The Role of Curiosity and Interest in Learning and Motivation

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Abstract: Curiosity and situational interest are powerful driving forces in learning and motivation that lead students to learn more effectively. In this chapter, we elucidate curiosity and situational interest by focusing on (1) conceptual definitions and characteristics, (2) antecedents, (3) cognitive and behavioral outcomes, and (4) strategies to foster them in school. Curiosity is a short-lasting, aversive state that desires an acquisition of specific information. Its properties contrast with those of situational interest, which is an overall positive affect and a general preference for a topic. Whereas curiosity and situational interest are stimulated by similar contextual features (such as collative variables), triggering curiosity requires one to perceive an information gap between what one knows and what one wants to know. Despite these differences, ample evidence displays that both curiosity and situational interest positively impact students’ learning, motivation, creativity, and well-being once triggered. Thus, in closing, integrative and specific pedagogical guidelines to enhance students’ curiosity and situational interest in education practice are suggested.

When we encounter something novel, uncertain, or outside our expectations, we often feel an urge to find out more about it. This psychological state, termed curiosity, is driven by an information gap and has been recognized as an important motivator for learning. For a long time, curiosity has been considered to be synonymous with interest (Rotgans & Schmidt, 2014; Silvia, 2006). Only recently have some researchers acknowledged the need to conceptually distinguish the two constructs. Interest has been posited as intrinsic motivation, and components of interest have been found to share common characteristics with those of curiosity (Grossnickle, 2016; Markey & Loewenstein, 2014; Renninger & Hidi, 2016). In classrooms, curiosity and interest are both

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positively and negatively affected by similar factors and, when triggered, both curiosity and interest can have an energizing effect on student learning. For these reasons, it seems, the two concepts have not often been differentiated in educational research or in practice. Nonetheless, separating them may be possible, and this could be vital for refining theories surrounding curiosity and interest and their application in education. Furthermore, understanding the shared and unique properties of the two constructs may shed light on how, both independently and together, they influence student learning and motivation, and what should be done to promote them in the classroom.

The purpose of this chapter is to further the understanding of curiosity and interest in educational settings by reviewing relevant research. First, the conceptual definitions of curiosity and interest are reviewed. Second, the underlying mechanisms of curiosity and interest are examined through a systematic review that addresses the common situational determinants of curiosity and situational interest, and identifies unique antecedents of curiosity that are not related to interest. In addition, the contribution of individual differences to the elicitation of curiosity and interest is noted. Third, the role of curiosity and interest in motivation and learning are discussed. In this section, the current understanding of the behavioral and cognitive outcomes of curiosity and interest in the context of education are reviewed. Finally, we discuss classroom variables that can facilitate or suppress student curiosity and interest, and suggest specific ways to promote these two psychological states. As such, we seek to establish educational implications and future directions for both research and practice.

**Definitions of Curiosity and Interest**

Curiosity and interest have frequently been conceptualized as synonymous. The two concepts are often used interchangeably in scholarly research and in everyday conversation (Grossnickle, 2016; Renninger & Hidi, 2016; Rotgans & Schmidt, 2014). This lack of distinction may be due in part to the similarities in their characteristics. For example, curiosity and interest can be triggered by similar factors and can lead to comparable cognitive and behavioral outcomes, such as increased attention, engagement, and exploration (Kidd & Hayden, 2015; Loewenstein, 1994; Renninger & Hidi, 2011). Nonetheless, with increasing attention being paid to the potency of curiosity in learning and the theoretical need to differentiate curiosity from interest, the discussion of the conceptual divide between curiosity and interest has recently turned heated among education researchers. From our point of view, curiosity and interest are related but not interchangeable constructs. Thus, in this section, we first describe the traditional concept of interest, and then the distinctive characteristics of curiosity that set the two apart.
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Interest

Interest has been conceptualized in various ways in the past, but it can be thought of as a preference for a certain activity, topic, or domain (Bergin, 2016). This preference can be either generated by specific stimuli in the environment or developed as a part of enduring characteristics. The former is termed situational interest and arises from attention-grabbing stimuli (Hidi & Harackiewicz, 2000; Mitchell, 1993), while the latter is individual interest – a relatively stable predisposition that causes individuals to gravitate toward certain classes of stimuli (Durik & Harackiewicz, 2007; Hidi & Harackiewicz, 2000). In an effort to explain how interest develops, Hidi and Renninger (2006; see Renninger & Hidi, 2016 for a more detailed discussion) proposed that an individual’s situational interest can develop into longer-term individual interest with an increase in value and relevant knowledge. The Four-Phase Model of Interest Development describes situational and individual interests as evolving through consecutive phases of triggered situational interest, maintained situational interest, emerging individual interest, and well-developed individual interest (Hidi & Renninger, 2006). In other words, interest develops in conjunction with the development of knowledge and value, but it also may fall off or regress if continued engagement with the content of interest is not supported.

