Design Thinking in a Technology-Mediated Discourse: Studying the Impact of Students Purposeful Learning

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Abstract

Designing is concerned with creating change and is undertaken in many different ways to fit solutions to the problem context. Design Thinking, as a unique way of understanding and solving problems, involves planning with meaningful intention and purpose. Broadly, it engages students in solving problems modeled as closely as possible on problems they will actually encountered in their professional practice (Barrows, 1985). To better invigorate ideation processes, connect and rise-above ideas comprises rational thought processes undertaken in knowledge building, which emphasize on conceptual artifacts (theories, designs, plans histories, etc) as product tools and objects of inquiry (Scardamalia & Bereiter, 2003). Within a holistic fabric of critical and creative thinking processes that also involves intuitive design responses in the realm of scientific facts and ideas, design activities such as model building, conducting experiments, and producing design plans are carried out in meaningfully identified needs, problems and wants calling for solutions that can be realised through manufactured artefacts.

The solutions may arrive through diverse methods where students demonstrated a special motivation, holistic involvement and abilities to harness resources. They learnt to generate ideas, to be divergent in their thinking and knew what to connect and how to connect, bringing ideas to fruition. The Knowledge Building environment provides flexible and coordination for sustained and creative work with ideas to support conscious efforts in research, investigation and on-going evaluation of information for decision made.

The purpose of this study is to discuss a technology-mediated discourse in design and technology education where immersion in knowledge building leads to a spin-off discoveries. We will present a framework depicting various dimensions important for idea improvement. Finally, we will describe conclusions for further research.

1. Introduction

There is a growing body of research in knowledge building that examines the truthfulness of ideas.

This paper presents a study of a research project investigation on the effect of Knowledge Building in Design and Technology education which aims to develop the depth of discourse in idea improvement. The emphasis will be on discussing how technology-mediated discourse has an impact for active monitoring, continual creation of ideas and advancement of group knowledge. In conclusion, we offer some reflections in knowledge building to enhance the Design Thinking process and examining the socio-cultural context for coursework innovation that has given direction to our findings. Designing is an archetype of design problem solving (Jonassen, 2002) and probem solving in a technology mediated environment calls for a greater attention to group skills development so that what is learned is better comprended and retained.

Knowledge-creating organizations emerge from a social process that engages participants in ‘complex, unpredictable interactions’ (Sawyer, 2003, p.19). They articulate their ideas about the phenomenon, comment and build on each other’s ideas, negotiate gaps between the ideas, and work toward achieving higher levels of understanding (Scardamalia, 2002), driving the need for education in which students are able to acquire knowledge and skills beyond that as stipulated in the syllabus through the context of the design-and-make activities. Knowledge Building provides opportunities for exploration of problems, concepts, however, often students become adept at completing the assignment without understanding of the underlying concepts intended to impart. The challenge to teachers is how to use students’ current understandings of the world to build design understandings of that problem.

2. Learning by Design - a new conceptual model

In a knowledge building setting, group skills develop when students engage other members on design consequences beyond their immediate learning boundaries. They make relevant associations between ideas and feelings related to managing group work experiences. The acquisition of skill sets in a group is a gradual process, reflected in the progressive steps of association, integration, socio-metacognition and extension (Figure 1). At each step of the knowledge building process, the students move from having designs and functions of putting ideas into frequent authentic opportunities for collaborating to continually improve and generating insights that make reflections of idea improvement which relate to student group skill processes.

The association (step 1) of positive group behaviours and with group process skills is mediated by the critical design factors, including emerging student efficacy, identification of design problem attributes and engagement of group skill sets through assessment. Individual combines information differently to generate unique associations to problems (Brown, 1989). The integration (step 2) of progressive inquiry allows students to express diverse ideas and aims clearly through identifying of key design issues to be investigated, monitoring discussion process, treating ideas and theories as improvable conceptual artifacts and constructive use of authoritative sources. The opening up of these avenues draw the students to undertake group roles that lead to greater student efficacy and role ownership. The teacher progressively facilitates and engages students in discourse by implementing assessment strategies at an entry level where each student is building efficacy, striving for depth of understanding through synthesizing different ideas and building theories (step 3). A more major step to activity in the design model is how knowledge extension can emerge from individual cognition to participation in work outside one's own group or transferring knowledge into other situations (step 4). The preceding steps suggest that a design-centered model of learning for knowledge building should provide for an immersive environment in which idea improvement is a pervasive emphasis.

