Materials Design Plan
Objective 6

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Introduction

The objective of this materials design plan is for preservice teachers to know content and teaching knowledge on fractions and consists with five modules. Even though preservice teachers may teach students fraction concept and computation, the insufficient of their knowledge has been reported by researchers (Naiser, Wright, & Capraro, 2004). To supplement preservice teachers’ insufficient teaching knowledge, they are provided basic knowledge of fraction and asked to design lesson plans using hypermedia materials. In special, identification of students’ misconception on fraction can be helpful for preservice teachers’ teaching knowledge. The lesson plans are needed to include scaffoldings, practice and feedback.

Theoretical Rationale

I discussed four cognitive perspectives (i.e. metacognitive skills, practice and feedback, social context and cultural norms and student belief) in the objective 2 and designed the content map on fraction in the objective 3. In this session, I will describe how my cognitive perspectives can be applied on online materials and the fraction content map and connect these cognitive perspectives to materials design plan and the assessment tool.

The Link between Cognitive Perspective and Materials Design Plan

Cognitive perspectives provide basic principles for teaching content knowledge. The Metacognitive skills mean “thinking about thinking” or “internal dialogue” (Bransford, Brown, & Cocking, 1999). Metacognitive is critical to let students to learn how they can organized their own learning by themselves. Education using hypermedia or cyber-learning is more student-centered than the classroom based learning. Because of this reason, online learning materials should include some components to teach students metacognitive skills. Under the diverse technological situation, metacognition has been studied with diverse aspects. Self explanation (Chi, Bassok, Lewis, Reimann, & Glaser, 1989, Conati, Larkin, & VanLehn, 1997, Moore, 1996), social interaction using discussion board on the web site (Bransford et al., 1999) is reported to improve students’ metacognitive skills. Practice means to let students experience many examples. Example has been considered as a critical factor in learning by Behaviorists and Constructivists. The online learning environment can provide good conditions for feedback. That is, teachers can offer feedback of students’ opinions and performances timely and students can revise their idea and concepts. Practice and feedback is more critical for mathematics than any other subject area. Furthermore, students construct their knowledge under the social context. NAS (2001) defined “social context” like that “much of what humans learn is acquired through discourse and interactions with others” (p. 88). This means that students learn knowledge through the communication with their teachers or peers. In addition to, the reason why social context is important in students’ learning process is that they can motivate and feedback with each other and finally construct their knowledge.

Learning fraction also should be taught under the environment consisted with these four components. Because fraction is an abstract concept for grade 6 students, online learning materials should include several concrete representation models such as fraction strip, pizza
model (pie chart), and bar graph. Also, contextual problems associated with students’ real world can be used to encourage students’ learning. Many practice problems in the knowing level can help students to be familiar with comparison and computation of fractions. Feedback on students’ performance should be given formatively and immediately.

The Link between Cognitive Perspective and Assessment Tools

The assessment tool that I will plan should be based on the four cognitive perspectives; metacognitive skills, practice and feedback, social context and cultural background. In special, metacognitive skills, practice and feedback is necessary to be focused in the mathematics subject. First of all, online materials including fraction content will be evaluated in terms of practice qualitatively and quantitatively. Explanation without enough examples or exercise problems can be less efficient. It is necessary to provide several practice opportunities for students after they are taught of conceptions. How many practice problems are provided and how diverse practice tools are offered can be evaluated. The feedback of the practice is also very critical factor for online learning materials. When I evaluated three hypermedia lessons, most of them have nothing for feedback. Students can have questions while studying with the online materials and the questions should be revolved immediately. If not, students can keep misconceptions that affect negatively on their cognitive process. Whether there are some roots that students can ask questions related to the content explanation or practice problems. In addition, whether the feedback to students’ questions is formative and prompt is a critical point.

Metacognitive skills of the online learning materials can be evaluated in terms of whether they include some devices to make students remind what they are doing. Students can lose the vein specially while doing some hands-on activities. Similar with this, devices using games can make students focus on only the fun activities, not on the learning contents. Additionally, social context and cultural background is a good factor to stimulate students’ interest in learning mathematics. Familiar background of the web page or graphics can make learners feel comfortable and stay long time for learning. In this sense, the online learning materials should be evaluated with two aspects; whether there are some tools to engage students’ metacognitive skills and the design of the web page or devices are familiar for learners.

Objective in Fraction

Objective 1: The student (grade 6) represents and uses rational numbers in a variety of equivalent forms. The student is expected to:

(A) compare and order non-negative rational numbers with concrete representation model such as fraction strip or pie chart with no errors.

(B) generate 5 or more equivalent forms of rational numbers including whole numbers, fractions, and decimals with concrete representation model such as fraction strip or pie chart.

