The IDC Theory: Habit and the Habit Loop

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Abstract: Researchers, educators and parents have long acknowledged the importance of cultivating students' good habit for learning. However, educators and parents continue to grapple with the challenges in helping students form new good habit and break old "not-so-good" habit. The research literature on learning habit formation is still limited in informing the teaching and learning practices in schools and beyond. This conceptual paper is written under the auspices of the Interest-Driven Creator (IDC) initiative, a theoretical synthesis effort carried out by a group of educational researchers in Asia. The intention is to co-construct a framework to guide the practitioners in fostering students' learning interests, capabilities in creation, and learning habits – the three anchored concepts of IDC theory. This paper focuses on delineating a three-component "habit loop": *cueing environment, routine*, and *satisfaction*. This paper will discuss the implications of the habit loop for student's interest-driven creation. Cultivating students' learning habit is fundamental to education but it is not a well-explored area. The paper raises some questions with the aim to stimulate further discussions among educators, researchers, parents and policy makers.
Keywords: Interest-Driven Creator (IDC) Theory, learning habit, habit loop

Introduction

Learning involves a persistent and stable change in what a person knows or does. Forming useful and productive habits learning is important for education and learning. Habit formation is often related to interest and persistence. Learning driven by interest with process mimicking in the creation process will produce no lasting effect on students unless it is repeated regularly in daily learning activities to accumulate its effects. To exert a long-term impact on student learning, a natural way is to cultivate creation with interest as a habit, desirably a lifelong habit.

Habit

Habit is a routine of behavior that is repeated regularly and tends to occur unconsciously. "Habits are the result of automatic cognitive processes, developed by extensive repetition, so well-learned that they do not require conscious effort" (Ronis, Yates, & Kirscht, 1989, p. 219). Oxford Dictionary (2014) defines habit as "a settled or regular tendency or practice, especially one that is hard to give up" and "an automatic reaction to a specific situation". Cognitive scientists often talk schema and automaticity when discussing cognitive processes involved in habit formation (Anderson, 1992; Schank & Abelson, 1977).

Building up good habit is a fundamental issue for people's life. People's behavior is largely affected by their habits. Thus, habits, to some degree, define who people are. Many philosophers, psychologists and educators have emphasized the importance of the habit. The notion of *habits of mind* encapsulates many prior discussions (Costa & Kallick, 2008). The pioneering psychologist and philosopher William James (1890) wrote, "All our life, so far as it has definite form, is but a mass of habits." "Any sequence of mental action which has been frequently repeated tends to perpetuate itself; so that we find ourselves automatically prompted to think, feel, or do what we have been before accustomed to think, feel, or do, under like circumstances, without any consciously formed purpose, or anticipation of results." "We are what we repeatedly do," Greek philosopher and scientist Aristotle famously proclaimed. "Excellence, then, is not an act, but a habit." The same goes for the reverse: problems and

failure can become habits too. Those who have formed good habit have higher chance to excel in various aspect of life.

Types of Habit

Habits can be divided into three types depending upon the nature of activities. The first type is motor habits which refers to the muscular activities of an individual. These are the habits related to our physical actions such as, standing, sitting, running, walking, doing exercise, maintaining particular postures of body, etc. Many motor habits are health related. For example, drinking a lot of water, doing exercise regularly, eating less oily food and more vegetables and fruits, brushing teeth in the morning and evening. A study on developing healthy habits (eating, drinking or exercises) found that automaticity increases and fits an asymptotic curve with repeated behaviors in a consistent context (Lally, van Jaarsveld, Potts, & Wardle, 2010).

The second type is intellectual habits which are related to psychological process requiring our intellectual abilities such as good observation, accurate perception, logical thinking, using of reasoning ability before taking decisions and testing conclusions, etc.

The third type is habits of character. Some of our characters are expressed in the form of habits. For example, helping others who are in need, trusting people, being honest, talking in a friendly way, time management, being considerate by opening the door for people instead of barging through it first, not interrupting or talking over people, hard working, keeping our dress clean and tidy, etc. These habits will have essence of feelings and emotions; hence these are also called as emotional habits.