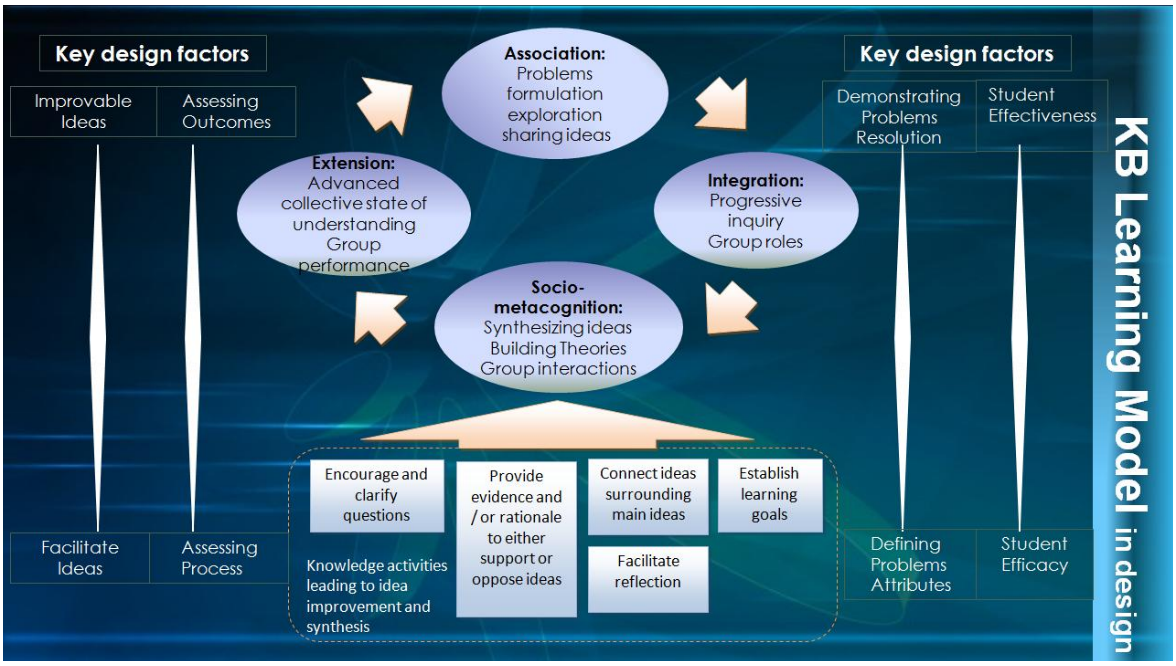

Fig.1. Knowledge Building Learning Model in Design

3. Method

3.2 Participants and context

This study is situated in the context of a multimedia community platform known as Knowledge Forum (KF) (Scardamalia 2003), which enables a computer-supported collaborative learning (CSCL) environment. Students contribute theories, working prototypes, plan, evidence, reference materials, and so forth to this collaborative workspace which allows students to create and co-author notes to make continual revisions, improvement of public artifacts, elaborations and advancing knowledge as a

designers' community. The participants in the study were 42 Design and Technology students from Secondary 3, Normal Academic stream. The students 26 boys and 16 girls, were introduced to knowledge building pedagogy in the context of situational tasks in problem formulation and identification as an induction move as knowledge enculturation for 12 weeks. The teachers presented an ill-structured task in advance and allow students to problematize, define and refine their problems of understanding using scaffold supports as broadly outlined in the training phases as follow:
Training Phases
a) Formal KF introduction in computer lab (2 warm up activities) and pedagogical training (3 days)
b) Weekly class consultation sessions (12 weeks during enculturation phase)
c) Lesson intervention as iterative design and online support (ongoing throughout study)

3.3 Data collection

At the end of 12 weeks, their notes were compiled and segmented into idea improvement categories. The notes were coded using the open coding method based on Grounded Theory. Open coding is part of analysis concerned with identifying, naming, categorization and describing phenomena found in text (Borgatti, 1996). Five main categories were identified in this case as depicted in Table 1, namely Problematization Refinement, Uncovering Depth, Advancing Design Development, Concretizing Ideas and Swing Notes by two raters in negotiation to reach an agreement on principal category and independently coded the notes. The inter-rater consistency is 78%. Rating for idea improvement increased over time as content of all notes using a 3-point scale (0=no evidence; 1=some evidence; 2=clear evidence) was assessed.