Curiosity

Although educational research has addressed curiosity, there is no single widely accepted definition of the concept (Grossnickle, 2016; Kidd & Hayden, 2015). While early philosophical discourse on curiosity regarded it as a passion or as being appetitive, the contemporary definition chiefly sees it as a desire for information in the absence of extrinsic reward (Jirout & Klahr, 2012; Markey & Loewenstein, 2014). However, these definitions are too broad and lead to conceptual confusion between curiosity and interest. Therefore, more specific definitions of curiosity need to be investigated in order to illustrate its uniqueness.

Curiosity can be categorized as either “state” or “trait.” State curiosity is associated with temporal arousal and the feeling of wanting to know something in a given context as a result of curiosity-evoking stimuli. This type of curiosity is often mistaken for situational interest, because the two appear to be very similar in terms of engagement. However, while situational interest embraces any information regarding topics or activities of interest and has no specific limitation in its duration, state curiosity usually revolves around the acquisition of specific information and does not last for a significant length of time, usually only until the situation in question has been resolved or the participant withdraws (Grossnickle, 2016; Markey & Loewenstein, 2014). Also, while situational interest is typically associated with the experience of positive affect, state curiosity is usually accompanied by the discomfort of knowledge deprivation or cognitive disequilibrium (Berlyne, 1954; Loewenstein, 1994).
Trait curiosity, on the other hand, refers to an individual's tendency to seek new knowledge and experiences (Grossnickle, 2016; Kashdan et al., 2004; Litman & Silvia, 2006; Loewenstein, 1994). Trait curiosity is thought to impact an individual’s experience of state curiosity, as those with high trait curiosity will feel curious with increased frequency and intensity (Litman & Silvia, 2006).

Both trait curiosity and state curiosity have been further subdivided by some researchers. Trait curiosity has been partitioned into cognitive curiosity, physical thrill seeking, and social thrill seeking (Reio et al., 2006); and interest-type and deprivation-type curiosity (Litman, 2010). State curiosity has been separated into perceptual and epistemic curiosity (Berlyne, 1954). For the purpose of the present chapter, we will mainly focus on state (epistemic) curiosity because of its close connection to situational interest.

Underlying Mechanisms of Curiosity and Interest

Despite the different definitions and characteristics of curiosity and interest, there exists a large overlap in the underlying mechanisms, both environmental and personal. However, it is possible to further separate curiosity from interest by identifying its unique antecedents.

Situational Determinants of Curiosity and Interest

Sources of situational interest. Situational interest is known to be elicited by a wide range of contextual features (Anderson et al., 1987; Hidi & Baird, 1988). For example, Bergin (1999) introduced a list of determinants that influence interest in classroom settings and divided them into individual (i.e., belongingness, emotions, competence, utility-goal relevance, and background knowledge) and situational factors (i.e., hands-on activities, discrepancy, novelty, food, social interaction, modeling, games and puzzles, content, biophilia, fantasy, humor, and narrative). Typically, situational interest can be divided into triggered situational interest and maintained situational interest, depending on the duration and relevance (Hidi & Renninger, 2006; Renninger & Hidi, 2016). Relatively superficial task characteristics – such as surprising information, character identification, personal relevance, or task intensity – have been discussed as sources of triggered situational interest (Schraw et al., 2001; Schraw & Lehman, 2001), whereas more meaningful and relevant features – such as project-based learning, group work, or tutoring – are considered to be sources of maintained situational interest (Mitchell, 1993). It can then be concluded that situational factors grabbing an individual’s attention trigger situational interest, and that situational and individual factors containing some form of personal value maintain it.
By dividing situational interest into its triggered and maintained forms, the similarity between situational interest – particularly triggered situational interest – and state curiosity becomes more apparent. Triggered situational interest and state curiosity are generated by contextual features that grab the attention (as opposed to meaningful features) and have the possibility to develop into maintained situational interest and individual interest. Common situational determinants of interest and curiosity include novelty, discrepancy, puzzles, uncertainty, and incongruous and surprising information. Curiosity and interest research has been influenced by the pioneering work of Daniel Berlyne, a psychologist who extensively studied the causes of both constructs (e.g., Berlyne, 1954, 1960). He suggested that collative variables – such as novelty, ambiguity, complexity, and surprisingness – are factors that trigger curiosity and interest. Numerous studies have utilized these variables in different ways to generate both interest and curiosity (e.g., Iran-Nejad, 1987; Kim, 1999; Silvia, 2006). Rather than having a direct influence on emotional aspects (through humor, fantasy, food, or task intensity) or self-relevant aspects (through character identification, personal relevance, or involvement), these variables prompt individuals to pay attention to the content by creating a disequilibrium in their schema (Ginsburg & Opper, 1969; Markey & Loewenstein, 2014). The curiosity and triggered situational interest evoked by these sources can thus be considered similar.