Learning Habit and Habit for Interest-Driven Creation

Students will experience success, difficulties, challenges and failures throughout their life. Helping next generation to succeed in the future is at the heart of educators and educational researchers. Cultivating students' good learning habit is to nurture them to excel in the future. The influential Chinese author and educator Yeh Sheng-t'ao stated that "what is education? To answer it in a simply way, just need one statement: nurturing good habits".

Students' future achievement includes things like marks, literacy, numeracy, effort, persistence, engagement, participation, collaboration, exploration, creation, etc. Some study habits, especially those habits related to persistence with regard to learning goals are directly related to students' academic performance, such as preparing the learning content before coming to the class and reviewing and reflecting what have learned after the class. According to Azikiwe (1998), "good study habits are good assets to learners because the (habits) assist students to attain mastery in areas of specialization and consequent excellent performance, while opposite constitute constraints to learning and achievement leading to failure". A recent study found that one's habits are related to whether one has growth or fixed mindset (Yan, Thai, & Bjork, 2014). For example, a student with growth mindset may be intrinsically motivated to learn and tend to have a habit of restudying.

Some researchers attempts to cultivate students' good learning habit to make them as life-long learner with 21st century competencies such as critical and inventive thinking, self-regulated learning, problem solving and collaborative learning etc. Such 'habits of mind' (or 'habits of thought', as John Dewey originally referred to them) require little or no effort on the part of the child to initiate or sustain them and would include inclinations to take responsible risks, persistence, manage impulsivity and think 'outside the box' when in problem-solving situations (Whitebread & Wingham, 2013). Costa and Kallik (2008) explains how habits of mind may be cultivated in children. They show how children can be taught, at home and at school, how to 'habituate' effective problem solving strategies and techniques into their mental repertoire so that they develop the propensity for skilful problem-solving in a variety of life settings. Good learning habits can be formed in student' schooling but can be sustained lifelong.

Educators hope the students can form good habits at the early stage of their life so that they are more likely to have a successful and productive life. Students' achievements due to good habit have a cumulative effect on future success. Therefore, those students who have had developed good learning habit earlier continue to sustain and increase the learning gains while those students who haven't had good learning habit have a harder time catching up – essentially, the stronger get ever stronger while the weaker only get weaker, due to habit. This is consistent with the research findings that suggest that prior learning performance of an experience is a good predictor of future learning (Jonassen & Grabowski, 1993). This exactly illustrates Nathaniel Emmons's saying that "habit is either the best of servants or the worst of masters".

In education context, the term 'habit' is widened from the commonplace definition meaning an oft-repeated action or an established practice or custom requiring little thought (such as brushing teeth or adding sugar to one's coffee) to mean unconscious mental propensities or processes, revealed as behavioural tendencies and dispositions as the student engages with the events and challenges of everyday life.

"Habit", the third anchored concept of IDC theory in our paper, speaks of nurturing habits of creation. If students learn with interest incessantly and habitually (as when following a school timetable that regulates daily routines), and their learning process emulates the creation process, then students will become creators, lifelong IDCs. Habit does not only substantiate the effect of learning, it also decides whether students are creators because shaping who they are is demonstrated by their daily repeated behavior, which in turn, is governed by their habits.

Educational researchers and instructional designers investigated the relationship between interest and habit and how motivation promote learning (i.e., result in more time spent on learning tasks) in the context of habit formation. The notion of interest encapsulates much of what is called motivation and volition (Keller, 2008). To cultivate interest-driven creator, there is a need to (a) determine those habits that contribute to interest driven creation, (b) identify current and desired habits of learners, (c) determine which learning habits of learners require additional support and development, (d) develop an instructional design framework that foster the habit of interest driven creation.

Mechanism of Habit Formation and the Habit Loop

To cultivate good habits of students we need to have a deep understanding of habit formation. A habit is a regularly repeated behavior pattern: a routine that is practiced frequently and hard to stop. Habit formation is the process by which new behaviors become automatic (Bargh, 1994). While the link between habits and learning is widely recognized, there is much less research that investigates how learning habits are formed in various circumstances with different learners. One of such research is Lally, van Jaarsveld, Potts, & Wardle's (2010) study on how to promote habit formation. They explored on strategies to initiate a new behavior, support context-dependent repetition of this behavior (cueing environment), and facilitate the development of automaticity. Lally and her Colleagues also provided the assumption that repeating a behavior in a consistent setting increases automaticity. Moreover, the term, habit, refers to a behavior that is done automatically with little thought.

