Bloom’s Taxonomy of Educational Objectives in Information System Courses

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Abstract. The new edition of Bloom’s taxonomy of educational objectives has been promoted for about 15 years. It is valuable for teaching reforms and courses construction. We used Bloom’s taxonomy in information system courses. We also used web-based instruction in the courses. The six levels of cognitive process in Bloom’s taxonomy were emphasized in class teaching or on course website. And different assessment methods were selected to suit for Bloom’s taxonomy according to the teaching objectives. Our practices show that it is a good approach to combine class teaching and web-based instruction.

Introduction
Information system courses are a series of courses in our university. For example, management information system, command information system, decision support system, battlefield information management, etc. They are similar in concept system, content organization and construction methods. We call them information system courses. We can use the same method to carry on teaching reforms in these courses because of their similarities. And now we have built teaching websites to implement web-based instruction. We want to find a way to combine the class teaching and web-based instruction.

Bloom’s taxonomy of educational objectives was promoted in 1956 by B. S. Bloom and his teammates [1]. It has been revised in 2001 by Anderson, L.W. [2] etc. Now it has been used in many fields, especially in foreign language teaching [3, 4] and medical education field [5, 6]. Bloom’s theory is often used to determine teaching objectives, arrange teaching contents and activities, check and assess the teaching results. Through analysis and comparison, we know that the revised Bloom’s taxonomy of educational objectives may be used to reform our teaching contents and activities in information system courses.

The Revision Edition of Bloom’s Taxonomy of Educational Objectives
The revision edition of Bloom's taxonomy of educational objectives divides the educational objectives into two dimensions, such as knowledge dimension and cognitive process dimension [3]. The knowledge dimension contains four main categories. The dimension is used to distinguish what the teachers shall teach and what the students shall know. The cognitive process dimension contains six main categories. The dimension is used to tell the teachers how to teach and show the students how to preserve and deepen their knowledge acquired.

Knowledge Dimension
Factual Knowledge. It includes the terminology to know and the basic elements required to solve problems.
Conceptual Knowledge. It is the relation among all the basic elements which have functions together in a much larger structure. For example, classifications, categories, principles, generalizations, theories, models and structures, etc.

Procedural Knowledge. It means the procedure, research method, techniques, computing rules or methods rules to accomplish something. The simple example of this kind of knowledge is the steps or process we summarized after we have done a certain things.

Metacognitive Knowledge. This is the general cognition and the knowledge about cognizing and perceiving ourselves. For example, the strategic knowledge we use when we study, think and solve problems. Another example is the knowledge that we know about ourselves.

Cognitive Process Dimension

Remember. This process means to extract certain knowledge from our long-term memory. For example, to identify the exact name of a technology or to say out it belongs to this process.

Understand. This process means to construct meanings from different kinds of information including oral, written or graphic style. It contains several aspects, such as, transforming one style to another, using examples to explain a principle, classifying things according to a certain rule, etc.

Apply. This process means to execute or use certain procedure to do something in specific scene. For example, you can do familiar tasks or unfamiliar tasks using certain procedure.

Analyze. This process means to disassemble a whole into multiple parts and determine the relations between different parts or relations between each part and the whole structure.

Evaluate. This process means to judge according to certain principle and standard. For example, we check the different schemes and discuss their advantages and disadvantages.

Create. This process means to make continuous and useful whole system from elements or to reassemble the elements into a new pattern or structure. For example, inventing a new product is a kind of creation.

The Knowledge Structure of Information System Courses

Quillian believes that people’s cognition consists of many core concepts. And each core concept connects to others by some relations. So, Reigeluth promoted elaboration theory for teaching in 1987. He suggests that teacher should help the students build macrostructure of the learning objectives first. Then, the teacher may discuss one subject in detail or deeply into the elaboration. After that, they will return to the macrostructure and enter another subject. Following this process, we will travel between the macrostructure and the elaborations time after time. Finally, we can help the students build a whole cognition structure about their knowledge.

Build Knowledge Graphs. As the first step of our teaching reforms, we must build our knowledge structure of information system courses. We have drawn multiple knowledge graphs for the whole course and each chapter. Fig. 1 is a simple example.
Remark Knowledge Categories. We also use different symbols to remark different knowledge categories in the knowledge graphs. These categories are consistent to the knowledge dimension of Bloom’s taxonomy. Because different kinds of knowledge has different teaching skills and different learning requirements, so, basing on the knowledge graphs, the teachers will know how to teach such knowledge and the students will know why or what they are required to learn.

As shown in Fig. 1, the symbol ‘*’ represents factual knowledge, the symbol ‘**’ represents conceptual knowledge, the symbol ‘***’ represents procedural knowledge, and the symbol ‘****’ represents metacognitive knowledge. For example, the terminology ‘information’ is a kind of factual knowledge. Management information system, as one category of information system, belongs to the conceptual knowledge. Development method is a kind of procedural knowledge. You must know the skills and the process of the method and learn how to use the method by obeying the rules and steps. Life cycle management belongs to the metacognitive knowledge because there is a lot of strategic knowledge in management process. So you can’t manage the information system very well until you have known which strategy is proper under each condition.

