A phenomenographic analysis of variations in secondary five students' conceptions of web authoring techniques and applications

中五學生在網頁設計及應用層面上的學習概念之變異分析

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Abstract

In this paper, a phenomenographic approach was utilized to create learning spaces in which 182 Secondary Five students under the guidance of the teacher (the action researcher) learned to do projects on applying suitable web authoring techniques to construct school, school alumni and e-learning websites across three school years in a local school. By means of the knowledge-building principles in an online learning community, some qualitative patterns of learning variations on learning conceptions, applications and synthesis were articulated. Throughout the learning and teaching process, some learning and teaching conditions varied whilst others were kept invariant to articulate inter-student learning variations and thereby formulate feasible teaching approaches. Finally, some critical conditions for such learning variations were further conceptualized for increasing learning effectiveness, and implications for sustaining online learning community are drawn for further research.

Keywords

learning community, knowledge building, web authoring, project work, phenomenography

摘要

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Introduction

Research findings using phenomenographic methods have demonstrated a *limited* number of qualitatively different means through which students, being unique in character, understand a particular phenomenon. Those different ways of phenomenal understanding necessarily involve cognitive discernment of a different set of critical aspects of the experienced phenomenon (Marton & Booth, 1997). If teachers pay close attention to such qualitative differences, they would gain better understanding of their students' learning concepts and be able to bring about their meaningful learning, provided that they can build on their prior understanding and experiences. This current study aims to articulate patterns of student learning variations (experienced by the teacher) with intended and enacted objects of learning in a school-based continuous assessment of uses of web authoring skills for improving information-seeking efficiency of school website, strengthening social functions of school alumni webs or enhancing e-learning concepts. As a result, the teacher (the action researcher) knew more about individual learning differences, and learned how to deepen their learning.

Literature review

Project-based learning or project work has been recognized as an important part of school curriculum and reforms in many East Asian countries. Project-based learning provides pupils and teachers with opportunities to break away from the compartmentalization of knowledge and skills resulting from subject-area instruction. Broad themes are used to bring various aspects of the subject-based curriculum or cross-curricular ones together (esp. development of generic skills in Cheong & Goh, 2002). This will help pupils see the interconnectedness of their learning and develop their life-long learning skills like creative and critical thinking, communication, collaborative learning and self inquiry skills, which are good preparation for future workplace areas under knowledge-based economies. Indeed, project-based learning is a complex cognitive and meta-cognitive process, which requires both hands-on and minds-on learning. It is action-oriented and focuses on doing something rather than learning about something (Moursund, 1999). Although project-based learning is such an important aspect of school curricula, its school implementation raises great challenges to many East Asian societies with strong stresses on open examinations. How to combine individual-based project work (assessing student learning process) and written open examination papers (assessing student learning outcomes) at senior secondary levels is an interesting assessment issue.

Despite vast research literature on uses of computer-mediated or -supported technology (Dillenbourg, 1999; Janassen, *et al.* 1999, Hung, 2001;

Puntambekar, 1997), there is still a lack of methodological parameters or theoretical frameworks accounting for individual learning differences among students in project work. Meantime, collaborative student learning using online learning platforms or knowledge building communities (Collins & Bielaczyc, 1997; Scardamalia & Bereiter, 1996) is infeasible in individual-based project assessment which is competitive in nature.

Recent research literature on the connections between public knowledge-building discourse and e-learning portfolios, and role of assessment in scaffolding students' collaborative inquiry and understanding in computer-supported learning platform has discovered that knowledge-building electronic portfolios governed by some knowledge-building principles help access and facilitate collective knowledge advancement (Lee, Chan, & van Aalst, 2006). And web-based learning communities should provide scaffolds or foster epistemic agency in the form of knowledge-building principles for students to co-construct new knowledge at communal level (Chan & van Aalst, 2003). So the current study aims to articulate learning variations by conceptualizing qualitative differences in students' co-constructing web-authoring knowledge with those knowledge building principles.

