The IDC Theory: Creation and the Creation Loop

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Abstract: Undertaken by a group of researchers in Asia, the Interest-Driven Creator (IDC) initiative is a collective endeavor intending to construct a holistic design theory for technology enhanced learning in the future. The IDC Theory hypothesizes that, with the support of technology, *driven by interest,* our students can be *engaged in creation* of knowledge or things, and, by repeating this process in their daily learning activities to foster their *learning habits,* our future generations will become *lifelong interest-driven creators*. Therefore, *interest*, *creation*, and *habit* form the three anchored concepts of the IDC Theory. Creation, the second anchored concept, is the core of learning because it makes learning productive, creative and achieving. This conceptual paper focuses on describing the three components of the *creation loop*, which consists of *imitating*, *combining*, and *staging*, and how they may support the development of creation capability.

Keywords: Conceptual paper, Interest-Driven Creator (IDC) Theory, creation capability development, imitation, combination, stage

1. Introduction

Learning must involve learners and learning activities. But what does a learning activity constitute? This is the subject of the second anchored concept—*creation*. In the IDC Theory, we view that learning is creating, and creating is learning. In the long history of human development, our ancestors learnt by creating, and, through learning, they created. Creation or creativity is not some mysterious capability only limited to a small group of people who are labeled as geniuses. Humans are natural and genuine creators—using and creating tools; observing how other people do things and then mimicking themselves; communicating with each other via gestures (initially in the ancient times), then via oral language when oral language was developed, then via written language when written language was developed, and, now, via digital media. Every act is a different act, combining what a person knows already to what that person perceives from various senses: visual, audio, tactile, and others. From ancient times to modern times, humans have been progressively creating knowledge and things. Now this process goes increasingly faster. Unfortunately, this natural acceleration process of creation has been distorted by formal education since the Industry Revolution, and particularly by examination-driven education in Asia. Nevertheless, with technological support, this natural creation process can resume, propelling schools toward forward-looking education in the twenty-first century.

Given this view of learning, we assert that creation consists of three components—*imitating*, *combining*, and *staging*—forming the *creation loop* (Figure 1). Each of the three creation components can be standalone activity (e.g. reading involves imitating and is usually a standalone activity) or group activity (e.g. complex tasks such as inquiry learning projects involve all three components and are typically group activities).

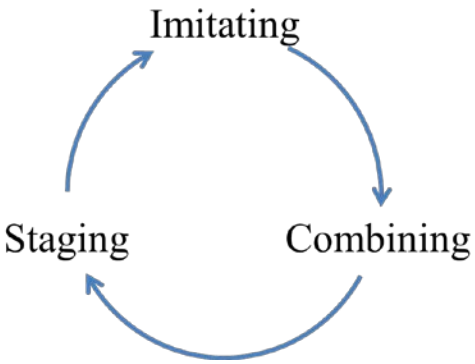

Figure 1: The Creation Loop

2. Imitating: the beginning of learning and creation

The present-day emphasis on creativity and innovation can easily devalue the imitation role in learning. Learning, as well as creation of ideas and things, however, begins with imitation. Meltzoff and Moore (1977) found that newborn babies, as young as 41-minutes old are able to imitate basic manual and facial gestures from an adult. Toddlers, before they develop their language, also demonstrate imitation behavior. Nadel (2002) sets up a playroom with two copies of everything. In the room, when one child picks up an umbrella, the other child picks up the other umbrella. When the first child starts spinning the umbrella, the second child spins her too. Such reciprocal imitation behavior goes on endlessly.

For adults, imitation behavior produces even far-reaching effect. Dawkins, in his book The Selfish Genes, describes how social practices, languages, ideas, as well as belief systems are being transmitted from generation to generation, producing different cultures throughout the world. The term 'meme' used in the book has become a word in the Oxford English Dictionary, referring to a type of behavior passed on from one member of a group to another by non-genetic means, especially copying or imitating. Indeed, unlike other species, we are able to learn by imitation -- the basis of human culture.

