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Developing Case-based Learning Activities Based on the Revised Bloom's Taxonomy

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Abstract

This study proposes the use of case study in teaching an undergraduate course of Introduction to Business Information Systems Development in class, based on the Revised Bloom's Taxonomy. According to the Revised Bloom's Taxonomy of cognitive skills, it includes six levels which are knowledge, comprehension, application, analysis, evaluation, and creation. The lower level of skill is required to be formed before progressing to the higher levels. Therefore, two lower levels of skills comprising knowledge and comprehension are inherent in the course before commencing a case study. In this study, learning activities associated with the Revised Taxonomy-based learning strategy are proposed to support the development of higher-level cognitive skills. The potential effects and benefits of these activities to teaching and learning will be discussed. A conceptual model and hypotheses will be recommended for future study.

Keywords: Incremental Learning, Revised Bloom's Taxonomy, Case-based Learning, Cognitive Skill.

Introduction

Incrementality has been applied to learning tasks (Giraud-Carrier, 2000). Incremental learning style gives students cognitive development through revising single knowledge structure with new experience. The basic principle of incremental learning is that first simple concepts are expressed in instances, and then more complex concepts are inducted in terms of high-level training cases (Sammut & Banerji, 1986; Shapiro, 1987). In other words, in incremental learning, new knowledge is created on new data and the existing knowledge base may be modified for improvement over time (Bouchachia, 2009). Unlike teachable knowledge, which uses facts or principles that are known, incremental learning tasks are solved by an instance-based framework (Aha, Kibler, & Albert, 1991; Ourston & Mooney, 1994). The incremental learning framework promotes metacognition and task generali-

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zation (Klebba & Hamilton, 2007). This rationale supports the action-oriented aspects of this research.

Bloom et al. (1956) proposed a cognitive Taxonomy that is consistent with critical thinking and educational learning hierarchies. The Revised Bloom's Taxonomy was introduced by Anderson et al. (2001). The Revised Taxonomy has incorporated student-centered learning prototypes into the original Taxonomy, which improves students' comprehension of and accountable for their own learning, cognition, and thinking. Basically, Bloom's six major features were changed from noun to verb forms. For instance, the knowledge level of the original Taxonomy was renamed as remembering, whereas the comprehension level of the original Taxonomy became understanding. The application/applying and analysis/analysing of Bloom's Taxonomy were preserved. Finally, the synthesis category was retitled to creating, and the order of synthesis/creating and evaluation/evaluating was interchanged in the Revised Taxonomy. However, in contrast to the original Taxonomy, the Revised Taxonomy (Anderson et al., 2001) allows the categories to overlap one another (Krathwohl 2002).

Taken together, both the original and Revised Bloom's Taxonomy have provided educators with high and low level thinking closely linked with problem-solving skills, creative and critical thinking when cognitive development ascends the hierarchy of cognitive process. For these reasons, structured case analysis can be adapted to courses that inquire about developing critical thinking (Klebba & Hamilton, 2007).

Case study method improves critical thinking in provided real-life context (Noblitt, Vance, & Smith, 2010). A structured case with focused questions provides a guide to group discussion which assists to produce solutions throughout data analysis and detailed study on the case (Hilvano, Mathis, & Schauer, 2014). In addition, case-based discussion, a formative assessment tool, encourages engagement in discussion and provides constructive feedback immediately (Awad et al., 2015). Although case-based instruction has been used extensively in a range of disciplines with various results (Moreno & Park, 2010), many speculative hypotheses on the benefits of case instruction have yet to be empirically confirmed (Bruning et al., 2008; Kim et al., 2006; Merseth, 1996). For instance, Kirschner et al. (2006) presented that inquiry-based teaching methods such as case-based instruction were less effective than traditional teaching methods because problem-based, case-based learning did not take knowledge of cognitive processes into consideration. The aim of this study is to explore the use of case study in teaching an undergraduate course of Introduction to Business Information Systems Development. This course was selected for conducting this study because it is expected that learning activities of case study, based on the Revised Bloom's Taxonomy (Anderson et al., 2001), are able to enhance students' learning experience.

