



**Universitas Negeri Surabaya**  
**Faculty of Mathematics and Natural Sciences**  
**Doctoral Study Program in Mathematics Education**

**Document Code**

**SEMESTER LEARNING PLAN**

Courses	CODE	Course Family	Credit Weight			SEMESTER	Compilation Date
Cognition Theory and Individual Differences (Cognition Theory and Individual Diversity)	8400202059		T=2	P=0	ECTS=5.04	1	July 17, 2024

AUTHORIZATION	SP Developer	Course Cluster Coordinator	Study Program Coordinator
	Prof. Dr. Tatag Yuli Eko Siswono, M.Pd	.....	Prof. Dr. Tatag Yuli Eko Siswono, S.Pd., M.Pd.

<b>Learning model</b>	<b>Case Studies</b>
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<b>Program Learning Outcomes (PLO)</b>	<b>PLO study program that is charged to the course</b>																																																																																					
	<b>Program Objectives (PO)</b>																																																																																					
	<b>PO - 1</b>	Describe theories of cognition and individual differences with a critical and creative scientific attitude																																																																																				
	<b>PO - 2</b>	Analyze the concepts of cognition theory and individual differences by constructing effective and communicative arguments to produce creative and original work;																																																																																				
	<b>PO - 3</b>	Applying the concepts of cognition theory and individual differences to design solutions to mathematics education problems																																																																																				
	<b>PLO-PO Matrix</b>																																																																																					
	<table border="1" style="margin-left: auto; margin-right: auto;"> <tr><td style="text-align: center;">P.O</td></tr> <tr><td style="text-align: center;">PO-1</td></tr> <tr><td style="text-align: center;">PO-2</td></tr> <tr><td style="text-align: center;">PO-3</td></tr> </table>		P.O	PO-1	PO-2	PO-3																																																																																
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<b>PO Matrix at the end of each learning stage (Sub-PO)</b>																																																																																						
	<table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td rowspan="2" style="text-align: center;">P.O</td> <td colspan="16" style="text-align: center;">Week</td> </tr> <tr> <td style="text-align: center;">1</td><td style="text-align: center;">2</td><td style="text-align: center;">3</td><td style="text-align: center;">4</td><td style="text-align: center;">5</td><td style="text-align: center;">6</td><td style="text-align: center;">7</td><td style="text-align: center;">8</td><td style="text-align: center;">9</td><td style="text-align: center;">10</td><td style="text-align: center;">11</td><td style="text-align: center;">12</td><td style="text-align: center;">13</td><td style="text-align: center;">14</td><td style="text-align: center;">15</td><td style="text-align: center;">16</td> </tr> <tr> <td style="text-align: center;">PO-1</td> <td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td> </tr> <tr> <td style="text-align: center;">PO-2</td> <td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td> </tr> <tr> <td style="text-align: center;">PO-3</td> <td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td> </tr> </table>		P.O	Week																1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	PO-1																	PO-2																	PO-3																
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<b>Short Course Description</b>	The study of cognition theory and individual differences in mathematics education includes concept formation according to Piaget's theory, abstraction, information processing theory, APOS theory, process theory, embodied cognition, semiotics, metacognition, as well as other aspects related to the theme or focus of student research. Lectures begin with an explanation of concepts and principles, assignments and discussions with students, as well as presentations using ICT with an assessment system including assignments (30%), participation (20%), mid-semester assessment (20%) and final semester assessment (30%).
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<b>References</b>	<b>Main :</b>
	<ol style="list-style-type: none"> <li>1. Rivera, F. (2013). Teaching and learning patterns in school mathematics: psychological and pedagogical considerations. Dordrecht: Springer</li> <li>2. Gutierrez, A &amp; Boero, P. (Eds.) (2006). Handbook of research on psychology of mathematics education: Past, Present, and Future. Rotterdam: Sense Publishers</li> </ol>
	<b>Supporters:</b>