2.1 Neurological basis for imitation learning

It is natural to predict that some innate mechanism must be present in human brain to allow spontaneous imitation behavior. Actually, humans are born to imitate. Scientists finally found the neuro mechanism of imitation. The groundbreaking discovery of a special class of brain cells, called mirror neurons, possibly provides a unifying framework for understanding learning, language, empathy, and possibly more other human mental abilities. The potentially far-reaching implications of mirror neurons explain why Ramachandran (2000) claims that mirror neurons will do for psychology what DNA did for biology.

Mirror neurons were discovered more than 20 years ago (Pellegrino, et. al., 1992; Rizzolatti & Fabbri-Destro, 2010). In experiments with monkeys, Rizzolatti and his colleagues noticed that some neurons in the monkey brain fired equally when the monkey performed an action, for example, reaching for a peanut, and when someone else performed the same action. These copycat cells and their mechanism were hard to imagine at the beginning. Later experiments with humans via functional magnetic resonance imaging (fMRI), which can examine the entire human brain at once, suggest that a much wider brain areas demonstrate mirror properties in humans than previously thought (Gazzola & Keysers, 2009).

Actually, when we are listening to other people, we are mirroring the speakers with their tongues as if we are simulating their speech by talking to ourselves the same speech (Fadiga, et. al., 2002). This is possibly the way our brain understand other people's speech, hypothesized by Liberman and Mattingly (1985). Likewise, reading will also invoke mirroring mechanism. Watching videos for some actions and reading sentences describing the actions, such as "grasp the banana" and "bite the peach," will activate the same specific areas of brains for controlling the movements of the hand and of the mouth, respectively. This suggests that mirroring process may help us understand what we read by internally simulating the actions we just read. It may also suggest that when we read a novel, mirror neurons in our brains simulate the actions described in the novel, as if we were doing those actions ourselves (Aziz-Zadeh, et. al., 2006).

In sum, mirror neurons fire when an individual bites an apple, sees an apple being bitten, hears an apple bitten, and even just says, hears and reads the word "bite" (Iacoboni, 2008). Thus, mirroring is an incessant neuron mechanism as we use our own senses—sight, hearing, etc.—to get information about the world around us.

However, to understand other people's minds, we need to identify their intentions (goals to achieve) because behind an action there could be possibly different intentions. Yet, mirror neurons are able to code differently the same action for different intentions (Fogassi, et. al., 2005).

Taking all these lines of research, it suggests that some part of our brain is "no longer 'private' but a part of our social brain, processing the states of others as if they were our own." (Keysers, Kaas & Gazzola, 2010). We do not need to analyze what and why other people are doing and feeling, we simply simulate in our brain, involuntarily and automatically, what they do and what they intend to do, then we understand their minds and feelings. Thus, empathizing people around us is natural to us because we tend to see other people similar to us, not different from us. Mirror-neuron mechanism may also indicate how humans survive and grow in a complex social world.

Despite excitement about the discovery of mirror neurons, some scientists express doubts on mirror neurons research in humans (Pascolo, et. al., 2009; Hickok, 2009). Nevertheless, mirror neurons research is still at its beginning stage, the continual advancement of mirror neuron research has already led us to rethink about learning, social relationships, and our very selves. Ramachandran (2000), for example, proposed that mirror neurons and imitation learning constituted the driving force behind 'the Great Leap Forward' in the history of human development.

2.2 Spectrum of imitation learning

Going beyond mimicking somebody's actions, voices, gestures, or manner, imitation can be viewed as a spectrum of learning activities with multiple forms and levels of interpretation. Imitation requires something or someone that serves a model for imitation, and the imitation process consists of two sub-processes: observation of the model and production based on the observation. The word 'observation' used here is not only by watching; it is used in a general sense: inputting information by our senses (sight, hearing, etc.) from the situation as well as reading text or watching video. Production is about outputting—delivering information, performing actions, or making things after observation—resembling the model to some degree.