Unique cause of curiosity. Although curiosity and situational interest share some triggering factors, identifying specific antecedents of curiosity allows it to be distinguished from interest. The information gap theory suggested by Loewenstein (1994) has gained support for its explanation of the causes of curiosity (Kang et al., 2009; Loewenstein, 1994). His theory stands out from other theories that deal with both curiosity and interest by investigating the roots of curiosity. In doing so, he pinpointed the information gap – the discrepancy between an individual’s current knowledge level and the level of knowledge they seek to attain – as a unique direct cause of curiosity. Researchers have supported this proposition and demonstrated that the most important factors leading to curiosity are the reference point of knowledge and deprived knowledge caused by curiosity-evoking stimuli (Kang et al., 2009; Markey & Loewenstein, 2014). Therefore, while interest may be provoked by the novelty or game-like features of a task that is informationally complete, curiosity is experienced only when the individual in question perceives that information is missing. Quizzes or trivia questions are typically used to evoke curiosity because they highlight the missing information (Kang et al., 2009; Stahl & Feigenson, 2015). This exposure to the unknown then creates a sense of discomfort or deprivation, which naturally instills the desire to learn more.

Individual Differences

Although both state curiosity and situational interest are primarily affected by environmental factors, they can be influenced by enduring individual factors, such as trait curiosity and individual interest.
**Trait curiosity.** Individuals with high trait curiosity are more prone to seek, notice, and become absorbed in curiosity-evoking experiences (Kashdan et al., 2004). Although curiosity can be experienced by most individuals depending on the situation, trait curiosity is expected to influence the frequency, and perhaps the intensity, of these experiences by increasing the awareness of and interactions with curiosity-evoking stimuli (Grossnickle, 2016). Several studies have provided empirical evidence that state curiosity is associated with trait curiosity and situational interest (Kashdan & Steger, 2007; Litman et al., 2005; Silvia, 2008). In a study by Kashdan and Steger (2007), where both trait curiosity and daily state curiosity were measured, correlations were found to be significant at 0.42. Litman and his colleagues (2005) compared their two measures of trait curiosity, the Epistemic Curiosity (EC) scale and the Curiosity as a Feeling-of-Deprivation (CFD) scale, to the state curiosity experienced in three feeling-of-knowing states: “don’t know,” “tip-of-the-tongue (TOT),” and “I know.” They found that their measures of trait curiosity correlated significantly with state curiosity in curiosity-evoking situations. In addition, when trait curiosity and situational interest are examined, trait curiosity has been found to positively predict situational interest when participants are engaged in complex tasks (Silvia, 2008). This process was mediated by appraisals related to coherence and comprehensibility.

**Individual interest.** Individual interest involves an individual’s positive attitude and stored content knowledge for, as well as the understanding and high value of, certain activities or topics (Hidi, 2006). When individual interest arises – not necessarily a conscious decision – individuals desire to engage in the task and generate their own questions and answers, and this engagement tends to be effortless (Hidi & Renninger, 2006). Because individual interest is related to spontaneous engagement, developed value, and stored knowledge, it is assumed to influence state curiosity and situational interest by providing more opportunities to interact with curiosity- and interest-evoking situations (Hidi & Renninger, 2006). For example, individual interest has been found to display a strong correlation with information-seeking, a behavior also demonstrated by individuals with high curiosity (Schiefele, 1991). In addition, more knowledge increases search efficiency and facilitates the acquisition of information (Brucks, 1985). Therefore, individual interest can help maintain curiosity until a successful resolution of curiosity is made by attaining desired information.

**Consequences of Curiosity and Interest**

Despite the conceptual distinction between curiosity and interest, they both have been found to be associated with similar positive outcomes in learning contexts. Researchers have consistently displayed the association between interest and adaptive outcomes, such as enhanced attention, persistence, and
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performance (Ainley et al., 2002; Hidi, 1990; Schiefele, 1991). Recent studies have demonstrated the beneficial effects of curiosity on attention, memory, and personal well-being (Gruber et al., 2014; Kang et al., 2009; Kashdan & Steger, 2007). In this section, the overlapping educational benefits of curiosity and interest are discussed in more detail.