Notably, past phenomenographic research findings mostly focus on student learning variations without the teacher's perspective and there is insufficient empirical case study on articulating teachers' learning spaces or spaces shared by students and the teacher (Marton & Morris, 2002; Marton & Tsui, 2004). To bridge such research gaps, the current study endeavors to articulate contextual inter-student learning variations on web authoring in an individual-based project work (combining formative and summative assessment)

using phenomenographic methods by addressing three research questions through teacher reflections in action research settings:

1. What were the cognitive and meta-cognitive levels of student performance in online discussion when students captured web authoring knowledge and web publishing skills on doing project works?

2. What were the crucial patterns of inter-student variations in capturing web authoring knowledge and web publishing skills?

3. What feasible teaching strategies were utilized for increasing learning effectiveness through teacher reflections in action research settings, based on some critical conditions of learning variation?

Theoretical framework

In phenomenography, learning is considered as a dynamic change in the state of awareness or ways of experiencing the phenomenal world (Marton & Booth, 1997). Throughout the learning process, varied and invariant patterns of learning necessarily involve steps of drawing contrasts, generalization, separation and fusion. Notably, *discernment, awareness* and *simultaneity* are key components of learning and closely linked together, each of which being a function of another. As a result, *creating a new learning space* means opening up a new dimension of learning variation, completely different from the take-for-granted nature of the absence of such variation (Marton & Morris, 2002, Marton & Tsui, 2004). In particular, the *object of learning* refers to those capabilities and necessary conditions in which students' inherent characteristics, didactical interactions and learning environments are considered for achieving *specific* learning and

teaching goals. Current pedagogical discussion on student-centered and teacher-centered instructions merely focuses on *general* non-referential aspects of learning and teaching without paying great attention to *specific* referential aspects of learning and teaching. Phenomenographic approach focuses on how learning phenomena are being perceived by students in *second-order* perspective and student learning experiences should be understood in terms of human-world relationship (Marton & Pang, 2008). In the light of a specific object of learning, the space of learning is a specific characterization of didactical interactions in the classroom. In the teacher's angle, the intended *object of learning* aims to achieve the teacher's intended learning outcomes and teaching objectives whilst the *enacted object of learning* points to what the intended object of learning is actually enacted in the classroom specifically. Finally, the *lived object of learning* constitutes the ways of how students see, understand and make sense of the object of learning after and beyond the lesson (Marton & Tsui, 2004, pp.224-225).

Research design

1. Studying Subjects and Topics

A total of 78, 44 and 60 Secondary Five students were guided to reconstruct the existing school web to increase its information-seeking efficiency, to devise school alumni web to strengthen its social networking functions, and to develop e-assessment web for enhancing primary students' self-learning in 2007-08, 2008-09 and 2009-10 respectively. Web information improvement included school announcements, schedules of extracurricular activities, open contests and fund-raising activities that fellow students might join and so forth. Technical concerns covered establishment of specific sub-pages where frequently updated information was given. Generic skills of using web-authoring software were provided, and fulfillment of the needs of various types of web surfers such as students, parents, teachers and the general public was made. In the school-based assessment (SBA) project, presentation contents were divided into two sections. Section one was to propose two desirable solutions, aiming at efficient information seeking in 2007-08, to compare two social networking webs like Facebook and Myspace in 2008-09, and to compare several plausible e-learning webs in 2009-10 (40%). Section two was to design and create web layouts on illustrating how a web user might seek information efficiently using one of the proposed solutions highlighted in section one in 2007-08, to work out feasible web layouts of the school alumni web by comparing two social networking webs in section one in 2008-09 (c.f. figure 1); and to work out e-assessment learning system by connecting with previous conceptions of e-learning in section one in 2009-10 (60%).

