The IDC Theory: Research Agenda and Challenges

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Abstract: In this paper, we examine some of the design principles and contextual conditions for fostering interest in learning. We hope to present some initial discussion of the research issues and challenges that need to be addressed in working towards iterating and refining the IDC theory. Explorations of facets of this theory are intended to motivate further research work and to derive practical implications such as design principles to impact learning and educational practices. We hope to further contribute to the understanding and promotion of interest-driven, creation-focused and habit-oriented perspectives towards a broader vision of what learning and education should be about in Asian countries and societies.

Keywords: Interest; Creation; Habits; Interest-based learning environment

1. Background

Consider the current situation in most of Asia, especially in the East Asian countries and regions. In school learning, developing students' interests towards disciplinary domains is an essential agenda for developing learners to have the knowledge skills and dispositions for careers and work in the 21st century. Students may view the subjects they learn in school as difficult and unrelated to reality. The abstract and synthetic curriculum content in schools does not allow them to meaningfully apply and utilize knowledge in real-life problems. Thus, it is necessary to involve students in interest-driven activities and to make connections between education and reality to increase students' attitudes and achievements towards subjects like STEM (McCrea, 2010). Students are also not motivated to study schools subjects in the humanities like literature, as they fail to see the relevance to their lives, or they perceive that it is difficult to get top grades for such subjects in high-stakes examinations.

Nevertheless, Asian researchers who desire to bring about a significant impact on transforming education have been faced with a great barrier of resistance: a considerable part of formal education in Asia remains "examination-driven" (Kirkpatrick & Zang, 2011a, b; Koh & Luke, 2009; Pong & Chow, 2002). Across Asia, educational practice is largely governed by the short-term goal of obtaining high scores on public examinations. This leads to over-emphasizing the mastery of disciplinary content, resulting some severe drawbacks: learning and teaching are tuned towards producing good examination performances; many students do not enjoy learning; it is difficult for students to develop positive attitudes towards the disciplinary domains.

The twenty-first century, however, marks an era of exponential change. Our world demands productive citizens to have a lifetime of creative and critical thinking, and to deliver new values, innovations, and productivity to thrust social and economic development. Have our schools found the right ways to prepare the young generation for the twenty-first century education? How to help them to develop interest towards the disciplines by building their interests, harnessing their positive habits and fostering their creativity within social contexts? The IDC theory makes a strong case for the roles of interest, creation and habits that enable and foster learning these skills and competencies, and acquiring these dispositions. While various researchers and policy groups have formulated frameworks for describing the skills, competencies and dispositions needed for the 21st century, the relationships and roles of interest, creation and habits in these frameworks need to be further examined and studied.

This paper presents some facets of a research agenda and challenges in the building of interest-based learning environments that provide opportunities for creating and for forming habits and routines. We consider three dimensions arising from the literature study (identity, attitude, and interaction) as basic principles for students to establish their interests. We will then discuss creation and habits together with the goal of building and advancing interest-driven learning environments in schools. Students need to learn through creation so that they develop the innovation mindset; they also need to develop good disciplinary habits of thinking and generic habits of learning. We postulate that approaching the balance between creation and habits as akin to the challenge of how to move up the innovation adaptivity corridor (Schwartz, Bransford & Sears, 2005). Efficiency and innovation are seen as two dimensions of adaptive expertise, and should be approached in tandem to move up the corridor to be adaptive experts.

2. How to drive interest in education?

In many Asian countries and regions, students are evaluated with regularly administered, standardized tests. Schools are also appraised based on how well their students have performed on those tests. With these evaluative methods in place, schools are understood as a place where students compete to acquire as much knowledge as possible and unfortunately, their academic achievements are often linked to their social identities. While we recognize the importance of schooling and standardized tests for education evaluation, one possible avenue to value-add in learning could be to create a different interest-driven learning environment, especially targeting for identity, attitude and interactions.

Identity is the story that we create for ourselves (Polman & Miller, 2010) and for students, their identity is embodied by their skills, academic achievements, interests, aspirations, that they are proud of – both in and out of school. As we develop and pursue interests in different contexts, our experiences develop identities that may influence how we project ourselves in the future (Penuel & Bell, n.d.). This includes acts of social positioning and identification that take place within classrooms (Bricker & Bell, 2008; Hegedus & Penuel, 2008; Wortham, 2004). Research in the anthropology and sociology of education has described how students' diverse social identities both influence and are shaped by schooling (e.g., Cazden, John & Hymes, 1972; Mehan , 1996; Varenne & McDermott, 1999). Research also indicates that one's identity affects their interests, motivations, and beliefs (Brickhouse, Lowery & Schultz, 2000; Carlone, 2003; Painter, Jones, Tretter & Kubasko, 2006).

