

## Appendix A

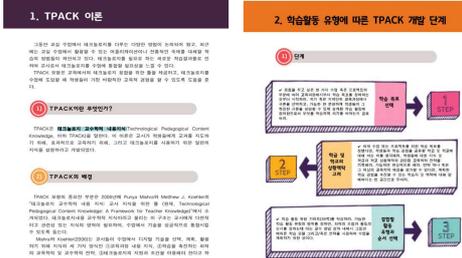
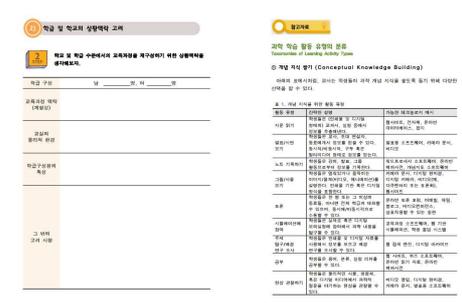
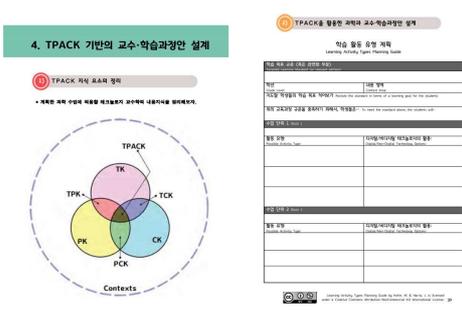
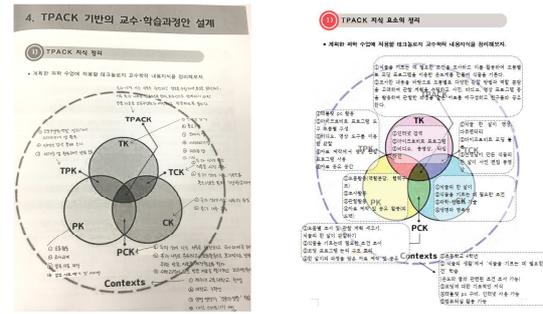
### Course Outline and Sample Materials

#### Course outline, description and expectations for teaching science with reflection on TPACK

Week	Time (Hours)	Lesson topic	Description of activities	Expectations		Content area
				Content	Outcomes	
1	2	1. The theory and the procedure of TPACK framework based on learning activity types	Teacher candidates learn the components of the TPACK framework and discuss the lesson planning phase based on TPACK.	Teacher candidates understand the ideas of the TPACK framework and the procedure of TPACK development based on learning activity types.		Pedagogy
2-3	4	2. Organization of the science content-based STEM lessons	In each stage, teacher candidates detail their plans for mock lessons and write down the process of lesson planning.	Teacher candidates organize science content-based STEM lessons at the elementary school level using the TPACK development procedure.	<ul style="list-style-type: none"> <li>Lesson planning with the following stages:               <ul style="list-style-type: none"> <li>determine targeted learning standards and goals</li> <li>consider the classroom and school contexts</li> <li>choose learning activity types and sequence</li> <li>make an assessment plan</li> <li>select learning materials and aids</li> </ul> </li> </ul>	Life Science or Earth Science
4	2	3. Lesson plan design based on the TPACK framework	Teacher candidates make an individual lesson plan for an integrated science lesson using their TPACK. They also include digital and nondigital options for each lesson block of learning activity types.	Teacher candidates review their TPACK and its constituents for the planned lessons.	<ul style="list-style-type: none"> <li>A Venn diagram for TPACK review</li> <li>Learning activity type planning</li> </ul>	Life Science or Earth Science
5	2	4. Preparation for STEM lessons using the TPACK framework	Teacher candidates experience the importance of TPACK for their planned lessons. They also rehearse applications of digital and nondigital materials according to the learning activity types.	Teacher candidates prepare for integrated science lessons using their TPACK.	<ul style="list-style-type: none"> <li>A science content-based STEM lesson plan with TPACK</li> <li>Digital or nondigital tools and resources for learning activity types</li> </ul>	Life Science or Earth Science
6-8	6	5. Practice and reflection on teaching with TPACK	Teacher candidates demonstrate their integrated lessons according to the plan.	Teacher candidates implement the integrated science content-based lessons applying their TPACK.	<ul style="list-style-type: none"> <li>Teaching demonstrations</li> <li>Lesson observations</li> <li>Reflective assessment</li> </ul>	Life Science or Earth Science



# Preservice Teachers Workbook

Contents	Examples	Features or sample outcomes
<p>The theory and the procedure of the TPACK framework based on learning activity types</p>		<ul style="list-style-type: none"> <li>• TPACK theory and discussion</li> <li>• Introduction on a flexible five-step process (Hofer &amp; Harris, 2015): ① Choose learning goals, ② Consider classroom and school contexts, ③ Select activity types to combine and sequence, ④ Select assessment strategies, ⑤ Select tools and/or resources</li> </ul>
<p>Organization of the science content-based STEM lessons</p>		<ul style="list-style-type: none"> <li>• The 2015 revised national science curriculum standards in Korea</li> <li>• Disciplines and steps for an integrated lesson</li> <li>• Assessment standards, method, and moments</li> <li>• Digital/non-digital resources</li> </ul>
<p>Lesson plan design based on the TPACK framework</p>		<ul style="list-style-type: none"> <li>• The science taxonomy LATs categories as conceptual knowledge building, procedural knowledge building, and knowledge expression (Hofer &amp; Harris, 2015)</li> </ul>
<p>Preparation for STEM lessons using the TPACK framework</p>		
<p>Practice and reflection on teaching with TPACK</p>		<ul style="list-style-type: none"> <li>• Teaching demonstrations of the preservice teachers' learning activity types planning which designed by their TPACK (e.g., planetarium software application Sky Map, storytelling, problem-solving activities, and stars and constellations in the pictures)</li> <li>• Discussion about teaching and learning of both colleagues and themselves.</li> </ul>