	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
Mathematical Thinking (Mathematical Thinking)	8400202042		**T=2**	**P=0**	**ECTS=5.04**	2	July 17, 2024

AUTHORIZATION	SP Developer	Course Cluster Coordinator	Study Program Coordinator
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Learning model: Case Studies

Program Learning Outcomes (PLO)

PLO study program that is charged to the course

Program Objectives (PO)

PO - 1	Describe the concept of mathematical thinking with a critical and creative scientific attitude (S2, P1)
PO - 2	Analyze mathematical thinking concepts by compiling effective and communicative arguments to produce creative and original work (KU2, P1)
PO - 3	Applying mathematical thinking concepts to design solutions to mathematics education problems (KK1, P1)

PLO-PO Matrix

P.O
PO-1
PO-2
PO-3

PO Matrix at the end of each learning stage (Sub-PO)

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																

Short Course Description: The study of mathematical thinking in solving mathematical problems includes the process of problem solving, understanding, various types of reasoning, solving and posing problems, critical thinking, creative thinking, and mathematical proof. 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%) .

References

Main :

1. Blitzer, R., & White, J. 2011. Thinking mathematically . Pearson Prentice Hall.
2. Mason, J., Burton, L., & Stacey, K. 2011. Thinking mathematically . Pearson Higher Ed.

Supporters:

1. Booker, G. 2005. Thinking mathematically–making sense and solving problems. The Mathematics Education into the 21th Century Project Universiti Teknologi Malayasia, Reform, Revolution and Paradigm Shift in Mathematics Education, Johor Bahru, Malaysia, Nov 25th-Des 1th .
2. Carpenter, T. P., Franke, M. L., & Levi, L. 2003. Thinking mathematically: Integrating arithmetic and algebra in elementary school . Hanover Street, Portsmouth: Heinemann
3. Thompson, P. W., & Carlson, M. P. 2017. Variation, covariation, and functions: Foundational ways of thinking mathematically. Compendium for research in mathematics education , 421-456.
4. WHAT IS MATHEMATICAL THINKING AND WHY IS IT IMPORTANT? https://www.researchgate.net/publication/254408829
5. MATHEMATICAL THINKING: THE STRUGGLE FOR MEANING https://www.jstor.org/stable/748986
6. CONSTRUCTIVISM, MATHEMATICS AND MATHEMATICS EDUCATION https://www.jstor.org/stable/3482498

Supporting lecturer: Dr. Pradnyo Wijayanti, M.Pd.
Prof. Dr. Tatag Yuli Eko Siswono, S.Pd., M.Pd.

Week-	Final abilities of each learning	Evaluation	Help Learning, Learning methods, Student Assignments, [Estimated time]	Learning materials [References]	Assessment Weight (%)