Table 1: Idea Improvement Category System

1. Problematization Refinement
1a. Problem Space Analysis: Statements that advance the definition of or state the causes behind the problem *1b. Critique of Problem Identification:* Statements that evaluate, review or make revision of the problem definition analysis statements
2. Uncovering Depth
Statements or sketches that open up possibilities (depth, appropriateness and unknowns) for new directions or lead to knowledge of understanding
3. Advancing Design Development
3a. Generation of Novel Ideas: Sketches of improved shapes and forms adopted from an original design becoming more appealing *3b. Preventive Forms and Creative Invention:* Notes or sketches that advance the mental construction of pre-inventive structures to visualized patterns and object forms. 3c. Significant Suggestion: Suggestion of alternative methods which seek to sieve truthfulness in generating new ideas *3d. Appraisals of Ideas:* Statements that surface decision in relation to applicable standards and implementation requirements which contributed to revision of ideas
4. Concretizing Ideas
4a. Idea Analysis: Statements that concern two or more entities for decision making or generating parameters for convergent of possible solutions *4b. Idea Elaboration:* Statements that provide details or elaborate on previous stated ideas *4c. Idea Confirmation:* Statements that state the decision in its final form or confirmation of the decision
5. Swing Notes
Statements that do not contributing to idea improvement. These are off-task notes, simple agreement or disagreement notes

3.4 Unit of Analysis

The unit of analysis is defined as a message idea. The notion of 'message idea' refers to design sketches or comments in the postings. Two or more codes could be assigned to most messages and each code was recorded. Multiple occurrences of the same message idea from the same student were coded once. On the other hand, if a message contained two or more ideas, each idea would be coded separately.

3.5 Convergence of Idea Improvement

The values of 1, -1, or 0 were assigned to each message where moving discussion towards (impact=1) or away (impact =-1) from idea improvement, or maintained status quo (impact =0).
Convergence of Idea Improvement (CII) which we adapt Markov model was used (Ross, 1996) to develop a measure for convergence, C, is a measure of position defined as $C= X_1-X_{-1}$ I X_1+X_{-1} $(-1<C<1)$ to show the extent a group progress towards idea improvement as the value is closer to 1.

3.6 Idea Improvement

Idea improvement is an explicit principle, something that guides the efforts of students and teachers rather than something that remains implicit in inquiry and learning activities (Scardamalia, 2002). In the knowledge building environment, the diversity of ideas raised by students is necessary. They work with the full set of ideas generated by the community, identifying gaps and weaknesses, engaging in constructive critiques, pursuing better explanations, formulating and refining new problems. Students' ideas are regarded as improvable objects through Knowledge Forum where interaction with the ideas of peers, new and improved ideas are continually diffused throughout the communal knowledge space. This fosters an inner-outer community dynamic that serves to further enhance knowledge advancement (Woodruff & Meyer, 1997).