Literature Review

Incremental learning is defined in terms of a paradigm for learning process arising from new example(s) and adapting what has been learned to the new example(s) (Geng & Smith-Miles, 2009). As such, the incremental learning process is bearing on a limited number of examples. Thus, in each step, its hypothesis can be built upon these examples and other former examples are forgotten. Consequently, the inferred knowledge is retained longer than the given knowledge (Hulstijn, 1992; Mondria & Boer, 1991). For medical applications, the feasibility of an incremental learning ensemble algorithm using support vector machines was able to learn additional information from new data while retaining previously acquired knowledge and preventing the loss of knowledge (García Molina et al., 2014). These principles suggest that students should learn incrementally.

The Revised Bloom's Taxonomy (Anderson et al., 2001) affixed the knowledge dimension to the skeletal structure, which formed the intersection of knowledge and cognitive process categories

for the purpose of supporting the design of learning strategies as well as facilitating learning assessment. Fiegel (2013) used the Revised Taxonomy for developing learning outcomes that were linked to lesson plans and assignments. The Revised Taxonomy was also used to teach a set of core knowledge learning objectives for accounting ethics education and it was beneficial to the course (Kidwell, Fisher, Braun, & Swanson, 2012). The Revised Bloom's Taxonomy has provided a framework that can be used to assist with the academic skills such as application, analysis, evaluation, and creation (Jideani & Jideani, 2012). The cognitive processes that underlie critical thinking are inextricably connected to subject matter, course content, and reflection (Hamilton & Klebba, 2011). Enquiry into best practices of developing learning objectives, using the Revised Bloom Taxonomy, still needs further examination.

Case study is a means of teaching that compels students to analyse and discuss a contextual and complex situation, often in addition to involvement with a dilemma or a problem requiring students to apply theoretical principles to consider possible solutions (Gullahorn, 1959). For the chemistry laboratory environment, students were favourable to the case study for qualitative analysis experiments (Frerichs, 2012), and those who took the chemistry courses found case study in teaching abstract concepts to be engaging versus lectures with PowerPoint presentations (Dewprashad, 2013). In relation to clinical training, most trainees believed the case-based learning improved their knowledge base and provided the basic fundamentals of evaluation and management (Mishra et al., 2013). Furthermore, case-based learning was found helpful for undergraduate nutrition education, which was designed for students bearing on the theoretical frameworks of phenomenology and Bloom's Taxonomy (Harman et al., 2015). However, case studies might need to be designed appropriately and be instructed cautiously along with proper learning activities (Nkhoma, Sriratanaviriyakul, Pham, & Lam, 2014). The utilisation of case-based learning in this study is expected to promote self-study and collaborative learning, which will improve cognitive skills, academic achievement and interpersonal skills.

Course Introduction and Designed Activities for Teaching and Learning

An undergraduate course of Introduction to Business Information Systems Development provides general notions in planning and developing application software in connection with business information systems. The aim of the course is to furnish students with skills in proposing solutions for problems commonly found in business so as to transform the proposed solutions into well-functioning computer programs. This is a compulsory course must be satisfactorily completed in semester one of first-year students. When students complete this course, they will have a comprehension of fundamental programming. They are also capable of designing solutions to simple business problems as well as implementing, testing and documenting a small business software application. Each student will be oriented towards approaching a complex problem that requires the design of an artefact or system. Thus, a full range of cognitive levels are expected to be achieved in the learning outcome.

A key goal of the Introduction to Business Information Systems Development is to improve the students' understanding of material covered during the course. To reach this goal, a learning strategy and a set of learning activities were developed for this course. Table 1 shows a variety of activities corresponding to different cognitive levels of the Revised Bloom's Taxonomy (Anderson et al., 2001).

Table 1: Learning activities in class based on the Revised Bloom's Taxonomy

Bloom's category / Learning activities	*Knowledge*	*Comprehen-sion*	*Application*	*Analysis*	*Evaluation*	*Creation*
Lecture, reading	X					
Discussion, reflection		X				
Case study in a concrete situation			X			
Make a flow chart				X		
Devise a way to solve the problem					X	
Conduct a debate						X

At first the instructor will provide the fundamental concept related to Business Information Systems Development along with a brief discussion and deep reflection upon comprehensive knowledge. Afterwards, a case study will be introduced to the students in class. The students will be divided into small groups and requested to apply learned materials in a concrete situation by identifying the problem presented in the case. Having studied the case, a flow chart will be made by each group in order to show relationships between parts provided. This informative graph can support the students in comparing and contrasting. When the case is understood properly, each group will devise a way to solve the problem. Eventually, each group will present their solutions in class. The students of other groups and the instructor will evaluate and question the solutions presented by the group while the members of the presentation group have to conduct a debate. It is expected that the activity could have a positive influence on their next set of activities together with their cognitive skills.