To drive interest-driven learning in education, we need to also look into student attitudes towards these subjects. Attitude refers to emotion, cognition and intention (Myers, 1993). It is viewed as individual's beliefs about an object (Fishbein & Ajzen, 1975). Student attitudes towards science are influenced by interest and emotion (Mamlok-Naaman, Ben-Zvi, Hofstein, Menis & Erduran, 2005). They find science abstract and complex (Piburin & Baker, 1993), boring and impractical because teachers focus on memorizing content (Nolen, 2003). Similarly for mathematics and engineering, students find knowledge complex and difficult to learn (Bingolbali, Monaghan & Roper, 2007). The lack of learning support in learning mathematics also decreases students' interests in learning; leading to negative attitudes (Stone, Alfeld & Pearson, 2008). Current engineering and mathematic courses emphasize theoretical understanding over practical application. Dewey (1913) wrote: "Things indifferent or even repulsive in themselves often become of interest because of assuming relationships and connections of which we were previously unaware. Many a student has found mathematical theory lit up by great attractiveness after studying some form of engineering in which this theory was a necessary tool."

Despite the inherent challenges involved, students do enjoy the study of science and mathematics. They understand these subjects as essential for engineering. They have positive attitudes towards engineering due to its contribution to society, and are willing to engage in engineering-related careers (Hilpert, Stump, Husman & Kim, 2008). However, students want to learn science in a practical way (Osborne & Collins, 2000). When students practice science knowledge and understand its applications in their daily lives, their interests in science may increase (George, 2006). Similarly students have a positive attitude towards mathematics. Students want to learn mathematics because it relates to their future careers and lives. Students' achievement in mathematics is also determined by the extent they are anxious about mathematics (Walsh, 2008).

At the core of Vygotsky's Cultural-Historical theory (1978) is the idea that interactions between children and their social environment nurture children's development. These interactions

involve the people around them, cultural artifacts, such as books or toys, along with culturally specific practices, in the classroom, at home or on the playground. Children construct their own meanings, knowledge, skills and attitudes based on these interactions. “A child’s greatest achievements are possible in play, achievements that tomorrow will become her basic level of real action and morality” (Vygotsky, 1978). Interaction supports development through imaginary situations where children take on roles, and rules while acting out their imagined scenarios. To Vygotsky (1978), these scenarios create the "zone of proximal development” and most effective learning happens here - when new skills and concepts are taught just on the edge of emergence.

During interaction, multiple pathways and outcomes are possible to allow for a greater range of experimentation and opportunities for observations, testing, failure, and success as the purpose and pathways that drive engagement and persistence are authored by the learner. Children develop exploratory as well as explanatory drives in interaction: they actively look for patterns, test hypotheses and seek explanations, leading to increased complexity in thinking, learning and understanding (Gopnik et al, 1999).

Thus, the learning environment as a site for identity development is likely to take on significance for students if it unifies the classroom and the outside life in a way that allows students to bring and explore their interests, their cultures, and their communities as part of curricular activities (McDermott & Webber, 1998). Hence, framing a learning environment that takes into account the identities and attitudes of students with multiple pathways of interactions would be beneficial for students through their school life and beyond.

3. How creation leads to an interest-based learning environment?

One long lasting line of research in creation as learning has been in the area of knowledge building. Tan, So and Yeo (2014) reports knowledge creation practices in schools, and asserts that schools should focus on developing students’ capacity and disposition in knowledge creation work. New programmes of research like Makerspace (Good & Krull, 2013) provide another perspective to knowledge creation. However, the epistemologies of knowledge building and creation are not resonant with those of prevailing school cultures, hence the challenges of incorporating and translating knowledge building practices to actual practices in schools persist in many countries and regions of the world that have attempted such approaches. One of the challenges to having students create knowledge and artifacts is that students engage in problem-based or project-based learning and inclined towards the completion of tasks with less consideration for learning. What learning tasks and situations, interactions and mechanisms need to be in place so that students doing staging or performance lead to learning? What are needed from the perspective of IDC is to study the types of school practices, pedagogical and collaborative patterns, and interaction protocols that can bring scaffold the Imitation-Combining-Staging loop of creation.