Attention and Memory

Curiosity and interest have been found to capture a learner’s attention (Shirey & Reynolds, 1988). Several studies have utilized objective indicators of attention – including pupil dilation, eye movement, and reaction time – to demonstrate the effect of curiosity and interest on attention (Beatty, 1982; Gottlieb et al., 2013; Kang et al., 2009). In a study by Kang et al. (2009), questions that more strongly evoked curiosity lead to increased pupil dilation. In addition, eye movement has been shown to be guided by the bias toward curiosity-evoking stimuli, indicating that curiosity drives people to pay attention to them (Gottlieb et al., 2013). Young children more frequently fixate on items they are interested in (Renninger & Wozniak, 1985), and students have been found to pay more attention to interesting rather than uninteresting text (Anderson et al., 1987). In a study that investigated the relationship between text-based interest and attention using reading time, participants spent less time reading interesting text compared to the uninteresting text (McDaniel et al., 2000). Researchers interpreted that the faster reading time means less cognitive demand when reading due to the automatic attention allocation (Hidi, 1995; McDaniel et al., 2000). The benefit of this is that the remaining cognitive resources can be used to improve memory and learning.

A number of studies on curiosity and interest have illustrated the links to memory. Neuroscience studies have revealed that the brain regions related to memory, such as the hippocampus, are activated when students are highly curious (e.g., about blurry pictures or the answers to trivia questions) or when their guesses about answers are incorrect (Gruber et al., 2014; Jepma et al., 2012; Kang et al., 2009). These studies have also shown that students were better at recalling answers or even irrelevant information associated with questions that provoked high curiosity, highlighting the powerful effect of curiosity on memory. A recent behavioral study illustrated the effect of curiosity on memory by demonstrating that the recall of interesting questions was high regardless of the provision of monetary rewards, whereas the recall of uninteresting questions was moderated by monetary reward (Murayama & Kuhbandner, 2011). Interest has also been found to influence memory and learning (Hidi, 1990; Schraw & Lehman, 2001). Researchers have shown that objects of interest or interesting text are better recalled compared to uninteresting objects or text (Renninger & Wozniak, 1985; Wade et al., 1993).
study conducted by McDaniel et al. (2000), efficient processing of interesting information due to the automatic attention allocation resulted in better memory and learning of the content. Both individual and situational interest in text-based learning have been found to predict the text recall rate (Ainley et al., 2002).

Motivation and Achievement

Curiosity and interest can function as motivators in academic settings either directly or indirectly. It has been claimed that curious individuals experience flow-like engagement in rewarding situations (Kashdan et al., 2004). In a flow state, children lose track of time and become deeply engaged in their task with a sense of control (Nakamura & Csikszentmihalyi, 2014). Thus, they are thought to self-regulate their cognitive resources to focus on the present task. In addition, curiosity has been linked to a greater use of resources and effort (Kang et al., 2009). In Kang and colleagues’ behavioral study, undergraduates rated their level of curiosity in trivia questions. If they desired to know the answers, they were asked to spend scarce resources (i.e., limited tokens or waiting time). It was found that students were more likely to spend resources to fill in information for questions that provoked a higher state of curiosity. Indeed, when individuals become curious, they are more motivated to seek unknown information (Loewenstein, 1994). This motivation to gain information is so powerful that even young infants are known to engage in exploration when faced with unexpected situations (Stahl & Feigenson, 2015). Several studies agree that exploratory behavior deriving from curiosity is associated with better learning and achievement (Kashdan & Yuen, 2007; Marvin & Shohamy, 2016; Von Stumm et al., 2011). For example, Von Stumm et al. (2011) proposed curiosity as the third determinant of academic performance. They found that even though intelligence is the strongest predictor of academic performance, the combination of curiosity and effort can be just as influential.

Like curiosity, interest has been found to motivate learners and to eventually result in better performance (Ainley et al., 2002). The positive association between interest and motivational constructs – such as engagement, perceived competence, and cognitive processing – have been reported by existing studies (Durik & Harackiewicz, 2007; Hidi, 1990; Schiefele, 1991). In an investigation that tested the effects of situational and individual interest in math, both were found to be positively associated with task engagement, perceived competence, and performance (Durik & Harackiewicz, 2007). Interest has also been found to be associated with the use of effective learning strategies – such as elaboration, information-seeking, and critical thinking – and a positive attitude toward learning content (Schiefele, 1991). Similar to curiosity, motivation triggered by interest leads to better learning (Ainley et al., 2002; Hoffmann, 2002). Ainley et al. (2002) demonstrated that individual and
situational interest could predict test scores for corresponding topics either directly or indirectly via positive affect and persistence. Situational interest, in particular, has been known to prompt even unmotivated students to learn (Hidi & Harackiewicz, 2000). An intervention study that generated situational interest using modified instruction showed that girls who received interesting instructions performed significantly better than those in the control group, despite a general lack of interest in science (Hoffmann, 2002). Therefore, both curiosity and interest serve as motivation for learning and influence academic success.