Discussion

Case problem has two external characteristics: problem context, and problem domain and context specificity (Jonassen, 2011a). Problem context provides the situation of the problems in a case, which brings about the circumstances and things occurring in the case. Domain and context specificity delineate cognitive strategies or conditional reasoning on which problem-solving relies.

Those characteristics affect cognitive processing and learning experience (Jonassen, 2011a). Furthermore, the other internal factors such as prior knowledge, experience, reasonability, cognitive styles and epistemic beliefs contribute to the nature of the problem topic, which affect problem-solving (Jonassen, 2011b). When solving a problem, cases require students to determine the type of solution. For instance, goal-based scenario tasks necessitate judging and resolving skills (Dabbagh & Dass, 2013).

Case-based learning allows students to apply their knowledge to a problem. Previous studies illustrated that case-based learning formed better understanding of basic conception (Dori, Tal, & Tsaushu, 2003; Mayer, 2002; Yadav, Vinh, Shaver, Meckl, & Firebaugh, 2014). Cases allow students to see the real-world issues and make them see the relevance of fields (Yadav et al., 2014). Additionally, open-ended questions in cases result in students' engagement because they have to elaborate their knowledge to solve procedural questions. For instance, Dori and Sasson (2008) exhibited the use of open-ended questionnaire to assess students' higher-order cognitive skills by the influence of case-based computerised laboratory, which improved their quality of chemical understanding. Carver (2006) and Shepard (2000) pointed out that open-ended tasks were capable of scrutinising students' competence in critical thinking, problem-solving and real-world approach.

The present study generalised the use of case studies, based on the Revised Taxonomy, to produce the desired effects of incremental learning in teaching Introduction to Business Information Systems Development. In addition, though knowledge of the Taxonomy is able to develop skills incrementally, there has not been any study to test causal relations between levels of the Revised Taxonomy throughout using case studies. Future study should measure the effectiveness of case-based learning that requires critical thinking as Figure 1, conceptual model and hypotheses.

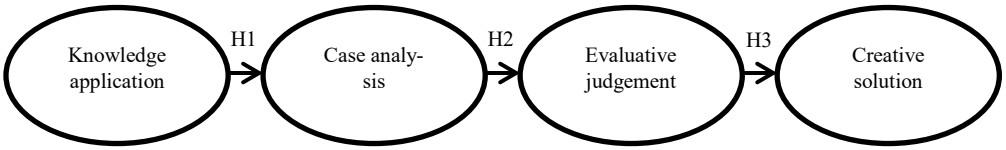

Figure 1: Conceptual model and hypotheses

Hypothesis 1: Knowledge application positively increases skills in case analysis.

Hypothesis 2: Case analysis positively increases skills in evaluative judgement.

Hypothesis 3: Evaluative judgement positively increases skills in creative solution.

Conclusion

The case method of teaching stresses developmental skills in conceptual analysis, interactions and decision-making. Case information stipulates a circumstance or a problem and it is necessary to propose a pertinent solution for it. The skill performance is expressed in the application of knowledge of theories and frameworks to practice in case-based model. The instructor, meanwhile, is accountable for assisting students in diagnosing problems and in prescribing viable solutions. Case-based learning prepares students for assessment and interpretation of multifaceted problems. Harman et al. (2015) also show that case-based learning, combined with group problem-solving, enhances professional skills development. Thus, case-based learning is attributed to high potential for promoting systematical analysis and problem-solving skills as well as proposed course of action.

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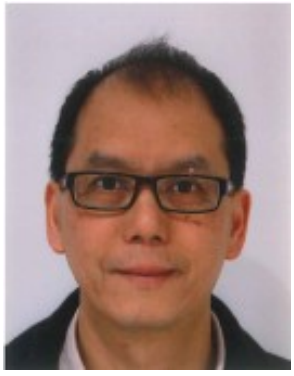

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