Data Modeling for Monitoring and Visualizing of Learning Outcomes based on Assessment Standards

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Abstract - The recent 2015-Revised National Curriculum guidelines emphasize the improvement of assessment system in order that assessments should focus on monitoring the students’ degree of achievement in accordance with educational objectives, and improving the quality of teaching and learning. In this paper, we propose a semantic data model for supporting achievement standards-based teaching and learning as well as an achievement assessment education system in subject areas. Our data models define classes and associations between them to formalize the structure of data created in the teaching, learning, evaluating, and feedback based on achievement standards and achievement levels. The importance of the models is that they can be useful as a knowledge base of the achievement-based teaching and learning support system.

Keywords: Achievement Standards, Assessment Standards, Learning Outcomes, Learning Path

1 Introduction

In Korea, the national curriculum guidelines have been developing the achievement and assessment standards to apply the achievement education system to all elementary and secondary schools since 2007. The recent 2015-Revised National Curriculum guidelines [1] emphasize the improvement of assessment system in order that assessments should focus on monitoring students’ degree of achievement in accordance with educational objectives, and improving the quality of teaching and learning. The guidelines provide the definition of evaluation criteria, assessment standards, and achievement levels for learning unit and sample assessment tools in all subject areas [2]. To conduct teaching and learning in accordance with the achievement standards in subject areas, schools should help students develop integrative thinking skills by considering the connection of content knowledge within and across subject areas [3]. In addition, they should assess contents and skills taught in classrooms in light of achievement standards and ensure coherence between instruction and assessment. Through achievement-based assessment, schools should guide students to reflect upon and improve learning by providing constructive feedback on assessment results and offering necessary follow-up instruction and use student assessment results to improve the quality of instruction.

The problem, however, is that there is no service framework or system to support achievement standards-based instruction process, which consists of instructional planning, teaching and learning activities, assessment planning, assessment, and feedback, for teachers and students. The curriculum guidelines and resources are provided as word and pdf documents uploaded in bulletin boards of the National Curriculum Information Center’s web portal. As the first step of the development of the proposed system, we design a universal data model to integrate and connect data sources referenced and produced at each step of the instruction process [4]. In this paper, we introduce the approach to design data models of achievement standards, teaching and learning plan, assessment analysis, and feedback tasks.

2 Conceptual Integration Model

To construct a universal data model, we define the structure of achievement standards, achievement statements, assessment standards and achievement levels as core entities at first. The other entity groups, like subject area, learning unit, learning concept, syllabus, learning activity, assessment plan, assessment, feedback, and learning path, are defined and connected to the core entities of achievement standards. Teaching and learning activity data created in classrooms can be stored and shared among teachers and students by the help of our proposed data model and service framework.
We also design a system architecture for implementing the integration data model, storing achievement standards-related educational data into repositories, and processing the data to provide multiple services depicted in figure 1. Our services support whole process of teaching, learning, evaluating, and feedback generating based on achievement standards. The achievement data service provides a method to retrieve the selected achievement statements and navigate the associated statements and teaching/learning plans based on the different kinds of relationships among them.

The evaluation data service manages and retrieves the evaluation plans and analyzed data of the performed evaluations. The service generates statistic data of evaluation to measure the achievement levels of students. The adaptive feedback service generates the feedback data which is composed of evaluation result and learning paths to guide students for improving their outcomes. The learning path shows learning units and links, which inform sequence of learning and relations of learning units.

3 Assessment Data Model

Assessment standards are the actual criteria for judging students’ achievement levels. Assessment standards are described three levels such as high/medium/low levels showing what students should accomplish through learning. Unit achievement levels describe the expected levels of knowledge, skills and attitudes which students are expected to achieve after the teaching and learning of each unit or area.

![Figure 2. Assessment data model represents classes and relationships to formalize assessment process and feedback based on assessment standards.](image)

Unit achievement levels can be specified with A/B/C three stages for primary schools and A/B/C/D/E five stages for middle schools. However, the three of five level stages do not represent sufficient and detailed information of outcomes to enable students to enhance their understanding and knowledge about certain learning units. Our proposed data model defines relationships among assessment entities, Exam, Question, TwoSpecTable, QuestionResponse, QuestionScore, and so on.

The assessment data model is composed of three groups, such as assessment plan, assessment result, and feedback. The assessment plan group contains classes defining learning activity, exam/quiz, question, and two-spec table to specify how to evaluate the learning quality of students. The classes of the assessment plan group should be associated with assessment standards.

The assessment result group contains classes and relationships to represent the result of assessment analysis, which produces detailed information about the degree of achievement of each student, such as response rate, accuracy rate, item difficulty, and item discrimination power. The feedback group contains classes and relationships for representing feedback data and learning path, which is composed of learning units and links that students should restudy them to improve learning achievement levels.

4 Conclusions

The purpose of our work is to provide more detailed visual information about the degree of achievement to students to enable they can understand their outcomes and make a plan to study certain learning units for improving their knowledge and skill. We design data models to construct knowledge bases of the achievement standards-based education service framework, which is being developed at now. Our universal model covers the whole instruction process from planning to feedback.

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6 References