**Creativity**

Curiosity and interest researchers have demonstrated a similar relationship between the two constructs and creativity (Day & Langevin, 1969; Karwowski, 2012; Maw & Maw, 1970). Curious people tend to prefer novelty (Kashdan et al., 2004; Loewenstein, 1994), and this tendency is thought to lead to novelty-finding and novelty-producing, which can be considered important processes for creativity (Schweizer, 2006). In addition to this, tolerance for ambiguity and risk taking, which are aspects of curiosity, have been recognized as necessary for creativity (Kaufman & Beghetto, 2009). This relationship between curiosity and creativity has long been recognized. For example, Day and Langevin (1969) proposed that curiosity and intelligence had a positive influence on creativity, and Maw and Maw (1970) also noted the association between curiosity and creativity in younger students. These researchers demonstrated that highly curious students were more adaptive and creative thinkers compared to less curious students. More recently, an empirical study expanded on the role of curiosity in creativity by examining curiosity in relation to two creativity-related self-concepts: creative self-efficacy and creative personal identity (Karwowski, 2012). The results showed a strong correlation between curiosity and both self-beliefs, implying that individuals with high curiosity are more likely to believe that they are creative.

Previous research has also identified the positive effect of interest on creativity. For example, in a study conducted by Amabile (1985), participants were asked to write a poem after being given intrinsic or extrinsic reasons for engaging in the task. Those who were exposed to intrinsic reasons (e.g., because I enjoy the opportunity; because I like writing) showed more creativity in their writing. In addition, the positive affect generated by enjoyment and satisfaction with work has been found to have a linear relationship with creativity (Amabile et al., 2005). Interested individuals attempt to satisfy their intrinsic needs with positive affect, and this, in turn, increases their knowledge and creativity (Fredrickson, 1998). Although the underlying mechanisms that lead to creativity may differ, both curiosity and interest motivate individuals to seek and explore new things, causing them to think and act in creative ways (Kashdan & Silvia, 2009).
Psychological Well-Being

Interest and curiosity have been recognized as being positively associated with various forms of well-being, such as life satisfaction, in various domains (Park et al., 2004; Ryan & Deci, 2000). In work environments, individuals were more productive and reported feeling less exhausted when they were working for the pleasure of learning new things and the enjoyment of challenge at work (Fernet et al., 2004). Moreover, individuals who engage in activities for the sake of interest in, curiosity with, and satisfaction from the task itself were found to have healthier lifestyles (Pelletier et al., 2004). In other research, individuals who participated in religious activities out of their own interest and for intrinsic reasons were found to experience positive changes, whereas those who participated for extrinsic reasons did not (Ryan et al., 1993). Participation for intrinsic reasons was negatively associated with negative psychological states such as anxiety or depression, and positively associated with outcomes like self-esteem and self-actualization. Participation for extrinsic reasons demonstrated the opposite trend. Consequently, general intrinsic motivation, which comes from interest and curiosity, can be seen to be associated with psychological well-being (Ryan & Deci, 2000).

Researchers have also tested the relationship between curiosity and life satisfaction and found similar results. A study that looked at the relationship between different character strengths and life satisfaction reported that individuals who are curious and interested in experiences and seek novelty are associated with greater life satisfaction (Park et al., 2004). Information-seeking and feedback-seeking behaviors, which can arise from curiosity, have also been found to be correlated with job satisfaction (Wanberg & Kammeyer-Mueller, 2000). In another study, the effect of curiosity on well-being was tested in an educational setting, with participants asked to write a diary entry daily for 21 days (Kashdan & Steger, 2007). It was found that individuals with high trait curiosity were more likely to search for and detect meaning in life and to experience life satisfaction. Furthermore, curious people seek challenges, and this tendency is accompanied by the self-perception of their competence, that is, the belief that they are capable of acquiring valuable knowledge (Kashdan & Silvia, 2009). As a result, they explore and adopt growth-oriented behaviors, which eventually increases their well-being (Kashdan & Steger, 2007).

Fostering Curiosity and Interest

Although there is widespread acceptance that curiosity and interest are valuable forms of motivation that should be promoted in educational settings to benefit students, many researchers have documented a dramatic drop in
student curiosity and interest when they move on to higher grades (e.g., Kim et al., 2015). A primary goal of school should be, therefore, to become the primary motivational environment where the development of epistemic curiosity and academic interest is encouraged. Previous literature on curiosity and interest has provided suggestions for how to encourage student inquiries and ways in which their curiosity and interest can be fostered in the classroom. Here we will identify some of the factors that affect curiosity and interest in the classroom, and recommend strategies to increase their influence in this setting.