Figure 1: Student discussion notes in an online learning platform
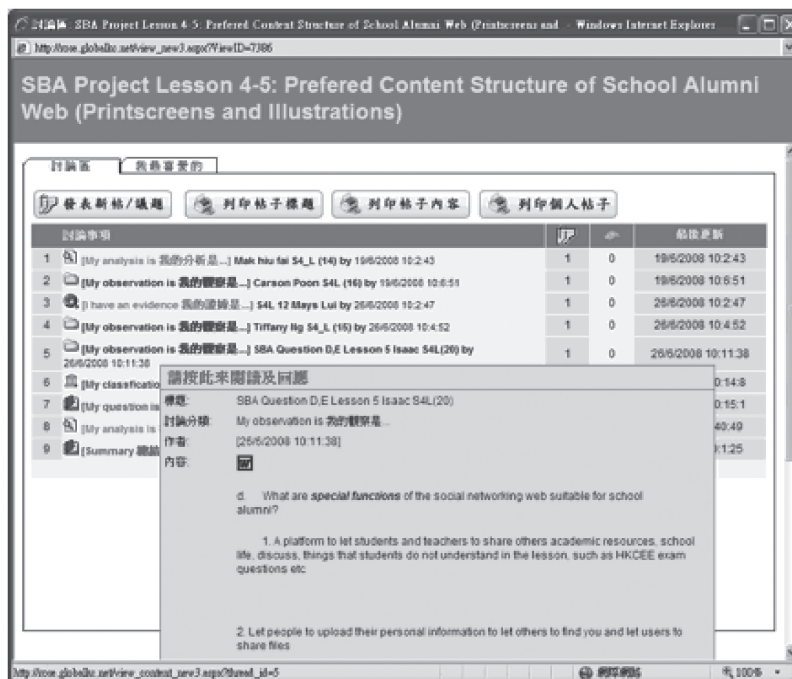
2. Working Procedure

Originally, such school-based assessment (SBA) project (HKEAA, 2009) is so *individual-based* that it occupies 20% of the public examination in one of four elective modules called 'web authoring and multimedia productions'. The duration of the project assignment lasted for six months for the two Secondary Five classes in a total of 78 students in 2007-08, 11 months for two Secondary Five classes in a total of 44 students in 2008-09, 10 months for three Secondary Five classes in a total of 60 student in 2009-10 before they sat for the remaining three written papers (occupying 80%). At the beginning, the teacher (the action researcher) endeavored to employ peer or group learning techniques to facilitate collaborative learning. An online discussion forum or a learning community was utilized to stimulate students to brainstorm, criticize and consolidate their preliminary knowledge about the studying problems, define key conceptual notions and technical terms found from search engines and other online references, and draft out timeframes and plan their necessary working stages. For the school year 2007-08, students did *not* have knowledge building principles whereas those in the school years 2008-09 and 2009-10 had some knowledge building principles (embedded in the online learning community and weekly practicum lessons) such as:

> progressive problem-solving discourse in which students had duties to answer other's questions and further raise other high-level questions at communal level (c.f. Bereiter & Scardamalia, 1993)
>
> collaborative efforts in which students helped summarize ideas and formulate clearer concepts or solutions (c.f. Scardamalia, 2002)

monitoring understanding in which students recognized misconceptions and misunderstandings through mutual discussion (c.f. Scardamalia, 2002)

constructive uses of authoritative sources in which students cited most online information sources and quoted online references with mutual criticism, integrated ideas collaboratively and even synthesized new conceptual frameworks (c.f. Scardamalia, 2002)

Online discussion was carrying out till the student subjects submitted the first drafts of their individual projects.

3. Action Research Team

An action research team, consisting of the action researcher (the teacher), co-researchers and lesson observers (teaching consultants and university professors), was set up to carry out the iterative cycles of planning-acting-observing-reflecting on teaching and learning instructions through lesson observation, reflexive journal writings, surveys and interviews with the involved 182 student subjects and some of their parents (c.f. Somekh, 1995; The State of Florida, 2008). Suitable strategic changes and didactical adjustments were made after the resulting learning variations were being categorized or further conceptualized. The main direction of action research was to depict inter-student learning variations from teacher's perspective, broaden teacher understanding of students' learning conceptions and modifications on teaching, and finally deepen the usage of school-based assessment using phenomenographic methods. Peer observation and teacher self-reflection on lesson studies followed

the Stigler & Hiebert's (1999) scheme of :

(a) defining the studying problem;

(b) planning, teaching and evaluating the e-learning environment through pedagogical reflections and peer review;

(c) revising the involved lessons and modifying the e-learning user-interface;

(d) teaching the revised lessons via stepwise evaluation and reflection;

(e) finally sharing results on conceptions of e-learning.

Results

After formation of students' concrete ideas during two-month trial period, sharing of ideas in the public domain of the online discussion forum or learning community was totally suspended for the fear that one's original ideas would be borrowed by another under keen individualistic examination competition in 2007-08. For further improvement, the action researcher (subject teacher) tended to include those knowledge building principles in 2008-09, 2009-10 and even motivated students by informing them that some marks (5% out of 100 under the marking rubric) would be counted in an online learning community or a discussion platform.