In schools, face-to-face classroom situations can host a broad variety of pedagogical patterns (e.g. think-pair-share, IRE, jigsaw, gallery walk) of student-student and student-teacher interactions. But the modularity of class periods, typically ranging from 35 to 90 minutes, imposes a premium in contrast with those (such as knowledge building activities) whose characteristic timescales are measured in days or months or even years. Of particular interest to teachers and administrators are such teaching practices that would not only carry the burden of content (e.g. science, math, foreign language) but also enhancing participating students’ development of so-called 21st century skills. For instance, in the design-based research work on GroupScribbles (Looi, Chen & Ng, 2010), students engage in rapid collaborative knowledge improvement patterns by posting their initial ideas on a common space (imitating), reading and building one each other ideas (combining), and creating group products or artifacts or presentations (staging). Questions that lend themselves to more work include: how to define success to find collaborative patterns that are efficacious for short/rapid and slower/longer-term knowledge creation and improvement? How to achieve success? Which patterns are most adoptable? How to support teachers to implement patterns? How to design pedagogical principles customized for unique needs? What are the determinants of learning? What are the favorable socio-cultural conditions, that is, how do we know learners have moved up the optimal adaptivity corridor?

4. What is the role of habits in learning?

The notion of 'Habits' is a broad term. One can think of disciplinary or professional habits of mind which a learner can aspire to attain. The literature mentions scientific habits of mind which postulates that learning science should be about helping learners to develop these habits of mind. In Dewey's own words, ''the future of our civilization depends upon the widening spread and deepening hold of the scientific habit of mind ... the problem of problems in our education is therefore to discover how to mature and make effective this scientific habit'' (1910, p. 127).

The habits loop points towards nurturing habits of creation and life-long attitudes towards being creators, so that these become dispositions shaping one's responses to learning situations, thereby generating interest in students. These become internalized as routines which help us to learn and perform better. The flip side of habits is to interpret habits as non-innovative routines on the efficiency dimension of the optimal adaptivity corridor. There needs to be opportunities to nurture innovation, so that the learner can also progress along the innovation corridor by their sustained interest in learning.

Habits can also refer to the routines by which we live life and we go about doing our study and learning. There is a flip side to such habits. Carey (2014) discusses what were thought of as "good" study habits in fact hampers learning. For example, students are usually told by their teachers or parents to always study in the same quiet space and time, and to create a ritual of studying. Carey points out some research studies that suggest that subtle variations in the routine such as going to a different room, or library, or coffee place; alternating the space or between light background music, silence, or the drone of people talking, might actually improve learning. The plausible explanation is that when we are studying, we are also registering cues from the world around us at a subconscious level, and weaving them into what is being learned. Different contextual cues make the connections richer, and are further strengthened if the material is reviewed in a different context than when it was initially learned. Each alteration of the routine further enriches the skills being rehearsed, making them sharper and more accessible for a longer period of time (Carey, 2014).

5. From IDC Theory to Practice: Research Agenda and Challenges

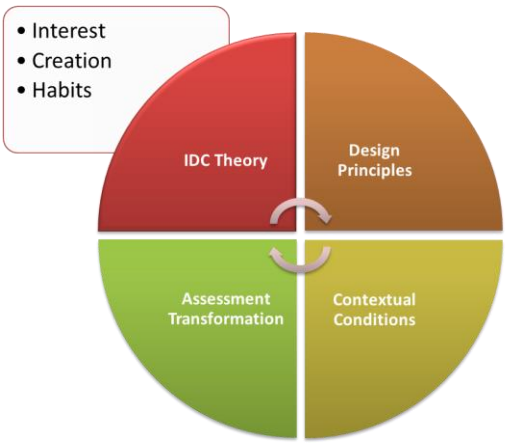

Figure 1. From IDC Theory to Practice: Research Agenda and Challenges

The work to probe elements of an IDC theory will bring us to a better understanding of the theoretical landscape with the vast variety of perspectives spanning psychological, neurological, developmental and socio-cultural accounts of interests, creation and habits. The goals would be to bridge across the various perspectives, and distill design principles which can be applied in an Asian setting.

From a theoretical perspective, we want to hear more stories and research into IDC that suggest alternative frameworks for interests, creation and habits that fall outside of the generic loops presented in the concept papers in this workshop. For example, the creation loop postulates imitation as one essential component in the process of creating; thus, are there creation cycles in which imitation is not part of the process? We need evidence and stories to be found from research, practice or our observations or insights that show the importance and relevance of interests, creation and habits.

Evidence is also needed from industry/real world that shows the impact of learners who are successful in their own ways because of their interests/creation/habits; or such stories.

5.1 Design principles to promote and optimise interest and creation in learning

The design of IDC learning environment could be an entry point for learning to happen in formal and informal context, supporting meaningful engagement of student interests. The underlying motivation applies equally well to the structuring and design of any system, be it mechanical, institutional, or social. It appears that interest-driven learning draws on the earlier concepts – in enabling applied learning as the emphasis on interest, creation and habits, in an authentic learning environment. By capitalising on and catering to students' varying abilities and interests, students develop skills and competencies that go beyond routine cognitive tasks, such as the ability to critically seek and synthesise information, the ability to create and innovate, and the ability to self-direct one's learning (Dede, 2010).