Durhigg (2012) considered that a habit can be thought of as being composed of three parts: a cue, a routine and a reward. Adapting from Durhigg (2012)'s framework, we proposed a habit formation framework in the context of education and learning which consists of three components: *cueing environment* (arrangement of place, time, people, or incidents), *routine* (repetitive pattern of activities), and satisfaction, forming the habit loop (Figure 1).

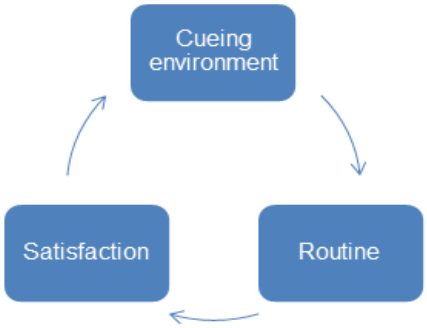

Figure 1: The Habit Loop

Cueing environment. In the habit formation process, first, there's a cue, or trigger, that tells your brain to go into automatic mode and let a behavior unfold. Cuing environment is important because it could provide learner perform the behavior consistently and then cue environment could trigger the learning behavior (Lally, & Gardner, 2013). Habits are formed when actions are tied to a trigger by consistent repetition so that when the trigger happens, you have an automatic urge to do the action. When a habit is triggered, the actor may sometimes do it without consciously knowing doing it. For example, brushing teeth is a habit. When most people wake up from their beds in the morning, they go to the bathroom and brush their teeth automatically, without asking themselves whether they want to brush teeth in that morning. Occasionally, the action is so automatic that people may forget later in the day that they brushed their teeth. An appropriate cue should be easy to identify by a learner and to influence habit formation and supporting the development of automaticity.

Psychologists have found that habits are cued by context (Wood, & Neal, 2007). Furthermore, there are two forms of contextual cues: direct and motivated cuing. First, direct cuing refers to repeated association between routine and environment. Such continuity may facilitate the encoding of learning patterns in students' procedural memory. For this reason, habits can be developed via providing a constant environment, for example, reading in the

same room at the same time, maybe with a favorite hot tea. Second, motivated cuing refers to the rewarding experience in the past. In other words, previous successful experiences may become a cached motive to do the same thing (Daw, Niv, & Dayan, 2005). For doing so, the cuing environment should include a supporting mechanism, for example, setting feasible plans before solving a complex learning task, like creating. On the other hands, some research also showed that a good everyday habit could be disrupted when specific contexts were changed (Wood, Tam, & Guerrero Witt, 2005).

Routine. The behavioral patterns we repeat most often are literally etched into our neural pathways. Through repetition, it's possible to form (and maintain) new habits in which new response mechanisms, called scripts or schema by cognitive psychologists, are formed. "Any sequence of mental action which has been frequently repeated tends to perpetuate itself; so that we find ourselves automatically prompted to think, feel, or do what we have been before accustomed to think, feel, or do, under like circumstances, without any consciously formed purpose, or anticipation of results." (Duhigg, 2012). A good way to start forming a new habit should keep it easy and simple. The previous study found complex behaviors took longer time to become habits (Lally, van Jaarsveld, Potts, & Wardle, 2010).

People's behaviors and actions can be goal-directed or habitual. Goal directed actions are rapidly acquired and regulated by their outcome. Habitual actions are reflexive, elicited by antecedent stimuli rather than their consequences. If people engage in goal-directed behavior on routine basis it may become habitual. A habit may initially be triggered by a goal, but over time that goal becomes less necessary and the habit becomes more automatic. Performance of instrumental actions in rats is initially sensitive to post-conditioning changes in reward value, but after more extended training, behavior comes to be controlled by stimulus–response (S-R) habits that are no longer goal directed. The research shows that it is possible to change goal-directed behavior with habitual behavior if people are engaged in certain behavior repeatedly or on a routine basis.

It is interesting to note that neural science research nicely complements both behavioral and cognitive learning research. Scripts and schema represent the cognitive treatment of automated responses, and mental models represent the cognitive treatment of a goal-directed non-automatized behavior. Roughly speaking, from the perspective of Piaget's perspective, the formation of mental models is a kind of accommodation on process and the formation of schema is a kind of assimilation process. Neural science provides an explanation of what is happening in the brain as those processes develop and habits form, and behavioral science provides a way to observe and measure the associated conditions and results.

