has obvious links to theories that propose distinctions between 'deep' and 'surface' learning [24] and psychological approaches that suggest 'deep' processing of information results in enhanced learning [25]. By presenting gaps in knowledge to students, they will, according to the information gap theory, become motivated to find the answers and will have to actively inquire into the subject in order to resolve their curiosity. Such theories, though from academic research, merge well with current philosophical, curricular and pedagogical approaches to teaching and learning based on student inquiry. These include a range of linked approaches to education and learning, which are presented with titles such as 'open inquiry learning' or 'inquiry based leaning' [26].These various educational approaches place emphasis on students identifying their own questions and investigation methods. Considering the findings and theories on human curiosity described above, it can be seen how such educational methodologies could act to increase student learning. The role of curiosity as a motivating factor is probably a key component of the success of inquiry based learning, and there is evidence that it is a driving force of dynamic inquiry in student learning [27].

**Practical Applications: Example of Second Language Teaching**

The concept of using information gaps to drive curiosity and enhance learning is found throughout second language teaching. In its most basic form it can be seen in 'gap fill tasks', which are almost ubiquitous in the field. Here, text is given with certain words replaced with a gap. There is generally sufficient information to allow the gist of the text to be gleaned, but the detail is missing and must be provided by the learner. Other approaches specifically create more elaborate information gaps in order to motivate students, indeed there is a group of tasks used in language teaching know as 'information gap' tasks which are thought to be particularly good at generating student interest [28]. An example of one such task would be for one member of a pair of students to

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verbally describe an image that the other cannot see. This is particularly linkable to Lowenstein's information gaps theory, as the gap in the students' knowledge will gradually become smaller as more information is transmitted in the target language, such that curiosity about the remaining information would be predicted to increase. This would explain the tasks popularity with students.

In recent years more complex teaching methods have been adapted for use within second language teaching that involve evoking student curiosity. The two primary forms are task based learning (TBL) and Problem Based Learning (PBL). Although TBL and PBL are applied in a range of subject areas, they have become particularly popular in second language instruction. TBL emphasizes the use of communicative tasks as an aid to language learning. Learners are presented with situations in which they must communicate in order to achieve a task, for example, role-playing a telephone conversation, or giving and receiving directions. A key feature of TBL is the recognition that the desire to communicate motivates the student to use the language, and it is this motivation which enhances learning. Willis (1990) goes further and argues that "*We must catch their interest in some way, or present them with a challenge they feel motivated to meet*" (p1). In other words, we must harness their natural curiosity in order to motivate them to communicate [29].

PBL takes the idea of TBL a step further. Here, learners are given a problem to solve, based on a real world difficulty. Typically, the problem will have a number of potential solutions. Learners are required to use the target language in order to research the issue and develop their response. The language use is closely related to the learner's knowledge base, and the development of problem solving strategies is part of the overall learning aim [30]. Thus in TBL, we can see how the principles thought to underpin curiosity are employed to enhance learning.

The main difference between the two approaches is that in PBL a real world problem is typically used, and it may be that no final solution is available. As such, learners are allowed to take their investigation in any relevant direction. In TBL the problem is more restricted and the path to the solution more directed. The solution is generally known to the teacher, and the situation may only be a simulation of a real world problem. However, in both cases the learners' motivation to use the new language is provided by piquing their curiosity by providing them with a challenge that needs to be solved.

**Practical Applications: Example of Medical Education**

It has been noted that medical trainees are essentially tested on their knowledge and skills base, but that this is inevitably incomplete at the point that they are qualified, there is thus a need for medical education to maintain curiosity, to drive lifelong learning [31]. Nevertheless, medical educators often fail to achieve this and face situations in which students are generally unmotivated and seem to want to only learn that which is necessary to gain qualifications [32]. A similar situation is observed in nurse training, in which there is a need to instill curiosity as means to promote life-long learning [33].

In the past at many medical training centers much emphasis was placed on rote learning of facts, which were then tested, for example via multiple choice tests. Although less frequently employed in medical education these days, such methods are still used, at least occasionally. This problem exists despite the nature of medicine being to a large part that of problem solving, and thus with much potential for mysteries to invoke curiosity and for 'deep' learning. There is therefore much scope for applying principles to intrinsically motivate students. One commentator, describing the traditional methods, went as far as to suggest that lectures in medical schools would be better presented as sequences of 'brain teasers', which the students must solve [34].