1. Shapiro, L. (2019). Embodied cognition. New York: Routledge
2. Clark, J. M., & Paivio, A. (1991). Dual coding theory and education. *Educational psychology review*, 3(3), 149-210.
3. Arnon, I., Cottrill, J., Dubinsky, E., Oktaç, A., Roa Fuentes, S., Trigueros, M., & Weller, K. (2014). APOS theory. A framework for research and curriculum development in mathematics education, 5-15
4. Arnon, I., Cottrill, J., Dubinsky, E., Oktaç, A., Fuentes, S. R., Trigueros, M., & Weller, K. (2014). From Piaget's Theory to APOS Theory: Reflective Abstraction in Learning Mathematics and the Historical Development of APOS Theory. In *APOS Theory* (pp. 5-15). Springer, New York, NY.
5. Harel, G., Selden, A., & Selden, J. O. H. N. (2006). Advanced mathematical thinking: Some PME perspectives. In *Handbook of research on the psychology of mathematics education* (pp. 147-172). Brill Sense.
6. Presmeg, N., Radford, L., Roth, W. M., & Kadunz, G. (2016). Semiotics in mathematics education (p. 40). Springer Nature.
7. Gullick, M. M., Sprute, L. A., & Temple, E. (2011). Individual differences in working memory, nonverbal IQ, and mathematics achievement and brain mechanisms associated with symbolic and nonsymbolic number processing. *Learning and Individual Differences*, 21(6), 644-654.

**Supporting lecturer** Prof. Dr. Tatag Yuli Eko Siswono, S.Pd., M.Pd.  
Prof. Rooselyna Ekawati, Ph.D.

Week-	Final abilities of each learning stage (Sub-PO)	Evaluation		Help Learning, Learning methods, Student Assignments, [ Estimated time]		Learning materials [ References ]	Assessment Weight (%)
		Indicator	Criteria & Form	Offline ( offline )	Online ( online )		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1	Comparing the concepts of cognition, thinking and reasoning	Evaluate the concepts of cognition, thinking and reasoning based on psychological theory.	<b>Criteria:</b> Suitability and accuracy of case solutions, depth of understanding of cases, critical thinking and analytical skills, creativity in problem solving	Assignments, Lectures, Presentations, and Discussions Case 1: When does an individual think or reason? 2 X 50	Assignments, Lectures, Presentations and Discussions via Googleclassroom/ Googlemeet, Zoom and Vilearn-Vinesa 2 x 50'	<b>Material:</b> Concepts of cognition, thinking and reasoning <b>References:</b> <i>Gutierrez, A &amp; Boero, P. (Eds.) (2006). Handbook of research on psychology of mathematics education: Past, Present, and Future. Rotterdam: Sense Publishers</i>	3%
2		Distinguish between the concepts of cognition, thinking and reasoning in mathematics.	<b>Criteria:</b> Suitability and accuracy of case solutions, depth of understanding of cases, critical thinking and analytical skills, creativity in problem solving	Assignments, Lectures, Presentations, and Discussions Case 2: What is the difference between thinking and reasoning in mathematics? 2 X 50	Assignments, Lectures, Presentations and Discussions via Googleclassroom/ Googlemeet, Zoom and Vilearn-Vinesa 2 x 50'	<b>Material:</b> Thinking and Reasoning in Mathematics <b>Bibliography:</b> <i>Rivera, F. (2013). Teaching and learning patterns in school mathematics: psychological and pedagogical considerations. Dordrecht: Springer</i>	3%
3	Analyzing individual differences based on cognitive style	Analyzing individual differences based on FI and FD cognitive styles.	<b>Criteria:</b> Suitability and accuracy of case solutions, depth of understanding of cases, critical thinking and analytical skills, creativity in problem solving	Assignments, Lectures, Presentations, and Discussions Case 3: Does the type of individual who is a global or analytical thinker have an influence on learning mathematics? 2 X 50	Assignments, Lectures, Presentations and Discussions via Googleclassroom/ Googlemeet, Zoom and Vilearn-Vinesa 2 x 50'	<b>Material:</b> FI and FD Cognitive Styles <b>References:</b> <i>Gutierrez, A &amp; Boero, P. (Eds.) (2006). Handbook of research on psychology of mathematics education: Past, Present, and Future. Rotterdam: Sense Publishers</i>	4%