Learning Content

Perhaps the most obvious yet important way of fostering student curiosity and interest is to provide them with topics, activities, and materials that can spark their curiosity and interest. Unfortunately, learning materials presented at schools are typically under-stimulating, fail to stoke the imagination, and discourage curious inquiry. This is because, even though research has identified the psychological underpinnings of curiosity and interest, the actual incorporation of these into educational materials has been much slower. We will thus revisit the antecedents of curiosity and interest, and suggest how they can be utilized in educational content to improve learning.

Providing ill-defined problems. The structure of a problem can affect learning experiences of students. That is, some problems may instill learners to only engage superficially without feeling curious or interested, while other problems may not only trigger learners’ curiosity and interest, but also encourage them to make deeper inferences to solve their curiosity and interest. Types of problems can be distinguished by well-defined problems (i.e., those with one correct, agreed-upon solution) and ill-defined problems (i.e., those with conflicting assumptions and where several different solutions are possible; Schraw et al., 1995). As opposed to well-defined problems where students’ thoughts are meant to converge and be guided in a uniform direction, ill-defined problems open the possibility to inquire into diverse ways (Chin & Chia, 2006; Smith, 1988), and thereby support interest and curiosity-guided exploration. In line with this, a case study by Chin and Chia (2006) found that ill-defined problems stimulated students to pose questions that led them to explore their own independent inquiries.

Therefore, teachers should provide students with problems or tasks that possess multiple solutions and solution paths, and fewer parameters (Chin & Chia, 2006). The examples of these may constitute creative writing, inference making, debating, and solving problems in real-life contexts. Given an ill-defined problem, students can freely guess and explore without worrying about providing wrong answers, and can resolve curiosity in their own ways. This autonomous problem-solving process, by resolving one’s curiosity, is an important source for the generation of interest (Iran-Nejad, 1987; Kim, 1999).
Incorporating collative variables. The decisions a teacher makes regarding the focus and characteristics of content and the activities used to deliver that content have important ramifications on curiosity and interest development (Pressick-Kilborn, 2015). Effective materials that can ignite student curiosity and interest are generally characterized as vivid, well organized, optimally novel, and challenging. That is, learning materials should incorporate sources of curiosity and interest – such as collative variables that encompass novelty, uncertainty, and surprise – to achieve an optimal level of both in students (Bergin, 1999; Berlyne, 1954, 1960; Durik et al., 2015). For example, vivid texts containing rich imagery, suspense, engaging themes, and intriguing information that surprises the reader have a positive influence on student interest and learning (Bergin, 1999; Garner, 1992). Personal relevance and meaningfulness are also important sources of interest that can be incorporated into learning materials (Pressick-Kilborn, 2015). Teachers can use authentic materials from real life to facilitate personal relevance and emphasize the value of learning about them to increase students’ interest (Durik et al., 2015; Pressick-Kilborn, 2015). At the same time, however, the materials should be designed and formulated in a coherent manner to guide the learners’ thoughts and imagination (Hidi & Baird, 1988; Schraw et al., 2001). It is important to note that texts including irrelevant but highly interesting content can interfere with learning by diverting student attention (Harp & Mayer, 1998; Hidi, 1990). Thus, collative features in learning materials must be chosen with caution to maintain coherence with the target content knowledge.

Materials that induce an information gap are another important source of curiosity. When children perceive a gap between what they know and what they want to know, a sense of deprivation encourages them to seek the information (Loewenstein, 1994). Thus, learning materials that are designed to create an information gap in children can serve to generate curiosity. Riddles, puzzles, and trivia questions have been found to be especially effective, because the missing information is presented in a salient manner (Kang et al., 2009; Loewenstein, 1994). This is because, even when appropriate material is presented, curiosity will not arise if children fail to recognize the information gap (Loewenstein, 1994). For instance, Loewenstein (1994) stated that curiosity could not be generated if children are overly confident about their knowledge and believe that they know the answer when they actually do not. In this case, teachers can guide the students to guess the answer and provide feedback.

Providing tasks of optimal difficulty. Certain levels of prior knowledge are necessary for both curiosity and interest. Previous studies suggest that an optimal level of knowledge (not too high nor too low) is needed to instigate curiosity (Kang et al., 2009; Loewenstein, 1994). An appropriate level of prior knowledge for the given material helps students make more inferences regarding the content, which is the genesis of curiosity and interest (Grossnickle, 2016; Kim, 1999). This aligns with Piaget’s moderate novelty principle, which
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posits that an object should be neither too familiar nor too novel to grab a student’s attention (Ginsburg & Opper, 1969; Grossnickle, 2016).