The idea of presenting medical information as puzzles is appealing, as it mirrors some of the issues that medical professionals may face in their professional lives. In addition it is in accordance with approaches to generating intrinsic motivation such as the information gap theory of curiosity. Indeed this approach underlies the concept of PBL which was described above in the context of language teaching but has also become popular in medical education. In this student centered teaching approach, realistic clinical problems are presented. A related procedure is Case Based

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Learning (CBL), which has many similarities to PBL but in which more advance preparation is encouraged and also the teacher takes a more active role, preventing students from dwelling on tangential issues. Medical students and trainers have been found in one study to overwhelmingly prefer CBL over PBL structured workshops [35]. Furthermore, PBL is associated with both improved clinical decision making and motivation [36] as compared to traditional teaching methods. Both PBL and CBL can be seen as forms of enquiry based learning [26]. It is likely that their success is due in part to their ability to motivate students, motivation that is consistent with the elicitation of curiosity to solve the problem [27], and with the principles described above in the psychology of curiosity.

**Practical Applications: Possibilities in Other Subjects**

The concepts for stimulating curiosity that have been described in terms of second language and medical teaching could potentially be applied to a range of other disciplines and contexts. According to the theory which has been focused on, the information gap theory of Lowenstein (1994), there are multiple general strategies that could be employed in general education contexts.

One point is that gaps in knowledge need to be identified to students. As described above such practices are central to enquiry based learning approaches and should be effective in stimulating curiosity. Other than this, simpler methods that can be applied in almost any higher or further educational context would involve withholding information and allowing students to then obtain it. This could be as simple as assembling questions and answers into cross-word puzzles [37].

A further point is that information gaps, i.e. what the students do not know relative to what they could know, need to be manageable. The psychological research suggests that when the gap is relatively small, curiosity is maximized. The consequence of this is that there is no point presenting problems that very difficult or involve large amounts of new learning. To ensure the gaps are not too large, it may be necessary to regularly assess the students' current understanding. This can potentially be done at the beginning of each teaching session such that the teacher can closely monitor the students' information gaps [38].

Providing regular feedback is also likely to stimulate curiosity. This is because it allows students to identify gaps in their knowledge. It is a general feature of human psychology that people think they know more about a topic than they actually do. Thus, there is a danger that students fail to become curious about material because they are ignorant about their own ignorance of it. Asking individuals to guess information and providing feedback has been shown to significantly increase curiosity for the unknown material [17].

**Conclusions**

Findings from the psychology of curiosity can be profitably employed to guide teaching practice, in a range of education contexts, to motivate students to seek information. In particular, inquiry based learning approaches such as problem based learning appear to be consistent with theories and evidence regarding the effective stimulation of students' curiosity. Even without switching paradigms, simple techniques such as providing regular feedback and assessments of students' current state of knowledge may aid teachers in enhancing learning via increased curiosity.