Modeling, a form of imitation learning, takes somebody as a model and attempts to understand and follow the model's ideas, methods, manners, or ways of making things. Bandura (1986, p.19) argued that "virtually all learning phenomena, resulting from direct experience, can occur vicariously by observing other people's behavior and its consequences for them." Modeling is indispensable in learning how to master complex skills. For example, to learn their mother

language, children must need to expose themselves to the utterances of adults who serve as their models. It is too costly to learn through trial and error. Learning hunting or swimming may even cause fatal mistakes if children learn by trial or error. We need competent models to follow.

Obviously, a source of competent models is expert or teacher. Modeling, the first step in the teaching process of cognitive apprenticeship (Collins, et. al., 1987) refers to an expert's demonstration so that learners can observe how the expert performs the task. Modeling enables the expert to externalize the usual internal process of performing the task, helping the learners to build a conceptual model of achieving the task.

In general, there are three aspects of imitation learning to be considered: what constitutes a model, types of observation, and degree of resemblance between the reproduced product and the model. A model can be somebody or some tangible thing. It can also be a character in a story book or movie, a method described in a book, depicted in a picture, illustrated in a video. Observation is about perceiving and examining either in physical reality or through printed or digital media.

For the degree of resemblance, if the outputted product replicates the model with high degree of resemblance, it is a pure form of imitation. Note that such high-resemblance imitation learning is usually demanded in learning about sports, learning to dance, or learning speech sounds of a language. If, on the other hand, the outputted product bears little resemblance to the model, yet the product is still found valuable, then one may call this imitation process *creative imitation* or simply *creation*. Thus, what turns an imitator to a creator depends on the degree of resemblance between the product and the model.

From a socio-cultural perspective of learning, learning means learning to be a member of the community. Learning to be is about enculturating into the practices of a field often via legitimate peripheral participation via apprenticeship (Lave, 1991; Brown, 2005). Being a legitimate peripheral participant becomes akin to observing and "imitating" the practices of the core member of the community. Joining the community and moving from the peripheral to the core would involve cycles of imitation and engaging the real work of the community through creation practices and staging practices through scaffolding by the more knowledgeable members of the community.

3. Combining: the mechanism to move from imitation to creation

At this point, it is interesting to review how the word 'learn' is defined in dictionaries. In the Merriam–Webster Dictionary, it is defined as "to gain knowledge or skill by studying, practicing, being taught, or experiencing something" or "to cause something to be in your memory by studying it." In view of these two definitions as well as both the argument on modeling by Bandura and the mirroring mechanism in the brain, as described above, it seems that learning is essentially imitating. Since humans are born to imitate in the brain, humans are born to learn too.

But what constitute "studying, practicing, being taught, or experiencing something?" If, in the imitation process, we address more on the production sub-process, the disparity of the product from the model, and the value of the product, then we shall move from imitation to creation. This explains why the IDC Theory regards that learning is creating and vice versa.

Actually, the taxonomy of educational objectives by Bloom and his colleagues (1956) has already delineated how we can move from imitation to creation. There are six levels in the taxonomy—*knowledge*, *comprehension*, *application*, *analysis*, *synthesis*, and *evaluation*—moving through the lowest level to the highest. The movement is even clearer if we look at Anderson and Krathwohl's revision of the taxonomy (2000)—*remember*, *understand*, *apply*, *analyze*, *evaluate*, and *create*. The revision switches Bloom's *synthesis* and *evaluation* to *evaluate* and *create,*

respectively. For Anderson and Krathwohl, they put *synthesis* at the highest level, and, like us, they view it (we use the word 'combination') as *creation*. For the first three levels, from *remember*, *understand* to *apply*, they represent imitations with different levels of outputting the product. For example, *remember* concerns least with the outputted product while *apply* concerns most. For the last three levels, *analyze*, *evaluate*, and *create*, perhaps we can look at them in different ways. In order to create (to synthase, or in our words, to combine), we need to *analyze* what we have and *evaluate* what elements to retain and what to get rid of. Then, with some planning and probably with some new ideas and elements of our own, we *combine* them with all the retained elements to form something new.