A level of difficulty that is too high will act as a barrier to curiosity and interest. For instance, in a study by Acee and his colleagues (2010), the presentation of completely familiar and easy content resulted in task-focused boredom stemming from meaninglessness and tediousness, while too novel and difficult content brought about self-focused boredom associated with frustration and dissatisfaction. In line with this study, Kang et al. (2009) reported that the relationship between curiosity and students’ confidence in their knowledge followed an inverted U-shape function, indicating that curiosity was the highest when confidence regarding current knowledge was optimal. Thus, learning materials that do not match the students’ level can result in boredom, anxiety, or frustration and may even lead to withdrawal (Chak, 2002).

One way to craft materials of optimal difficulty is to introduce the unfamiliar through the familiar (Hoffmann, 2002; Schraw et al., 2001; Xu et al., 2012). That is, teachers can use students’ prior knowledge, past experience, and interests in familiar contexts to connect to new ones. Alternatively, when introducing novel concepts, teachers can provide students with the appropriate background knowledge to facilitate their understanding and the perception of the information gap in learning. Forming a meaningful connection with the learning materials would boost student curiosity and interest. If teachers can make an effort to supply information that can provoke interest and engagement, these materials will serve as direct primary sources for curiosity and interest in students.

Learning Context

Individuals with a curiosity mindset have a better tolerance for ambiguity (Kashdan et al., 2011). They are more likely to consider difficulties as challenges than as threats (Hodgins & Knee, 2002). It is a concept similar to “embracing” – a willingness to embrace the novelty and uncertainty, and to gain new experiences and knowledge (Kashdan et al., 2009). The curiosity mindset is important in learning, because it enables individuals to value curiosity and information-seeking under uncertain situations instead of avoiding them (Kashdan, 2007; Silvia, 2006). The curiosity mindset can be fostered by encouraging questions, permitting errors, guiding exploration, and experiencing successful resolution. We thus present some specific strategies for establishing a learning context that welcomes questions and exploration.

Establishing a nonthreatening environment. An environment or practice that intimidates students discourages them from becoming curious and expanding on their interests. Threatening elements in the classroom – such as overt competition, a focus on normative evaluation, or a controlling instructional style – may induce anxiety, which is a psychological state known to hinder
interest and exploration (Ames & Archer, 1988; Stefanou et al., 2004). Even if learning materials are devised to increase student curiosity and interest, Lee (2016) suggested that anxiety due to an upcoming competitive test might deter students from deeply engaging in learning, thus lowering the effect of curiosity-evoking material on curiosity. In particular, a threatening environment that generates anxiety can be harmful to student curiosity and interest in two ways: first, by weakening informational processing and attentional control due to overloading the students’ cognitive capacity with worry (Eysenck et al., 2007; Lee, 2016), and second, by limiting exploratory behavior due to repeated experiences of failure to satisfy the need for knowledge (Peters, 1978).

Therefore, teachers need to establish a safe and nonthreatening environment where students can focus more on the content to be learned and where they feel comfortable asking questions and exploring knowledge further. For example, in a real-life classroom, students with high trait curiosity ask more questions when they perceive their instructor to be patient, accepting, gentle, and warm; whereas their rate of questioning falls to a level reflecting low trait curiosity when they perceive their instructor to be impatient, critical, harsh, and cold (Peters, 1978).

**Permitting errors.** Curiosity involves errors in its own process (Loewenstein, 1994). That is, curiosity is evoked when students detect an error or a discrepancy in their thoughts, beliefs, and behaviors, and the process of resolving curiosity through exploration accompany risks of failure. Mistakes and errors lead to a violation of expectation (surprise) and create an information gap that facilitates active information-seeking. Thus, without acknowledging one’s error as an essential part of the learning process, the growth of curiosity is unlikely. A learning environment that turns students’ errors and failures into valuable learning opportunities empowers students to be resilient to failures, explore persistently, and try to reduce errors. Since normative assessment makes students feel anxious regardless of its valence (Kim et al., 2010), negative feedback in response to errors is likely to elicit shame and make students avoid novel and challenging tasks. On the other hand, informative feedback regarding errors would encourage reflexive awareness of the information gap and promote deeper exploration.