Some research showed that the number of repetitions required to form a habit depends on the complexity of the task (Lally, van Jaarsveld, Potts, & Wardle, 2010). For example, it will take 18 or fewer days for easy tasks (e.g. riding a bicycle, drinking more water) and up to 254 days for more complex tasks (e.g. going to the gym). Ericsson, Krampe, and Tesch-Römer (1993) argue that it takes as long as 10 years to develop very high-level performance of complex tasks. Moreover, van Merriënboer (1997) distinguishes recurrent tasks (e.g., those that are performed more or less the same way regardless of surrounding circumstances) from non-recurrent tasks (e.g., those that require modifications in performance depending on variations in the circumstances). Recurrent tasks are more amenable to the formation of automated responses and the development of habits, whereas non-recurrent tasks typically require the activation of mental models to perform some aspects of the task, and, as a result, are not so easily automated. The literature on habits of mind could be interpreted in part as referring to how a person develops coping mechanisms to respond to non-recurrent tasks.

Satisfaction (reward). Through the routine behavior and action, people feel their needs get fulfilled or have a sense of satisfaction or achievement. Our brain likes satisfaction, fulfillment, achievement and enjoyment, which helps us remember the "habit loop" in the future. Reward or satisfaction in the new habit possibly increases a positive feedback loop that helps the repetition of the new behavior in the future (Neal, Wood, Labrecque, & Lally, 2012; Lally, & Gardner, 2013). Because Rothman (2000) also noticed that "the feeling of satisfaction indicates that the initial decision to change the behavior was correct (p. 66)", the role of satisfaction as a reinforcer of cue-response associations.

In other words, habits are automatic behavioral which responses to environmental cues, develops through repetition of behavior in consistent contexts, and reinforces a learner's satisfaction. In short, to create a habit, a learner needs to repeat the behavior in the same situation. Hence, we can adopt that the habit loop may provide a mechanism for establishing new behaviors, and learning habit formation is a desired outcome for many interventions.

Cultivating Habit for Interest-Driven Creation

We have discussed the importance of cultivating interest-driven creator in previous paper. Developing habit is related to developing interest, for example, developing reading habit is also developing interest in reading. Once

students have the interest, they will have attention and concentration and will make sincere efforts. While we, educators, are more concerned with the development of complex cognitive behaviors than simple repeated behaviors, it is challenging to unpack the underlying mechanism of how a certain cognitive action becomes an automatic behavior, and is eventually sustained to become a habitual routine behavior in a long term. The formation and execution of habits involving complex cognitive behaviors is more than the simple chain of stimulus and response since one's habit is highly related to the influence of affective aspects and cognitive control. The recent literature on technology adoption, for instance, has highlighted the role of habit, emotion and environmental cues to explain the habitual continuing use of information technology (De Guinea & Markus, 2009; Lee, 2014). This view is dramatically different from the traditional theoretical view on the continued use of technology (e.g., Technology Acceptance Model) that emphasizes the role of intentional and reasoned actions. De Guinea and Markus (2009) argue that the habitual use of IT is less driven by intentional actions but is more driven by triggers in environmental cues.

Start from manageable behavior. To make students be interested in creation, students need to have a good start. Educator need to get students at a manageable pace to. Students will be overwhelmed if they are to form too many new habits within short period of time. Success is more likely when students are focusing on only one or two changes which is manageable for them at a time. Forming habits of complex behaviors may reach the levels of automaticity more difficult than forming simple ones (Verplanken, & Wood, 2006). This is due to the fact that complex behaviors involve more thinking processes (Wood, Quinn, & Kashy, 2002). For this reason, when developing students' habits, it is easier for them to start with creation activities which are not too complex. We can take a spiral progressive approach to get students engaged in more complex creation activities at a later stage.

Create a cueing environment (a reminder). for example, if a student start to engage in knowledge creation work at a fixed time for a fixed length of period, we should provide a cueing environment which make them not hesitating from the beginning. It is ok to remind students at the beginning of habit formation by clarifying the goal of the learning activities with the students. If the student knows the purpose of the activity, he/she can focus on the learning and the study will be goal directed which can become habitual later.