4		Analyzing individual differences based on Impulsive and Reflective cognitive styles.	<b>Criteria:</b> Suitability and accuracy of case solutions, depth of understanding of cases, critical thinking and analytical skills, creativity in problem solving	Assignments, Lectures, Presentations, and Discussions Case 4: Are impulsive people unsuccessful in learning mathematics? 2 X 50	Assignments, Lectures, Presentations, and Discussions via Googleclassroom/ Googlemeet, WAG, and Vilearn-Vinesa 2 x 50'	<b>Material:</b> Differences between Impulsive and Reflective Cognitive Styles <b>References:</b> <i>Gutierrez, A &amp; Boero, P. (Eds.) (2006). Handbook of research on psychology of mathematics education: Past, Present, and Future. Rotterdam: Sense Publishers</i>	4%
5	Analyzing individual differences based on learning styles.	Analyzing individual differences based on learning styles (visual, auditory, kinesthetic)	<b>Criteria:</b> Suitability and accuracy of case solutions, depth of understanding of cases, critical thinking and analytical skills, creativity in problem solving	Assignments, Lectures, Presentations, and Discussions Case 5: Does learning style influence success in learning mathematics? 2 X 50	Assignments, Lectures, Presentations and Discussions via Googleclassroom/ Googlemeet, Zoom and Vilearn-Vinesa 2 x 50'	<b>Material:</b> Differences in Learning Styles <b>Reference:</b> <i>Rivera, F. (2013). Teaching and learning patterns in school mathematics: psychological and pedagogical considerations. Dordrecht: Springer</i>	4%
6	Analyze individual abstraction concepts.	Analyzing individual abstraction abilities based on Piaget's theory	<b>Criteria:</b> Suitability and accuracy of case solutions, depth of understanding of cases, critical thinking and analytical skills, creativity in problem solving	Assignments, Lectures, Presentations, and Discussions Case 6: Is it through assimilation or accommodation of students' mathematical abstractions? 2 X 50	Assignments, Lectures, Presentations, and Discussions via Googleclassroom/ Googlemeet, WAG, and Vilearn-Vinesa. 2 x 50'	<b>Material:</b> Individual abstraction concept <b>References:</b> <i>Gutierrez, A &amp; Boero, P. (Eds.) (2006). Handbook of research on psychology of mathematics education: Past, Present, and Future. Rotterdam: Sense Publishers</i>	4%

7	Analyzing APOS Theory.	Analyzing APOS theory.	<b>Criteria:</b> Suitability and accuracy of case solutions, depth of understanding of cases, critical thinking and analytical skills, creativity in problem solving	Assignments, Lectures, Presentations, and Discussions Case 7: How is a mathematical concept scheme formed? 2 X 50	Assignments, Lectures, Presentations, and Discussions via Googleclassroom/ Googlemeet, WAG, and Vilearn-Vinesa 2 x 50'	<b>Material:</b> APOS Theory <b>References:</b> Arnon, I., Cottrill, J., Dubinsky, E., Oktaç, A., Roa Fuentes, S., Trigueros, M., & Weller, K. (2014). <i>APOS theory. A framework for research and curriculum development in mathematics education</i> , 5-15 <hr/> <b>Material:</b> APOS Theory <b>References:</b> Arnon, I., Cottrill, J., Dubinsky, E., Oktaç, A., Fuentes, SR, Trigueros, M., & Weller, K. (2014). <i>From Piaget's Theory to APOS Theory: Reflective Abstraction in Learning Mathematics and the Historical Development of APOS Theory</i> . In <i>APOS Theory</i> (pp. 5-15). Springer, New York, NY.	4%
8		Midterm exam	<b>Form of Assessment</b> : Test	Midterm Exam 2 X 50			20%
9	Analyzing Procept Theory.	Using Procept theory to analyze individual differences.	<b>Criteria:</b> Suitability and accuracy of case solutions, depth of understanding of cases, critical thinking and analytical skills, creativity in problem solving	Assignments, Lectures, Presentations, and Discussions Case 8: Does the process of solving a problem build individual knowledge? 2 X 50	Assignments, Lectures, Presentations and Discussions via Googleclassroom/ Googlemeet, WAG, Zoom and Vilearn-Vinesa 2 x 50'	<b>Material:</b> Procept Theory <b>Bibliography:</b> Clark, JM, & Paivio, A. (1991). <i>Dual coding theory and education</i> . <i>Educational psychology review</i> , 3(3), 149-210. <hr/> <b>Material:</b> Procept Theory <b>Bibliography:</b> Harel, G., Selden, A., & Selden, JOHN (2006). <i>Advanced mathematical thinking: Some PME perspectives</i> . In <i>Handbook of research on the psychology of mathematics education</i> (pp. 147-172). Brill Sense.	3%