**Providing autonomy.** In most learning environments, students merely follow the curriculum and instructions set by their teachers. In these circumstances, students may not develop a sense of ownership over their learning (Stefanou et al., 2004). Students are often found to express their curiosity or interest when they are not participating in teacher-directed activities. This observation can be utilized to nurture curiosity in the classroom by allowing students to freely make choices (about such things as topics, homework, assessments, and learning activities) and to make their own inquiries. Choice is a major driver of increases in the sense of self-determination (Deci et al., 1991), and it has been shown to increase student interest (especially in otherwise low-interest
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students) and performance outcomes (Ryan & Deci, 2000; Schraw et al., 2001). It has been reported that when students are given a chance to choose what they want to learn, they exhibit a greater ownership, interest, confidence, and sense of value in a task (Patall, 2013). The sense of having a choice is so powerful that it can even weaken the negative feelings associated with undesired activities (Patall et al., 2010). In addition, providing students with opportunities to generate and answer their own questions enhances their perceived ability to close information gaps and further elevates their levels of curiosity and interest (Markey & Loewenstein, 2014).

As can be seen, students often develop a good idea of what they want to know when they are given a sense of freedom. Nevertheless, precautions should be taken when providing choices in the classroom. For example, offering too many choices can burden students with cognitive overload (Patall et al., 2008). Because the act of choosing is effortful and draws on cognitive resources, the provision of too many choices can lead to fatigue and can adversely affect student learning (Muraven & Baumeister, 2000). This cognitive depletion can also negatively affect curiosity and interest, both of which require sufficient cognitive resources to engage in learning activities.

Facilitating social interaction. An important way in which students can develop their curiosity and interest is through social interaction (Bergin, 2016). In the classroom, students not only acquire knowledge and values, but also learn how to expand and refine their inquiries or preferences for specific topics, by interacting with teachers and their peers. In particular, a growing consensus holds that friends and peer groups are an important context where students’ beliefs and preferences are socialized (Bergin, 2016; Ryan, 2001). Students tend to feel interested in a task or activity that allows them to socialize, especially with their friends (Bergin, 1999, 2016). When working together in a group, students can stimulate each other’s curiosity and interest by sharing their thoughts, preferences, and questions on the topic or problem. At the same time, students’ prior interest and curiosity can be cultivated with the support of peers. A recent study reported that peer responsiveness contributes positively to the maintenance of interest among adolescents (Thoman et al., 2012). Therefore, teachers should create the social realm of learning, where students can work together and interact with each other to solve problems and engage in academic tasks.

Role of the teacher. A study has shown that, given a list of qualities to be encouraged in students, teachers are quick to agree that curiosity is an essential element of the classroom. When teachers are asked to come up with the qualities on their own, however, only a few mention curiosity (Engel, 2011). As indicated by this result, teachers often fail to actively encourage curiosity in the classroom. Instead, they subtly push aside student inquiries during instructional practice in an effort to meet the standards of mandated curricula.

Instilling curiosity and interest in children is best achieved when teachers themselves are curious and interested, such as when they are excited, involved,
self-directed, and trying new things (Engel, 2011; Pressick-Kilborn, 2015). Xu et al. (2012) determined that exemplary science teachers who promote student interest must have a genuine interest in science, in promoting student interest in science, and in forming strong relationships with their students. When teachers themselves are curious and interested, students are more likely to model their behavior. For instance, Engel (2011) introduced a study in which she found that children who observed teachers showing an interest in exploring a topic further and deviating from the task at hand exhibited increasingly more curious exploration compared to children who watched teachers adhering to conventional instruction. Furthermore, a recent study has demonstrated that spending time with an enthusiastic teacher in the classroom significantly boosts a student’s interest in the course (Kim & Schallert, 2014; Long, 2003). This research emphasizes that a teacher has a powerful effect on the development of curiosity and interest in students. These two important constructs may well emerge in the interaction between students and teachers, with a supportive relationship between the two providing students with a foundation for their curiosity and interest to bloom.

Concluding Thoughts

In this chapter, we have discussed the possible distinction between curiosity and interest by outlining their conceptual definitions and identifying their shared and unique underlying mechanisms. We have also summarized the current understanding of the educational merits of the two constructs and introduced ways to promote curiosity and interest in an educational context.

To date, curiosity and interest have not been firmly distinguished from each other, and research on curiosity in an educational context is still in its early stages. In addition, as opposed to interest, for which the development and influence on students have been extensively studied and widely validated (Ainley et al., 2002; Durik & Harackiewicz, 2007; Hidi & Renninger, 2006), there remain significant gaps in theories and empirical evidence regarding curiosity in educational settings. As conceptual clarity is a necessary step toward the empirical advancement of the theories, more work is needed to investigate the similarities and differences between curiosity and interest in terms of their respective definitions, antecedents, and consequences for achieving their effective utilization in the classroom.

References


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