In comparison, students in 2008-09, 09-10 showed great improvement in learning motivation, self-reflections on working progress, justifying hypotheses using others' opinions and even synthesizing others' ideas raised from the online learning community. To answer research question one, some inter-student learning variations in using discussion notes in their reports are depicted in cognitive and meta-cognitive domains in table 1.

Table 1: Rating levels of student performance by using online discussion notes in 2008-09 and 2009-10

Level 1 (N=11 in 2008-09) (N=19 in 2009-10)	simple definition or conceptual citation without criticism no citation of sufficient factual information for supporting arguments / no confirmation or falsification of research hypotheses
Level 2 (N=17 in 2008-09) (N=28 in 2009-10)	conceptual elucidation and criticizing other ideas citation of sufficient factual information for supporting arguments without confirmation or falsification of research hypotheses
Level 3 (N=16 in 2008-09) (N=13 in 2009-10)	in-depth conceptual exploration and extension of new ideas based on others' or synthesizing others' ideas confirmation or falsification of research hypotheses

[Note: 'N' stands for the number of student subjects fulfilling certain specified learning patterns of variation in one particular school year]

Notably, the teacher built on new learning spaces by *varying* some learning aspects or didactical conditions whilst keeping other *invariant*, depicted in table 2 through stepwise reflections in teaching. Some students experienced new conceptions of learning and conceptual relationships on web authoring tools and web publishing techniques during school years 2007-08, 2008-09 and 2009-10.

On one hand, those learners with good articulation of research problem and skilful strategic research techniques could develop self-reflective working plans (placed at the beginning of their written reports), workable timeframes, and use illustrative diagrams and figures to visualize newly learned concepts or correlate their interrelationships. Some could find out their own research literature by themselves and even establish strong theoretical frameworks in which two desirable solutions were in juxtaposed comparisons and formulate clear-cut

key definitions or concepts, far beyond the scope of Secondary Five level. Some with strong motivation to get higher grades tended to study the rubric assessment descriptors closely to make their working steps or contents in line with those contextual descriptors.

On the other hand, those learners without good articulation of research problems or skilful strategic research techniques frequently delayed their submissions and requested the teacher for giving standardized formats, or concrete working directions. Concepts or misconceptions were loosely presented without any linkage between the two sections. There was no juxtaposed comparison of the two desirable solutions or commensurable parameters for comparing the solutions. To answer research question two, crucial patterns of inter-student learning variations on web authoring are summarized in the following table 3.

Table 2: Variations and invariant parameters during learning process

Learning Instructions	Variation	Invariance
Based on one particular info-seeking or social networking mechanism, find out suitable features of web publishing	Features for web construction or web publishing	Info-seeking, social networking mechanisms and e-learning conceptions
Under a web construction dimension, compare efficiencies of info dissemination and info-seeking or social networking mechanisms, evaluate their interrelationships	Efficiency of info dissemination and info-seeking Fruitfulness of social networking Usefulness of e-assessment	One particular or a fixed set of web construction or publishing feature(s)
Using a particular desirable solution, figure out feasible means for improving info-seeking, social networking mechanism or e-learning	Means for improving info-seeking, social networking mechanism or self-learning in e-learning system	One particular solution
Based on one particular criterion, compare two feasible solutions	Two feasible solutions	Commensurable criteria (through generalization)
To suit a certain group of web surfers, consider desirable aspects of efficient info-seeking, social networking or e-learning	Efficiency concerns on info-seeking, social networking and e-learning	Certain type of web users
For one particular info-seeking feature, analyze needs of various types of web users	Various types of web users (similarities and differences and underlying reasons)	One fixed set for fulfilling efficient info-seeking, social networking or e-learning
Articulate possible dimensions for comparison of two solutions by considering one by one	Possible commensurable criteria for evaluating web authoring techniques and authoring tools	One chosen solution or web layout
Consider possible format of one solution when considering the combination of web authoring tools and web authoring techniques	Variety of web authoring tools and web authoring techniques	Fixing one solution or web layout

Table 3: Student Conceptions of Learning in Two Sections in 2007-2008, 2008-09 and 2009-10