Indeed, everyone can create, just as creating novel speech 'on the fly' when talking with somebody (Andreasen, 2006). And we never cease to create, but genuinely original creation is rare. Most creations are re-creations, and new things are built on from the old things. What is 'new' and what is 'old' depend on an individual's brain or a specific community's brains. Actually, when perceiving new information from the environment, we always make sense of this new information (possibly through mirroring in our brain) and combine it with our own background knowledge (what has had already in our brain) in order to create another piece of new information as our outputted product.

The notion of learning as creation has many adherents in various frameworks and approaches to learning; ranging from learning by doing, knowledge building, constructionism, tinkering, and the more recent Makerspace movement. These take somewhat different perspectives and nuances to learning as creation, but there is one common underlying idea—combination—putting different ideas and things together to form something novel and valuable to the community.

Assessing the processes and products of creation poses a challenge to mass education, as it involves more time-consuming but thoughtful deliberations of them. Designing rubrics for assessment, nurturing a culture of self-evaluation and self-regulation; peer-assessment, etc., are strategies that have been reported in the literature. Assessments usually compromise between efficiency of administration and grading, and authenticity. For example, MOOCs pose a challenge to creation because of the challenges of assessing created products and assignments.

4. Staging: sustaining, improving and advancing creation

Maslow's hierarchy of needs, from lower level to higher level, presents five levels of needs: the *physiological* needs, the *safety* needs, the *love* needs, the *esteem* needs, and the needs for *self-actualization*. We may conjecture that our imitation behavior, which aims at how we are similar to others, tends to meet the two lower-level needs—*safety* and *love*—so that, just like everyone else, we can be recognized as a part of the community. On the other hand, our creation behavior, which aims at producing something new and valuable to the community, tends to meet the two higher-level needs—*esteem* and *self-actualization*—so that we are not only a part of the community, we are, with our own creations, able to contribute something valuable to the community. But we need a stage to demonstrate and prove the value of our creations.

Shakespeare said: "All the world's a stage, and all the men and women merely players." The world is your stage. Imagine when you are playing a role in this stage, you have opportunities to demonstrate the value of your existence through your creations. If you are a student in school, for example, the community around you is your stage. When you talk to one of your classmates about your idea (i.e. your creation), then your classmate becomes your stage; when you talk to a small group of classmates, then they become your stage; when you talk to the whole class, the whole class becomes your stage; when you talk to a large online community, then the online community is your stage. In this process, your creation gets recognized by your community. At the same time, the

feedbacks received from the community sustain, improve and advance your creation. Of course, the same argument applies to creations by a collaborative group of students. To excel, staging is essential, whether the creations are individual or group products.

Staging is an indispensable component of creation process. One implication is the design of learning tasks that require performance and staging on the part of learners – learners create artifacts or stage their performance that can matter and not just be thrown away. The knowledge building paradigm posits advancing knowledge in the community; articulations of learning as being authentic, problem-based or project-based learning point to providing a context or stage for learners to be engaged in such authentic learning experiences. Staging also has implications for assessment and learning; solving a quest or problem in a virtual world or in a well-designed game-like environment is not only staging, but a demonstration of competencies in both the domain and non-domain – which may hold more validity in just doing traditional forms of assessment like paper-and-pen tests. Assessment itself is learning.

5. Summary

In this paper, we describe the three-component creation loop. Imitating, the first creation component, talks about learning through observing others, adopting examples, or absorbing information through any means to mimic or emulate somebody or something that serves as a model. Combining, the second creation component, refers to synthesizing the thoughts or things of others and the self's own to form something new or different. Staging, the third creation component, mentions about displaying products, presenting new thoughts, or demonstrating achieved outcomes to others.

Imitating is the beginning of creation; combining the core of creation mechanism; and staging the platform for advancing creation.

