Designing an Assessment Model of Computational Thinking in Elementary and Secondary Education.

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Title

Designing an Assessment Model of Computational Thinking in Elementary and Secondary Education.

1. Aims & Objectives

This proposal research is to create the assessment tools to evaluate students' learning of computational thinking. This research involves the following:

. attempts to reshape the definition and elements of computational thinking within the current elementary and middle school of computing curriculum in Korea.

. provides a computational thinking assessment model for teachers to assess what students know and how learning progresses

. Verification and evaluation of the assessment model by applicability of the assessment contents according to the elementary and middle school level.

In order to complete this research, literature review of computational thinking is essential. we will argue trends of latest related research and limits of existing researches.

In use of Design and development, we will propose various methodologies applied with computational thinking assessment models; these include all forms of multimedia such as Evidence-Centered Design (ECD). (Mislevy, Behrens, Dicerbo, & Levy, 2012, p.11)

In a verification part, the evaluation model was applied to specific elementary and junior high school teachers and then the teacher survey was conducted.

2. Background

3.1 Computational thinking

The viewpoint of computing thinking can be summarized in two ways. Papert (1981) focuses on specifying and expressing ideas, while Wing (2006) defines computing thinking as a process of problem solving. In other words, the way computers scientists think to solve problems is defined as Computational Thinking (CT). In addition, CSTA (2011), an association of computer science teachers in the United States, is a core principle of computer science focusing on abstraction, automation, and analysis that permeates all K-12 computer science standards, this is a problem-solving methodology that provides a clear means of analyzing and developing solutions to problems that can be solved by computers that can relate to one another. This is in line with Wing's (2006) claim that it is the ability to solve problems by integrating human thoughts and digital technologies by abstracting the key elements of the problem and automating the solution through computerized devices. Cuny, Snyder & Wing (2010) defines the problem process as a thinking process related to formalizing the problem and its solution, so that the problem solution is expressed in a form that can be efficiently executed by the information processing agent. In analyzing domestic and foreign literature, sub-elements of computing power can be summarized as in analyzing domestic and foreign literature, sub-elements of computing power can be summarized as in <Table 1>

Table 1

Sub-elements of computational thinking

<table>
<tr><th colspan="2">KERIS(2015)</th><th>Wing (2006)</th><th>CSTA & ISTE (2011)</th><th>CAS (2016)</th><th>Google (2014)</th></tr>
<tr><td colspan="2">Data Collection</td><td rowspan="6">Abstraction</td><td>Data Collection</td><td rowspan="2">Patterns</td><td rowspan="3">Pattern recognition</td></tr>
<tr><td colspan="2">Data Analysis</td><td>Data Analysis</td></tr>
<tr><td colspan="2">Structuring</td><td>Data Representation</td><td>Logic</td></tr>
<tr><td rowspan="3">Abstraction</td><td>Decomposition</td><td rowspan="2">Problem Decomposition</td><td>Abstraction</td><td>Abstraction</td></tr>
<tr><td>Modeling</td><td rowspan="2">Decomposition</td><td rowspan="2">Decomposition</td></tr>
<tr><td>Algorithms</td><td>Abstraction</td></tr>
<tr><td rowspan="3">Automation</td><td rowspan="2">Coding</td><td rowspan="6">Automation</td><td>Algorithms & Procedures</td><td rowspan="3">Algorithms</td><td rowspan="6">Algorithms</td></tr>
<tr><td rowspan="2">Automation</td></tr>
<tr><td>Simulation</td></tr>
<tr><td colspan="2" rowspan="3">Generalization</td><td>Simulation</td><td rowspan="3">Evaluation</td></tr>
<tr><td rowspan="2">Parallelization</td></tr>
</table>

The sub-elements discussed above (Table 1) are primarily knowledge and function elements,

In recent years, besides the Approaches area in the CAS in the United Kingdom, the AP course in the United States offers examples of how to learn CT by presenting Big Idea and Computational Thinking Practices (CollegeBoard, 2016). In addition, reports have been published that present sub-elements, including various positive and dynamic elements.

3.2 Assess computational thinking

Recent years have witnessed an increasing emphasis on integrating computer science into K-12 settings. This boom is being driven by many factors including economic and technological demands for a future workforce with necessary computer skills. In the Korea, there has been a governmental level push in computer science education. Starting computer science education in K-5 contributes critically to this initiative since teachers have faced is the lack of evaluation standards and tasks. (교육부,2015b) The question "what should we assess in computational education?" directly links to the ultimate goal in computing education, which is developing student computational thinking. Particularly, the flow of educational evaluation nowadays is a Construct-centered approach which can be evaluated in the subject-oriented content evaluation, including the understanding of various complex thinking processes and content, and the ability to use the knowledge, (Messick, 1994) suggest that the constructivist approach may be valuable in society, such as critical thinking and creativity. However, if it is difficult to assess students' abilities with existing assessment methods, claiming to evaluate constructs. If we need to evaluate constructs that are complex and difficult to assess, such as our thinking on computing, the existing content-based assessment method is not appropriate and the component-based assessment method is appropriate. The Evidence-centered Design Assessment is a method that can be used to develop a structure evaluation system based on the evaluation logic. Evidence-based evaluation design is a comprehensive evaluation system that explains all elements of mathematical computation and reasoning methods used in the concept of education evaluation, task development, and evaluation "(Mislevy, Behrens, Dicerbo, & Levy, 2012, p.11) A theoretical and practical approach to the development and design of evaluation tasks in our research.

Proposed methodology

The characteristics of the computational thinking assessment model can be summarized as follows.

1. To derive the components of computing thinking through literature related to domestic and international computing thinking. The element of computing thinking appropriate from the perspective

of elementary and middle school education is set through expert consultation

2. To develop the evaluation criteria for evaluating the components of computing thinking using ECD technique. The cognitive function of computing thinking is assessed by Dr. Scratch's modifying rules, and the attitude is evaluated by analyzing the student portfolio.

3. To develop the computational thinking assessment model satisfied with all such conditions, We will make web-application modules and code analysis DB system modules using web-programming languages such as Javascript, JAVA, php to improve information exchange as well as to evaluate alternative plans effectively. In addition, I will use MS-SQL to save data and information created and reorganized by participants.

4. To validate Computational thinking model, after applying the evaluation model to 20 elementary and junior high school teachers' classes, we will conduct teacher survey and get a conformity to the field application of the computational thinking ability model and system was confirmed through FGI (Focus Group Interview) targeting elementary and middle school teachers.

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