Levels of understanding (total no. students for each class)	Student Conceptions of Learning	Referential Aspects In Section One	Structural Aspects Between Section One & Section Two
0 07-08: N=26 (33.3%); 08-09: N=16 (46.3%); 09-10: N= 23 (38.3%)	No comparisons	Simple formats of solutions without theoretical inputs	No linkage between section one and section two
1 07-08: N=13 (16.7%); 08-09: N=6 (13.6%); 09-10: N= 16 (26.7%)	Mere description of the two solutions without commensurable parameters	Formats of solutions articulated without self-reflection or practicality concern	No linkage between section one and section two
2 07-08: N=18 (23.0%); 08-09: N=11 (25.0%); 09-10: N= 12 (20.0%)	Juxtaposed comparisons under commensurable dimensions	Commensurable items increasingly added to enrich contents of two solutions in section one, and rational choice of the preferable solution in section two	Loosely connecting between section one and section two
3 07-08: N=21 (26.9%); 08-09: N=11 (25.0%); 09-10: N=9 (15.0%)	Penetrating comparisons	Reflexive articulation of commensurable dimensions and conceptual reformulation of the two solutions and consistent illustration	Linking the two sections tightly, developing ability to differentiate between two sections

[Note: 'N' stands for the number of student subjects fulfilling certain specified learning patterns of variation in one particular school year (in quoted percentages)]

The teacher (action researcher) experienced spaces of learning for deepening understanding of inter-student learning variations on advancing information-seeking, strengthening social networking capabilities and broadening student conceptions of e-learning in multiple perspectives. From the teacher perspectives, the student subjects experienced methodological and contextual variations in approaching the studying problems by building communal sharing areas in which they could appreciate other interpretations, correlate with their own and even make self improvements.

Some critical conditions accounting for such learning variations included:

no persistency in finishing research item strategically

failure in linking previous conceptions of web authoring techniques to the studying problem

no indication for improving the research design further when polishing the project works

no communal sense of engagement in online learning community and no sustainable development of online discussion

For resolving problems of individual learning differences, the teacher reflected that basic conceptions of doing research, web 2.0 and e-learning (especially e-assessment) needed to be grasped by the majority of students through mass lessons and group tutorials whereas advanced and preliminary techniques in web authoring could be mastered by high-achievers and low-achievers respectively through individual consultation.

To answer research question three, based on the above critical conditions, feasible teaching strategies for increasing learning effectiveness included:

    continuation to provide individual or communal guidance through the e-learning community platform

    in-person consultation on modifying under-achievers' action time plans with achievable tasks and refining research problems by sharpening research foci

    constant revision of the assessment rubric scale and descriptors in the process of conceptualizing those inter-student variations (in tables 2 and 3) for achieving an authentic assessment system

Discussion

Owing to the limited length, this paper could not trace out how the online discussion forum or learning community fosters those students' high-order thinking in the involved projects in the two school years. Nor could the paper evaluate the learning effectiveness of the phenomenographic approach on depicting intra-student learning variations over time.

In an online learning community or ecology models, there arise some potential membership and sustainability problems. Regardless of their technical establishments, some web-based learning communities or ecologies may fail to attain high-level communal or knowledge co-construction stages and even fail to sustain after their formation, subject to social cultural barriers (Gilbert & Driscoll, 2002). In the current study, those Secondary Five students were accustomed to competitive open examination. Despite the fruitfulness of collaborative learning enhanced through online discussion forum or learning community at the very beginning, student subjects were not fully engaged in collaborative online knowledge-building discourse after the first training periods. Indeed they did not share a good communal sense of knowledge building on web authoring. Subsequently, online learning community was not sustained and some student subjects failed to integrate online discussion notes into their project work, fully reflected in one of the above critical conditions. For further research, learning design should be aligned with modes of educational assessment and more marks should be allocated to group-based discussion through online learning community. Perhaps this is a big challenge to Hong Kong's and other East Asian curricula, in which written papers in the form of *individual-based* summative assessment usually occupy higher proportions of examination marks. Last but not the least of all, some future try-out action research studies should incorporate more knowledge-building principles (accommodating student learning variations) for investigating the effectiveness of individualist and communal co-construction of new knowledge through online discussion forum or learning community.

Acknowledgements

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