10	Analyzing Embodied Cognition.	Using Embodied Cognition theory to analyze individual differences.	<b>Criteria:</b> Suitability and accuracy of case solutions, depth of understanding of cases, critical thinking and analytical skills, creativity in problem solving	Assignments, Lectures, Presentations, and Discussions Case 9: Do gestures influence knowledge acquisition? 2 X 50	Assignments, Lectures, Presentations and Discussions via Googleclassroom/ Googlemeet, WAG, Zoom and Vilearn-Vinesa 2 x 50'	<b>Material:</b> Embodied Cognition <b>References:</b> <i>Harel, G., Selden, A., &amp; Selden, JOHN (2006). Advanced mathematical thinking: Some PME perspectives. In Handbook of research on the psychology of mathematics education (pp. 147-172). Brill Sense.</i>  <b>Material:</b> Embodied Cognition <b>References:</b> <i>Shapiro, L. (2019). Embodied cognition. New York: Routledge</i>	3%
11	Analyzing individual differences in adversity.	Using AQ Theory to analyze individual differences.		Assignments, Lectures, Presentations, and Discussions Case 10: Do challenges influence success in learning mathematics? 2 X 50	Assignments, Lectures, Presentations and Discussions via Googleclassroom/ Googlemeet, WAG, Zoom and Vilearn-Vinesa 2 x 50'	<b>Material:</b> Adversity Theory <b>Bibliography:</b> <i>Gullick, MM, Sprute, LA, &amp; Temple, E. (2011). Individual differences in working memory, nonverbal IQ, and mathematics achievement and brain mechanisms associated with symbolic and nonsymbolic number processing. Learning and Individual Differences, 21(6), 644-654.</i>	3%
12	Analyze individual gender differences.	Using Gender Theory to analyze individual differences.	<b>Criteria:</b> Suitability and accuracy of case solutions, depth of understanding of cases, critical thinking and analytical skills, creativity in problem solving	Assignments, Lectures, Presentations, and Discussions Case 11: Does gender influence success in learning mathematics? 2 X 50	Assignments, Lectures, Presentations and Discussions via Googleclassroom/ Googlemeet, WAG, Zoom and Vilearn-Vinesa 2 x 50'	<b>Material:</b> Gender Differences <b>References:</b> <i>Gullick, MM, Sprute, LA, &amp; Temple, E. (2011). Individual differences in working memory, nonverbal IQ, and mathematics achievement and brain mechanisms associated with symbolic and nonsymbolic number processing. Learning and Individual Differences, 21(6), 644-654.</i>	4%