What are the design principles for fostering disciplinary habits of thinking, and effective habits of learning? A key habit of learning is to adopt the creators' habits of mind -- a growth mindset that encourages the belief that one can learn to do anything, and for individuals to become engaged citizens and agents of change (Dweck, 2006). The notion of habits is also encompassing, covering habits or learning and re-learning; automaticity to allow focus on learning; a range of habits ranging from scientific habits to social media habits to dispositions and routine ways of thinking and acting.

What are the design principles for providing opportunities for learners to model, to adapt and to perform in the creation loop? From a research perspective, we need to understand the interplay between individual creativity and collaborative/collective creativity, much akin to work in CSCL which seeks to understand the mutuality of individual and group/community cognition. "Things indifferent or even repulsive in themselves often become of interest because of assuming relationships and connections of which we were previously unaware. Many a student has found mathematical theory lit up by great attractiveness after studying some form of engineering in which this theory was a necessary tool" (Dewey, 1913).

5.2 Contextual conditions to promote interest learning in students

To motivate interest-driven learning in schools, we need to identify how school-based education builds, hampers or affects the foundations for interest-based learning, and on how interest-based learning builds the foundation for strong school-based learning. From a learning sciences perspective, the relevant research question is: what are the design principles for triggering, immersing and extending the development of learners' interest? There are also challenges are when students develop their identities, attitudes and interactions in the school curriculum, namely, that will require internal motivation from students, how to support learning objectives outside of learners' interests, and the impractical levels of resources and flexibility in supporting the divergent interests of individual students (Edelson & Joseph, 2004). The challenge of coverage faces the tension from having to cover a national or state curriculum. Nonetheless, many education systems expect students to achieve a large number of learning objectives. What is needed is to connect objectives to interests and to help teachers and students establish relevance. School practices need to be transformed to enable students to create knowledge in classrooms as in "knowledge building approach." interpret or solve problems from new perspectives, and be creative in the innovation sense.

Interest-driven learning is important to sustain learning. Increasing students' exposure to resources, mentors, inspiring projects, and opportunities — in school, but also in libraries, museums, clubs, and digital spaces — will result in interest-driven learning (Barron, 2006). In postulating her conjectures, Barron (2006) postulates that interest led learners to choose, create, and seek out learning opportunities; Interest driven activities were likely to be boundary crossing, that is move across settings of home, school, work, community, and online; as learning opportunities expanded they increasingly became connected to a sense of present and possible future selves; learning opportunities dynamically developed, for example expertise was often taken up by others which resulted in new learning opportunities. From an Asian perspective where formal education is prominent, pertinent issues are: How about informal learning strengthen formal learning and vice versa? How do we reinforce knowing and knowledge by frequent inter-contextual use? (Looi et al, 2010; Tabak & Nguyen, 2013).

5.3 Transforming assessment to drive IDC theory in education

Assessing the processes and products of creation poses a challenge to mass education, as they require more time-consuming labour intensive processes. Designing rubrics for assessment, nurturing a culture of self-evaluation and self-regulation, and peer-assessment are examples of strategies that have been reported in the literature that attempts to address assessment at scale. Indeed, assessments usually face a trade-off between efficiency of administration and grading, and authenticity of the assessment task. For example, MOOCs pose a challenge to supporting creation processes for learners because of the challenges of assessing such student products and assignments at scale.

6. Conclusion

Although much of the discussion in this paper has emphasized the implications of the IDC perspective on learning in schools, learning environments also permeate the diverse learning spaces from formal to informal learning environments (via notions of seamless learning and inter-contextuality). There is much work on research into informal learning that can also shed light on the roles of interests, creation and habits in fostering learning in spaces like science centres, community clubs, the home, or virtual or cyber communities. Brown (2005) postulates a hybrid model of learning, where we combine the power of interest-based participation in niche communities of practice with a "minimalist" core curriculum for teaching the rigorous thinking and argumentation specific to that field. For students in school, finding and joining such communities could well happen outside formal schooling, as has happened as guilds and interest groups.

Ultimately, more work and research needs to be done to depict the goal and vision of a future of Lifelong Interest-Driven Creators. Indeed, how lucid is this vision in terms of what does the future look like if this vision is a reality? How do schools become transformed? How do spaces for learning look like that resonates well with the IDC theory? What are the unique characteristics in an Asian context? Are such notions utopian scenarios, or in what ways things may not quite work out, and they may turn into dysfunctional scenarios?

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