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**References**


1. Friedman TL. The World is flat: A brief history of the 21st century. New York: Farrar Straus Giroux; 2007.
2. Pink D. Tom Friedman on education in the 'flat world'. The School Administrator. 2008;65(2):4-8.
3. James W. The Principles of psychology. New York: Dover; 1890.
4. Gorlitz D. Exploration and attribution. In: Gorlitz D, Wohlwill JF, editors. Curiosity, imagination, and play: on the development of spontaneous cognitive and motivational processes. Mahwah, NJ: Lawrence Erlbaum Associates; 1987.
5. Henderson BB. Social support and exploration. Child Development. 1984;55:1246-51.
6. Vygotsky LS. Mind in Society. Cambridge, MA. : Harvard University Press; 1978.
7. Skinner BF. The behavior of organisms: an experimental analysis. New York: Appleton-Century-Crofts; 1938.
8. Skinner BF. The technology of teaching. New York: Appleton-Century-Crofts; 1968.
9. Hull C. Principles of behavior. New York: Apple-Century-Crofts; 1943.
10. Birke LIA, Archer J. Some issues and problems in the study of animal exploration. Exploration in animals and humans. Wokingham: Van Nostrand Reinhold (UK); 1983. p. 1-21.
11. Cloninger CR, Svrakic DM, Przybeck TR. A psychobiological model of temperament and character. Archives of General Psychiatry. 1993;50:975-90.
12. Naylor FD. A state-trait curiosity inventory. Australian Psychologist. 1981;16:172-83.
13. Coie JD. An evaluation of the cross situational stability of children's curiosity. Journal of Personality. 1974;42:93-116.
14. Neisser U. Cognition and reality: Principles and implications of cognitive psychology. New York: W H Freeman & Co; 1976.
15. Berlyne DE. A theory of human curiosity. British Journal of Psychology. 1954;45:180-91.
16. Berlyne DE. Conclift, arousal and curiosity. London: McGraw-Hill; 1960.
17. Loewenstein G. The psychology of curiosity: a review and reinterpretation. Psychological Bulletin. 1994;116(1):75-98.
18. Koffka K. Principles of gestalt psychology. New York: Harcourt-Brace; 1935.
19. Schmitt FF, Lahroodi R. The epistemic value of curiosity. Educational Theory. 2008;8:125-48.
20. Day HY. The role of specific curiosity in school acheivment. Journal of Educational Psychology. 1968;59:37-43.
21. Gentry JW, Burns AC, Dickinson JR, Putrevu S, Chu S, Hongyan Y, et al. Managing the curiosity gap does matter: What do we need to do about it? Developments in Business Simulation and Experiential Learning. 2002;26:67-73.
22. Rossing BE, Long HB. Contributions of curiosity and relevance to adult learning motivation. Adult Education Quarterly. 1981;32:25-36.
23. Litman JA, Hutchins TL, Russon RK. Epistemic curiosity, feeling-of-knowing, and exploratory behaviour. Cognition and Emotion. 2005;19.
24. Marton F, Saljo R. On qualitative differences in learning I. Outcome and process. British Journal of Educational Psychology. 1976;46:4-11.
25. Craik F, Lockhart R. Levels of processing: A framework for memory research. Journal of Verbal Learning and Verbal Behavior. 1972;11:671-84.
26. Brew A. Teaching and Research: New relationships and their implications for inquiry-based teaching and learning in higher education. Higher Education Research & Development. 2003;22:3-18.
27. Zion M, Sadeh I. Curiosity and open inquiry learning. Journal of Biological Education. 2007;41:162-8.

ISSN 1512-1801

28. Ur P. A course in language teaching: theory and practice. Cambridge, UK: Cambridge University Press; 1996.
29. Willis D. The lexical syIlabus: A new approach to language teaching. London: Collins E.L.T.; 1990.
30. Stover D. Problem-Based Learning: Redefining self-directed instruction and learning. The Forum: Sharing Information on Learning and Teaching. 1998;7:9-10.
31. Richardson P. Clinical competence and curiosity. British Medical Journal. 1986;292:1481-2.
32. Mann KV. Motivation in medical education: How theory can inform our practice. Academic Medicine. 1999;74:237-9.
33. Kedge S, Appleby B. Promoting curiosity through the enhancement of competence. British Journal of Nursing. 2010;19:584-7.
34. Strayhorn J. Aspects of motivation in preclinical medical training: A student's viewpoint. Journal of Medical Education. 1973;48:1104-10.
35. Srinivasan M, Wilkes M, Stevenson F, Nguyen T, Slavin S. Comparing problem-based learning with case-based learning: effects of a major curricular shift at two institutions. Academic Medicine. 2007 Jan;82(1):74-82.
36. Yoo MS, Park JH, Lee SR. The effects of case-based learning using video on clinical decision making and learning motivation in undergraduate nursing students. J Korean Acad Nurs. 2010;40(6):863-71.
37. Davis TM, Shepherd B, Zwiefelhofer T. Reviewing for exams: Do crossword puzzles help in the success of student learning? Journal of Effective Teaching. 2009;9:4-10.
38. Ginsberg SM. “Mind the Gap” in the classroom. Journal of Effective Teaching. 2010;10:74-80.

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