13	Analyzing individual differences in intuition.	Using Intuition Theory to analyze individual differences.	<b>Criteria:</b> Suitability and accuracy of case solutions, depth of understanding of cases, critical thinking and analytical skills, creativity in problem solving	Assignments, Lectures, Presentations, and Discussions Case 12: What is the difference between intuition and success in learning mathematics? 2 X 50	Assignments, Lectures, Presentations and Discussions via Googleclassroom/ Googlemeet, WAG, Zoom and Vilearn-Vinesa 2 x 50'	<b>Material:</b> Intuition <b>Bibliography:</b> <i>Harel, G., Selden, A., &amp; Selden, JOHN (2006). Advanced mathematical thinking: Some PME perspectives. In Handbook of research on the psychology of mathematics education (pp. 147-172). Brill Sense.</i>	4%
14	Analyzing individual differences in metacognition.	Using Metacognition Theory to analyze individual differences.	<b>Criteria:</b> Suitability and accuracy of case solutions, depth of understanding of cases, critical thinking and analytical skills, creativity in problem solving	Assignments, Lectures, Presentations, and Discussions Case 13: Do individual differences in metacognition influence success in learning mathematics? 2 X 50	Assignments, Lectures, Presentations, and Discussions via Googleclassroom/ Googlemeet, WAG, and Vilearn-Vinesa 2 x 50'	<b>Material:</b> Metacognition <b>Bibliography:</b> <i>Gutierrez, A &amp; Boero, P. (Eds.) (2006). Handbook of research on psychology of mathematics education: Past, Present, and Future. Rotterdam: Sense Publishers</i>	4%
15	Applying several theories of cognition and individual differences becomes part of the research study for the dissertation.	Apply theories of cognition and individual differences to develop the theoretical framework of the dissertation	<b>Criteria:</b> Suitability and accuracy of project solutions, depth of understanding of the project, critical thinking and analytical skills, creativity in problem solving  <b>Form of Assessment :</b> Project Results Assessment / Product Assessment	Assignments, Lectures, Presentations, and Discussions Project Assignments: Preparation of a Dissertation Theoretical Framework using Cognition and Individual Differences Theory 2 X 50	Assignments, Lectures, Presentations and Discussions via Googleclassroom/ Googlemeet, WAG, Zoom and Vilearn-Vinesa 2 x 50'	<b>Material:</b> Preparation of a Theoretical Framework for a Dissertation <b>Bibliography:</b> <i>Gutierrez, A &amp; Boero, P. (Eds.) (2006). Handbook of research on psychology of mathematics education: Past, Present, and Future. Rotterdam: Sense Publishers</i>	3%
16		Final Semester Examination (UAS)-Final Project Report	<b>Criteria:</b> Appropriateness and accuracy of the article format (20%), novelty of the research theme (30%), accuracy and coherence of the theoretical framework (40%) and accuracy of writing and use of language (10%)	Project Report Preparation of Theoretical Framework 2 x 50'			30%

#### Evaluation Percentage Recap: Case Study

No	Evaluation	Percentage
1.	Project Results Assessment / Product Assessment	3%
2.	Test	20%
		23%

#### Notes

- 1. Learning Outcomes of Study Program Graduates (PLO - Study Program)** are the abilities possessed by each Study Program graduate which are the internalization of attitudes, mastery of knowledge and skills according to the level of their study program obtained through the learning process.
- 2. The PLO imposed on courses** are several learning outcomes of study program graduates (CPL-Study Program) which are used for the formation/development of a course consisting of aspects of attitude, general skills, special skills and knowledge.

3. **Program Objectives (PO)** are abilities that are specifically described from the PLO assigned to a course, and are specific to the study material or learning materials for that course.
4. **Subject Sub-PO (Sub-PO)** is a capability that is specifically described from the PO that can be measured or observed and is the final ability that is planned at each learning stage, and is specific to the learning material of the course.
5. **Indicators for assessing** abilities in the process and student learning outcomes are specific and measurable statements that identify the abilities or performance of student learning outcomes accompanied by evidence.
6. **Assessment Criteria** are benchmarks used as a measure or measure of learning achievement in assessments based on predetermined indicators. Assessment criteria are guidelines for assessors so that assessments are consistent and unbiased. Criteria can be quantitative or qualitative.
7. **Forms of assessment:** test and non-test.
8. **Forms of learning:** Lecture, Response, Tutorial, Seminar or equivalent, Practicum, Studio Practice, Workshop Practice, Field Practice, Research, Community Service and/or other equivalent forms of learning.
9. **Learning Methods:** Small Group Discussion, Role-Play & Simulation, Discovery Learning, Self-Directed Learning, Cooperative Learning, Collaborative Learning, Contextual Learning, Project Based Learning, and other equivalent methods.
10. **Learning materials** are details or descriptions of study materials which can be presented in the form of several main points and sub-topics.
11. **The assessment weight** is the percentage of assessment of each sub-PO achievement whose size is proportional to the level of difficulty of achieving that sub-PO, and the total is 100%.
12. TM=Face to face, PT=Structured assignments, BM=Independent study.