Objective 2: The student (grade 6) adds, subtracts, multiplies, and divides to solve problems and justify solutions. The student is expected to:

(A) model addition and subtraction situations involving fractions with objects, pictures, words, and numbers.
(B) use addition and subtraction to solve problems involving fractions and decimals with no errors.

These objectives including level 1 and 2 were made by the ABCD model for writing objectives. The evaluation of online-materials on fractions for 6 grade students should be based on the objectives mentioned above. Although students’ achievement cannot say how the learning materials are appropriate, it is still critical for teachers who make the learning materials. For the learning of fraction, students are required to compare, order fractions, find equivalent forms of fraction, and add, subtract, multiply, and divide including fractions. To achieve these objectives, the learning materials should include correct conceptual explanations, enough practice examples and feedback. Also, if the learning materials include learner-centered activities to encourage students to construct their own knowledge on fraction, the achievement should be improved.

### Multimedia Specifications

These online modules have multimedia specifications; online discussion board, video clips and presentation in the virtual classroom. All of these procedures can be implemented in the traditional classrooms; but the effectiveness can be improved when those are implemented in the online class. Online discussion board provides formative feedback timely and students can access easily to the video clips when they are available. In addition, presentations in the virtual classroom can relieve the time and space limitations.
Content Map of Fraction

14 Use addition, subtraction, multiplication, and division to solve problems involving fractions and decimals

13 Use addition and subtraction to solve problems involving fractions and decimals

12 Compare two fractional quantities in problem-solving situations using a variety of methods, including common denominators

11 Generate a mixed number equivalent to a given improper fraction or generate an improper fraction equivalent to a given mixed number

10 Generate a fraction equivalent to a given fraction such as 1/2 and 3/6 or 4/12 and 1/3

9 Use concrete objects and pictorial models to generate equivalent fractions

8 Model fraction quantities greater than one using concrete objects and pictorial models

7 Compare and order fractions using concrete objects and pictorial models

6 Relate decimals to fractions that name tenths and hundredths using concrete objects and pictorial models

5 Construct concrete models of equivalent fractions for fractional parts of whole objects

4 Compare fractional parts of whole objects or sets of objects in a problem situation using concrete models

3 Use fraction names and symbols to describe fractional parts of whole objects or sets of objects

2 Use concrete models to represent and name fractional parts of a whole object or sets of objects

1 Describe fractional parts of whole objects or sets of objects
Concept Map for the Preservice Teachers

**Content Knowledge**

**Practise**
- Simple Quizzes
- Exercise problems
- examples

**Content**
- Decide specific content
- Decide objective

**Identification of students’ misconceptions on fraction**
- What kinds of misconceptions do students have?
- What is the reason of the misconceptions?

**Basic knowledge of fraction**
What is the fraction?
How compute with fractions?

**Teaching Knowledge**

**Assessment Tools**
- Formative assessment
- Summative assessment

**Feedback**
- Timely and formative feedback

**Scaffoldings**
- How to remind students’ prior knowledge

**Resources and Materials**
- What resources can be used?
- What materials can be used?

**Remediation of students’ misconceptions on fraction**
- Using diverse of representations
- Using hands-on activities
- Using concrete models

**Representation skill**
Fraction strip, pie chart, concrete
Big Picture for 5 Modules

- The whole professional development for preservice teachers includes 5 modules.
- The objective of these modules is to let preservice teachers to know basic knowledge, standardized objectives of fraction and to develop hypermedia resources for elementary level students.
- Intended length of an on-line module is one hour.
- Each module consists with specific hypermedia tools.
- Online class for modules requires discussion board, individual e-journal and feedback from content experts.
- Each module has specific objective, scaffolds (presentation of information), self-assessment, assessment for instruction, exercise problems and feedback.

<table>
<thead>
<tr>
<th>Module</th>
<th>Contents</th>
<th>Resources</th>
<th>Action</th>
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</thead>
</table>
| 1      | - Basic knowledge of fraction (Content and teaching knowledge)  
- TEKS & TAKS | - Presentation  
- Simple Quiz\(^1\) to evaluate prior knowledge | - Self-Check of prior knowledge through the quiz  
- Decide objectives  
- E-journal |
| 2      | - Introduction for project to develop hypermedia resources  
- Making project groups | - Links to existed hypermedia resources about fraction | - Design big idea for developing hypermedia  
- E-journal |
| 3      | - Misconceptions on fraction | - Video Clip on students’ explanation of solving process | - Identification of misconceptions  
- Discussion about remediation methods |
| 4      | - Technology skill  
- Assessment instruments | - Presentation to explain technical skill  
- Examples for assessment\(^2\) and rubric | - Developing technology skill and constructing hypermedia  
- Making assessment and rubric |
| 5      | - Presentation  
- Self-assessment  
- Survey on online modules | - Virtual classroom for presentation  
- Survey tool | - Presentation  
- Self-assessment  
- Survey |