Another cue could be the educator himself/herself. Teachers can be the role model of students as interest-driven creator. Previous research on mirror neurons shows that observing other people's behaviors may facilitate unintentional and non-conscious mimic behaviors (Rizzolatti, Fadiga, Gallese, & Fogassi, 1996). The finding suggests that students should be situated in a learning environment with good behaviors. In classrooms, teachers should become the role models so that students can mimic what routines we want them to do. Besides, the teachers should also setup a norm that is conducive to develop crowd habits in classrooms.

It is helpful to view the process of habit development, especially for more complex forms, as the interplay between one's agency and situational resources. That is, one's will alone is not sufficient to develop and sustain routine behaviors in a long term, unless situational opportunities and resources are provided as affective and cognitive support. Situational resources act as triggers in a cueing environment. For instance, the design of an immersive simulation in classrooms (Lui & Slotta, 2014) demonstrates the possibility of using technology as a trigger for collaborative inquiry activities. The large public display on the classroom walls provides a situational cue where students can easily monitor the collection of ideas and the current status of the community knowledge. When entering the room with the situation cue, the students are engaged in actions where they can easily check and monitor ideas. Further, the immersive simulation on the large display may be able to trigger routine behaviors for students to check what questions are posted and to contribute ideas for collective knowledge advancement.

When we shift our focus of habit formation from the inside of one's mental activity to the interplay between individuals and environmental cues, designing and embedding triggers in environments becomes a central issue. The criticality of environmental cues in habit development suggests the need to design tools and platforms that effectively provide relevant triggers. With that, we can explore how the recent development of emerging technologies can help provide effective and meaningful triggers to students. For instance, the recent use of wearable technologies has demonstrated the potential of detecting, capturing and analyzing data generated by individuals with a wearable device. Data is seamlessly collected in an unconscious manner, hence reducing one's cognitive load of tracking and monitoring. Data from such wearable devices can prompt individuals to evaluate their performance, and in some cases can provide motivational triggers to alter certain habitual behaviors. Such applications for raising self-evaluation and self-regulation have been proposed mainly in the field of healthcare systems, including the visualization of eating habits and the sensor-based system to monitor dietary habits (Faudot, Lopez & Yamada, 2010; Shuzo et al. 2010). However, the application of such wearable and data-based technologies for educational purposes is in its infancy. Perhaps, learning analytics is the most actively researched area that concerns with the use of the vast amount of data for enhancing teaching and learning (Siemens, 2013). Considering that many online crowd-based learning platforms leave a vast amount of learner's habitual data such as reading, writing, and study patterns,

such data can be automatically detected and made meaningful to users as motivational triggers to reinforce positive habits or to develop new habits.

Get students engaged in the behavior on a routine basis (do the same thing at the same time everyday or on regular basis). It is essential for students to practice the new habit regularly until it becomes a routine in their life. Postponement or interruption should be avoided because it weakens the habit formation. The routine schedules in schools provide such possibility as educators can get students engage in knowledge creation work in a fixed time slot.

The Fostering a Community of Learners (FCL) (Brown, 1992) is a classic example of classroom implementation where students were able to develop a habit of sharing their ideas and interest horizontally in a classroom and also vertically across different grades (Collins, Joseph, & Bielaczyc, 2004). FCL employed a dramatically different structure where students are engaged in crosstalk and reciprocal teaching to discuss across different topics, to work in different groups, and to co-teach each other for understanding. Such built-in activities and structures influenced the emergence of a classroom culture where students were able to freely share ideas and ask questions. This culture is a huge deviation from the traditional classroom culture where individual students often engage in fixed activities. What makes FCL successful is the fact that the routine activities of sharing and discussing ideas function not as simply procedural activities, but were operated as a system with the interdependent activities that the underlying objectives are articulated (Bielaczyc & Collins, 1999). That is, both teachers and students as community members were aware of why they are engaged in certain procedures, thereby creating the shared understanding about their actions.