6. Future Work

Also, we shall investigate further community creation vs individual creation. Since creative thinking is an important 21st century skill, we shall explore teaching creativity in schools.

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References

Anderson, L. W., & Krathwohl D. R., (2000). *A Taxonomy for Learning, Teaching, and Assessing—A Revision of Bloom's Taxonomy of Educational Objectives*. Allyn & Bacon.

Andreasen, N. C., (2006). *The Creative Brain: The Science of Genius*. Plume.

Aziz-Zadeh L., Wilson S. M, Rizzolatti G., and Iacoboni M. (2006). Congruent embodied representations for visually presented actions and linguistic phrases describing actions, *European Journal of Neuroscience*, *15*(2), 399-402.

Bandura, A., (1985). *Social Foundations of Thought and Action: A Social Cognitive Theory*, Prentice Hall.

Bloom, B. S., (1956). *Taxonomy of Educational Objectives: The Classification of Educational Goals*, (eds.) Longman.

Brown, J. S. (2005). New learning environments for the 21st century. Retrieved from http://www.johnseelybrown.com/newlearning.pdf/

Collins, A., Brown, J. S., & Newman, S. E. (1987). Cognitive apprenticeship: Teaching the craft of reading, writing and mathematics *(Technical Report No. 403, Center for the Study of Reading, University of Illinnois at Urbana-Champaign)*.

Fadiga1, L., Craighero1, L., Buccino, G. and Rizzolatti, G. (2002). Speech listening specifically modulates the excitability of tongue muscles: a TMS study, *Current Biology*, *16*(18):1818-23.

Fogassi, L., Ferrari, P. F., Gesierich, B., Rozzi, S., Chersi, F., and Rizzolatti, G., (2005). Parietal lobe: From action organization to intention understanding, *Science 308*, 662–67.

Gazzola, V. & Keysers, C. (2009). The observation and execution of actions share motor and somatosensory voxels in all tested subjects: single-subject analyses of unsmoothed fMRI data, *Cereb Cortex 19*(6): 1239–1255.

Hickok, G. (2009). Eight problems for the mirror neuron theory of action understanding in monkeys and humans, *Journal of Cognitive Neuroscience*, *21*(7): 1229–1243.

Iacoboni, M., (2008). *Mirroring People: The New Science of How We Connect With Others*, Farrar, Straus and Giroux, *1E*, p.12.

Lave, J. and Wenger, E. (1991) Situated Learning. Legitimate peripheral participation, Cambridge: University of Cambridge Press.

Liberman, A. M., and Mattingly, I. G. (1985). The motor theory of speech perception revised, *Cognition*, *21* 1-36.

Maslow, A.H. (1943). A theory of human motivation, *Psychological Review 50*(4) 370–96..

Meltzoff, A. N., and Moore, M. K. (1977), Imitation of facial and manual gestures by human neonates, *Science 198*, 74-78.

Nadel, J. (2002). Imitation and imitation recognition functional use in preverbal infants and nonverbal children with autism, in A. N. Meltzoff and W. Prinz, *The Imitative Mind: Development, Evolution, and Brian Bases* (Cambridge, UK: Cambridge University Press, 2002)

Pascolo, P. B., Ragogna, R, and Rossi R, (2009). The mirror-neuron system paradigm and its consistency, *Gait Posture*, *30* (Supplement 1): 65.

Pellegrino, G. di, Fadiga, L., Fogassi, L., Gallese, V., & Rizzolatti, G. (1992). Understanding motor events: A neurophysiological study, *Experimental Brain Research*, *91*(1), 176–180.

Ramachandran V. S. (2000), Mirror neurons and imitation learning as the driving force behind 'the Great Leap Forward' in human evolution, *Edge 69*, June 29.

Rizzolatti, G. and Fabbri-Destro, M. (2010). Mirror neurons: from discovery to autism, *Experimental Brain Research*, *200* (3–4): 223–37.