\(^1\) Hypermedia tools for self-check quiz should be developed. It needs to include exercise problems and
\(^2\) Assessment includes score scheme for hypermedia lessons and students’ performance and achievement.
### Scoring Scheme for Preservice Teacher

#### Formative Assessment

Formative assessment means continuous feedback for students. Also, it indicates the use of assessments as sources of feedback to improve teaching and learning. Formative assessment makes students’ thinking to be visible through the discussion, papers and tests. That is, teachers can give feedback for students’ work in progress and let them to revise their incorrect or inappropriate points. One of the formative assessments is a portfolio assessment. Portfolio includes many prior works of students and this can make them to reflect and remind prior knowledge. And online based formative assessment tool is teachers’ on-line monitoring system. When students upload their work on the web-site, teachers continuously give feedback on their work. In the aspect of teachers, appropriately designed assessments can help teachers realize the need to rethink their teaching practices and technology can help teachers to solve the problems, limited time. For teachers, formative assessment gives teachers much information of students’ prior knowledge and their final appropriate goals. Furthermore, through the formative assessment, teachers can have a chance to rethink their instructional methods and revise them for students’ learning with understanding. Meanwhile, students also have good feedback to improve their learning from the formative assessments. Opportunities to work collaboratively are also good formative assessment for students.

These learning modules ask students to design lesson including scaffolds, identification of misconceptions, practice and feedback. In the final module, students may present their lesson plan like as a teacher in the classroom. To evaluate this performance, the holistic rubric can be used.

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<th></th>
<th>Exceeding Adequate (9-10)</th>
<th>Adequate (7-8)</th>
<th>Approaching Adequate (5-6)</th>
<th>Not Attempted or Not Adequate (1-4)</th>
<th>Comments</th>
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<tbody>
<tr>
<td>Comprehension</td>
<td>Appropriate Goal</td>
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<td>Scaffold</td>
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<td>Misconception</td>
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<td>Feedback</td>
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<td>Preparedness</td>
<td>Presentation Material</td>
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<td></td>
<td>Collaboration</td>
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<td>Hypermedia</td>
<td>Content</td>
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<td></td>
<td>Structure</td>
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<td>Total</td>
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### Scoring Scheme for Hypermedia Lessons

<table>
<thead>
<tr>
<th>Content/Instruction component</th>
<th>Exceeding Adequate (9-10)</th>
<th>Adequate (7-8)</th>
<th>Approaching Adequate (5-6)</th>
<th>Not Attempted or Not Adequate (1-4)</th>
<th>Comments</th>
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<tbody>
<tr>
<td>Appropriate goal</td>
<td>Meaningful learning</td>
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<td>Motivation and interest</td>
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<tr>
<td>Scaffold</td>
<td>Prior knowledge/Supplement information</td>
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<td>Feedback</td>
<td>Formative/Timely</td>
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<td>Collaboration</td>
<td>Problem/project-based</td>
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<td>Diverse Participants</td>
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<tr>
<td>Structure</td>
<td>Correctness</td>
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<td>Explicit/Redundancy</td>
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<td>Technical support</td>
<td>Access availability</td>
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<td>Design features</td>
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<td>Total</td>
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### Schedule for Developing Modules

<table>
<thead>
<tr>
<th>Tasks</th>
<th>Start</th>
<th>Finish</th>
<th>Duration</th>
<th>June 6 – 12</th>
<th>June 13 – 19</th>
<th>June 20 – 26</th>
<th>June 27 – 3</th>
<th>July 3 – 9</th>
<th>July 10 – 16</th>
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<tbody>
<tr>
<td>Organization of project team</td>
<td>6/6/11</td>
<td>6/12/11</td>
<td>7 days</td>
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<tr>
<td>Development of content</td>
<td>6/13/11</td>
<td>6/30/11</td>
<td>18 days</td>
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<tr>
<td>- Developing presentation for scaffolds</td>
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<td>- Video Clip</td>
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<td>Establish online class</td>
<td>6/13/11</td>
<td>7/3/11</td>
<td>21 days</td>
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<tr>
<td>Development of assessment tools</td>
<td>6/27/11</td>
<td>7/3/11</td>
<td>7 days</td>
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<tr>
<td>Preparing resources for technology skill</td>
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<tr>
<td>Pilot test system</td>
<td>7/6/11</td>
<td>7/9/11</td>
<td>4 days</td>
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<td>Students' sign up</td>
<td>7/10/11</td>
<td>7/16/11</td>
<td>7 days</td>
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