Reinforce students' satisfaction. The sense of satisfaction can help students engage in new behaviors in the habit loop. If students are satisfied by the experience of a new routine, they typically attempt to facilitate behavioral changes, and vice versa. Specifically, we consider that the satisfaction of the habit loop will increase the strength of the habit formation, whereas low satisfaction will gradually weaken it. Satisfaction may be boosted by reinforcing un-existing wanted habits, or disrupting existing unwanted habits. Regarding the former, the satisfaction of habit loop can potentially help students form new good habit, such as, inculcating the reading habit (Asraf, & Ahmad, 2003), or becoming an amateur astronomy (Azevedo, 2013); regarding the latter, satisfaction can also help students break old "not-so-good" habit, such as, weight loss (Finch, Linde, Jeffery, Rothman, King, & Levy, 2005), and smoking cessation (Baldwin, Rothman, Hertel, Linde, Jeffery, Finch, & Lando, 2006). That is, the satisfaction of habit loop can apply a habit formation approach in designing behavior change interventions.

The key to students' satisfaction is to create successful learning experience as often as possible. Fortunately, educators and researchers have already provided several feasible ways to doing so. Generally speaking, successful learning experience can be achieved by cognitive and affective scaffolding. Cognitive scaffolding may support students to complete difficult learning tasks, such as questioning, providing hints, explaining, coaching, and modeling (see van de Pol, Volman, & Beishuizen, 2010), while affective scaffolding may encourage students to finish tasks and prevent possible negative emotions, such as anonymity (Cornelius, Gordon, Harris, 2011) or information hiding (Cheng, Wu, Liao, & Chan, 2009). In particular, teachers should provide low-ability students with additional assistance, so that students can acquire the satisfaction in the habit loop of interest-driven creation.

Conclusions and Discussions

Building good habit is important and fundamental for education, be it in school or out of school. It will have in-depth impact on student's life-long learning and will nurture them as interest-driven creator. There are so many intervention projects in schools which use innovations to transform students learning experiences. However many these interventions' impact on school practices is limited. More research is needed in addressing the fundamental issues on education. Nurturing good habit is one of them.

Can habit formation be cultivated by educators? The answer is yes. As discussed in the paper, the mental processes and dispositions for habit can be taught and practised, so that they become habitual ways of working towards thoughtful, purposeful, self-regulated action in facing the challenges of life. Having said this, there are many issues remains to be addressed when cultivating students habit in interest-driven creation.

The first issue is time. The widely touted theory, highlighted in a 1993 psychology paper and popularized by Malcolm Gladwell's book Outliers, says that anyone can master a skill with 10,000 hours of practice. One can say that habit formation is the basis for becoming an expert in a particular area. If we are able to get students accumulate considerable amount of time on a regular basis if not daily, students are more likely to form a habit and become an expert in the area later. However it is not realistic to expect students to be an expert in too many areas because forming habits takes time but students' time is not unlimitedly as they need to do other activities as well. Therefore educators and researchers need to prioritize the learning habits we would like students to form. It is found in the

literature that researchers and educators tried various innovations in teaching and learning to help students learn better. Do we need to take step-by step approach to address more fundamental learning habit (e.g., reading) first? If yes what are those more fundamental and important learning habits that we want students to form so that they can be successful in learning?

The second issue is the satisfaction (reward) out of the new learning practices. as many learning habit we would like to students to may not have immediate impact on students learning which is measured by traditional exam, how to make students more satisfied through the new learning experiences? More research is needed in this area to reinforce the students' satisfaction from the new learning experiences.

The third issue is the relationship between interest and habit in the IDC theory. We need to tab on students interest in cultivating their learning habit. If we provide a cueing environment for students' habit formation, is this in align with their interest? What if students do not have this interest at the beginning? Or can they develop interest after we introduce them the new learning practices?

The fourth issue is the balance of educator's effort and students' effort in habit formation. The intrinsic motivation is important for habit formation. Educator and parent can provide cueing environment and provide scaffold and support. How much scaffold and support is needed? How to increase students' intrinsic motivation for the habit formation?

Last but not least, for cultivating students' interest-driven creation habits, do educators, parents, or researchers, as students learning designers, need to form habit in interest-driven creation or designing learning environments for cultivating and developing interest-driven creators? If yes how?

We may not have immediate answers for all these questions and there could be more issues need to be addressed. More research and discussions are needed in exploring this under-explored area. We raise the questions here to stimulate more in-depth discussions among educators, parents, researchers and policy makers.

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