The Teaching Activities in Practice

Bloom’s taxonomy has divided the cognitive process into six dimensions. We should detail the teaching objectives, activities and the assessing measurements according to these dimensions. Except the class teaching, we now have course website in our campus intranet. So we want to apply Bloom’s taxonomy to combine the class and the website. Our practice is shown in Table 1.
Table 1. Applying Bloom’s Taxonomy of Educational Objectives.

<table>
<thead>
<tr>
<th>No.</th>
<th>Cognitive Process Dimension</th>
<th>Class Teaching</th>
<th>Web-based Instruction</th>
<th>Check and Assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Remember</td>
<td>Recall the contents Prompt to say out</td>
<td>Test to identify the correct terminology</td>
<td>Blanks Choices</td>
</tr>
<tr>
<td>2</td>
<td>Understand</td>
<td>Explain the concept Give examples Say out the categories Summarize the functions Predict the trends Compare the difference Explain the reasons</td>
<td>Give text explanations List examples Show classification charts Describe the principle Plot the curve Data visualization Modeling the system</td>
<td>Choices Explanations Questions</td>
</tr>
<tr>
<td>3</td>
<td>Apply</td>
<td>Demonstrate the methods Using the formulas Learn to use development tools</td>
<td>Demonstrate the steps of the methods Give executing examples Tools using exercises</td>
<td>Application practice Compute with formulas Design exercises Experimental test</td>
</tr>
<tr>
<td>4</td>
<td>Analyze</td>
<td>Focus on the main factors Analyze the system structures</td>
<td>Practice to analyze system requirements Analyze case videos Give the relation graph</td>
<td>Analyze requirements Analyze relations Analyze functions</td>
</tr>
<tr>
<td>5</td>
<td>Evaluate</td>
<td>Discuss the advantages and disadvantages Judge the better scheme Self-summarization</td>
<td>List the advantages and disadvantages Select solutions</td>
<td>Synthetic exercises Evaluate solutions Construct test questions</td>
</tr>
<tr>
<td>6</td>
<td>Create</td>
<td>Independent analysis and design</td>
<td>Problem solving exercises</td>
<td>Solve problems Course paper</td>
</tr>
</tbody>
</table>

**Class Teaching**

In class teaching, we emphasize the teacher’s enlightenment, leading and contents organization. In the same time, the students need to participate in the class and discuss in detail with the teacher actively. The teachers will adopt different teaching activities according to different cognitive process of Bloom’s taxonomy shown in Table 1.

For example, the classification of information system is a kind of knowledge to be understood. In class, we may adopt the following activities. First, explain the concepts of different kinds of information system. Then, give simple examples for each category. We can ask the students to say out
the categories and additional examples. We need to discuss the functions and compare the differences of the categories with the students. Furthermore, we can discuss why information system has been divided into those categories.

**Web-based Instruction**

In recent years, the Web-based instruction or e-learning has been popular more and more [7]. Some colleges have built online platform [8] or exercises base [9] to support class teaching and online teaching. So, we build our course website. On the website, we have provided many teaching resources for the students to learn in their spare time. Also, they can test themselves online. In class, the teacher may also link to the website to download materials or analyze cases. These resources are organized according to the Bloom’s taxonomy.

For the same example as above, in order to support the students learning the classification of information system, we give explanations of the categories in text and list the examples on the website. Also we have provided the classification charts for each sort and described the classified principles. Such contents and representation styles suit for knowledge to be understood according to Bloom’s taxonomy. So, through Bloom’s taxonomy, we can syncretize the online learning and the class teaching.

**Check and Assessment**

Bloom’s taxonomy has been also applied in check and assessment of the courses. There are multiple methods to assess each dimension of the cognitive process. Usually, in term examination, there must be such examination questions as blanks, choices, explanations, questions and synthetic questions. Look at Table 1, to test how the students have understood the knowledge, we may give choices for them to choose the correct category, and we may ask them to give explanations for certain category, also we may give questions.

In experimental class, the students are required to complete application practices, design exercises and experimental test. The students will complete a whole process of information system development, including requirement analysis, system design, programing and system test. So we have prepared synthetic exercises for the students to enhance their capabilities of solving complex problems. Finally, they must complete a research paper in the end of the course. That belongs to the dimension of ‘evaluate’ and ‘create’ in Bloom’s taxonomy of educational objects.

**Summary**

The new edition of Bloom’s taxonomy of educational objectives has divided knowledge into four dimensions and cognitive process into 6 dimensions. It is very useful for guiding us to plan the course contents and teaching activities. We have applied it in information system courses. According to the knowledge dimension, we built the knowledge graph to suggest what knowledge to teach and how to teach. According to the cognitive dimension, we designed different teaching activities in class teaching and in web-based instruction. We try to combine the above two approaches through the cognitive dimension. And the course website has become a good helper for teaching and learning. Finally, in course test, we provided different kinds of exercises to assess the student’s capabilities in different cognitive processes. We also required the students to do application exercises in experimental class and to submit course paper in the end of the courses. So, the Bloom’s taxonomy has been fulfilled in every corner of the courses.

**References**


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