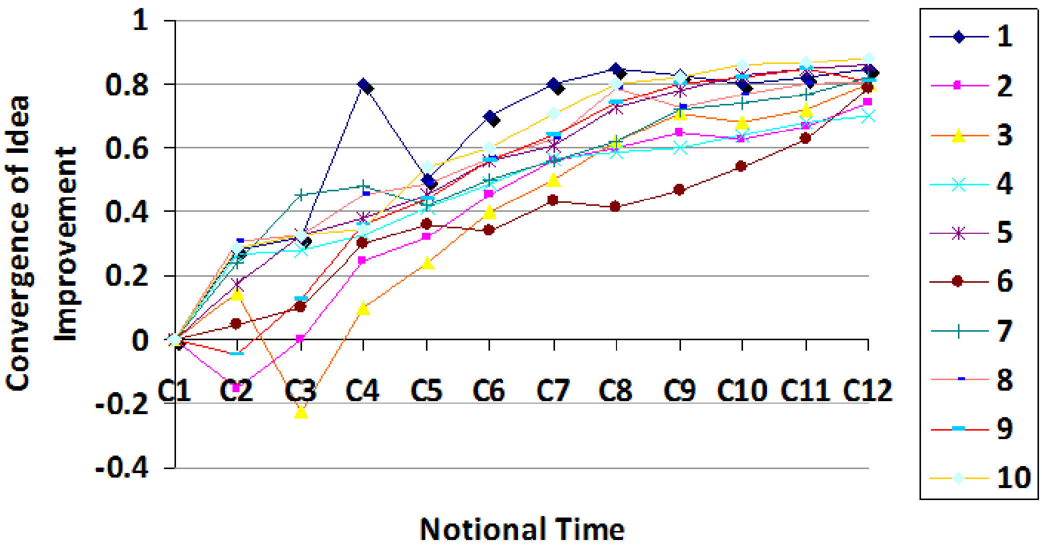

Fig.2. Convergence of Idea Improvement curves

Figure 2. further shows detailed results of 42 participants' interactions in the knowledge-building stages to work at idea improvement. The focus of students' discourse with regard to idea improvement changed over time from the early to the later knowledge building stages. In this particular analysis, although none of the groups' discussions managed to reach the full extent of idea improvement, the curves do indicate a positive trend of moving towards and almost reaching the ideal CII value of 1. One large deviation from the positive trend is that, after group 1 discussion pushed strongly towards idea improvement from week 3 to 4 with a sharp rise in CII value, it plunged from a high CII value of 0.8 to 0.5. This resultant came from a large number of notes deviating from the learning task, non acceptance to criticisms of ideas and new solutions. However, the group's discussion managed to recover from the sharp drop in the extent to which it pushed towards idea improvement and comparatively reaching the proximate level as the other groups in the following weeks. Henceforth, we can see that different paths can lead to similar results, and the multiple points of a curve must be considered in deducing learning and problem solving processes that took place in reaching idea improvement. Therefore it is necessary to treat all ideas as improvable and allow time for iterations, taking into account a successful process to improving ideas.

In addition, Figure 3. further illustrates the contribution profiles in relation to elucidate students' exchanges of knowledge for conducting in-depth discussion which promote common conceptual understanding through online discourse.

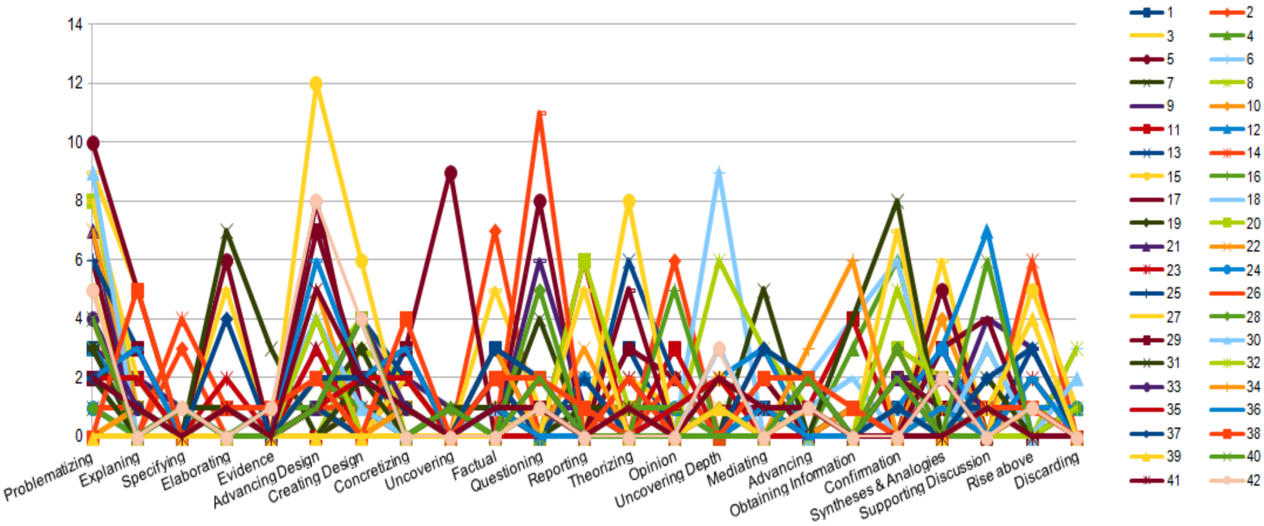

Fig.3. Contribution profiles

4. Conclusions

The proof of knowledge building is in the community knowledge that is publicly produced by the students. The creation of "epistemic artifacts," tools that serve in the further advancement of knowledge (Sterelny, 2005) engage students in "the deliberate creation and improvement of knowledge that has value for a community" (Scardamalia & Bereiter, 2003). The main value is this epistemic agency, in which setting forth ideas and negotiating a fit of ideas using contrasts to spark and develop newer knowledge rather than conforming to accepted knowledge in enabling further growth regardless of how naïve an idea can be. Learning is not an 'acquisition', but a 'shaping-up' where students also need to learn from mistakes and sensible risk-taking when working with ideas. Providing the learning model in design provides a "process foundation" for more complex learning and problem solving.

Broadly, groups that solved ill-structured problems produced more extensive arguments in support of their solutions because of the importance of generating and supporting alternative solutions (Cho and Jonassen, 2002) influenced how they learned from how problems are solved, which in turn, helped them discern critical and relevant aspects to develop an improved product in design and technology.

When knowledge building fails, it is usually because of a failure to deal with problems that are authentic. In order to gain a complete understanding of what determines idea improvement, various facets need to be taken into account. In view of limited time for curriculum intervention, future analysis should also consider on combining several aspects (e.g. such as scientificness, see Zhang at al., 2007) which could lead to more interesting findings and outputs. Furthermore, examining the influence of learner differences on interaction can provide more insights to enhance learning interests and improve their own quality of thinking.

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