	stage (Sub-PO)	Indicator	Criteria & Form	Offline (*offline*)	Online (*online*)		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1	Analyze mathematical thinking concepts from various sources, journal articles or books	Able to describe the meaning of thinking in general, scientific thinking, and mathematical thinking	**Criteria:** Suitability and accuracy of case solutions, depth of understanding of cases, critical thinking and analytical skills, creativity in problem solving	Collaborative reciprocity and class discussion. 2 X 50	Live (Zoom meeting), Case Based Learning, Discussion, Question and Answer Case 1: Does a psychologist, scientist or mathematician think differently? 2 x 50‘	**Material:** Thinking Mathematically **References:** *Blitzer, R., & White, J. 2011. Thinking mathematically. Pearson Prentice Hall.* **Material:** Mathematical Thinking **Literature:** *WHAT IS MATHEMATICAL THINKING AND WHY IS IT IMPORTANT? https://www.researchgate.net/...*	3%
2	Analyze the concept of thinking from a behavioristic view from various credible article sources	Describe the concept of thinking from a behavioristic view	**Criteria:** Suitability and accuracy of case solutions, depth of understanding of cases, critical thinking and analytical skills, creativity in problem solving	Collaborative case analysis, presentation and class discussion. 2 X 50	□ Asynchronus or Synchronus uses Vinesa LMS or other platforms. □ Introductions, agreements, and lecture targets. □ Interactive discussion (brain storming) about Case 2: Thinking is a mental activity or behavior? 2 x 50‘	**Material:** Mathematical Thinking as Behavior **References:** *Booker, G. 2005. Thinking mathematically–making sense and solving problems. The Mathematics Education into the 21th Century Project Universiti Teknologi Malayasia, Reform, Revolution and Paradigm Shift in Mathematics Education, Johor Bahru, Malaysia, Nov 25th-Dec 1th .*	3%
3	Analyze thinking concepts based on Information Processing Theory from various credible article sources	Describe the concept of thinking based on information processing theory	**Criteria:** Suitability and accuracy of case solutions, depth of understanding of cases, critical thinking and analytical skills, creativity in problem solving	Group assignments, presentations and class discussions 2 X 50	□ Asynchronus or Synchronus uses Vinesa LMS or other platforms. □ Introductions, agreements, and lecture targets. □ Interactive discussion (brain storming) about Case 3: Is the thinking process mechanistic? 2 x 50‘	**Material:** Thinking Based on Information Processing Theory **Bibliography:** *Blitzer, R., & White, J. 2011. Thinking mathematically. Pearson Prentice Hall.*	4%
4	Evaluating the concept of mathematical thinking based on the views of individual and social constructivism	Evaluating the concept of mathematical thinking based on the views of individual and social constructivism	**Criteria:** Suitability and accuracy of case solutions, depth of understanding of cases, critical thinking and analytical skills, creativity in problem solving	Assignments, presentations, and class discussions. 2 X 50	□ Asynchronus or Synchronus uses Vinesa LMS or other platforms. □ Introductions, agreements, and lecture targets. □ Interactive discussion (brain storming) about Case 4: Which is better for building self-knowledge or social influence? 2 x 50‘	**Material:** Constructivism **Library:** *CONSTRUCTIVISM, MATHEMATICS AND MATHEMATICS EDUCATION https://www.jstor.org/...*	4%
5	Analyze mathematical thinking concepts based on APOS Theory based on credible article sources	Comparing mathematical thinking concepts based on Piaget‘s Theory and APOS Theory	**Criteria:** Suitability and accuracy of case solutions, depth of understanding of cases, critical thinking and analytical skills, creativity in problem solving	Assignments, presentations, and class discussions and class discussions. 2 X 50	□ Asynchronus or Synchronus uses Vinesa LMS or other platforms. □ Introductions, agreements, and lecture targets. □ Interactive discussion (brain storming) about Case 5: What is the difference in acquiring knowledge based on Piaget‘s theory vs APOS theory? 2 x 50‘	**Material:** APOS theory **References:** *Booker, G. 2005. Thinking mathematically–making sense and solving problems. The Mathematics Education into the 21th Century Project Universiti Teknologi Malayasia, Reform, Revolution and Paradigm Shift in Mathematics Education, Johor Bahru, Malaysia, Nov 25th-Dec 1th .*	4%
6	Analyze mathematical thinking concepts based on concept images based on credible articles.	Comparing mathematical thinking concepts based on Concept Image Theory and APOS Theory		Assignments, presentations, and class discussions. 2 X 50	□ Asynchronus or Synchronus uses Vinesa LMS or other platforms. □ Introductions, agreements, and lecture targets. □ Interactive discussion (brain storming) about Case 6: How to differentiate knowledge acquisition based on Concept Image theory vs APOS theory? 2 x 50‘	**Material:** Concept Image Theory **References:** *Carpenter, TP, Franke, ML, & Levi, L. 2003. Thinking mathematically: Integrating arithmetic and algebra in elementary school. Hanover Street, Portsmouth: Heinemann*	4%

7	Analyze the concept of Thinking according to Embodied Cognition Theory from various credible sources	Describe the concept of Thinking according to Embodied Cognition Theory		Collaborative assignments, presentations, and class discussions 2 X 50	□ Asynchronus or Synchronus uses Vinesa LMS or other platforms. □ Introductions, agreements, and lecture targets. □ Interactive discussion (brain storming) about Case 7: How to differentiate knowledge acquisition based on Concept Image theory vs Embodied Cognition theory? 2 x 50‘	**Material:** Embodied Cognition Theory **References:** *Booker, G. 2005. Thinking mathematically–making sense and solving problems. The Mathematics Education into the 21th Century Project Universiti Teknologi Malayasia, Reform, Revolution and Paradigm Shift in Mathematics Education, Johor Bahru, Malaysia, Nov 25th-Dec 1th .*	4%
8		Midterm exam	**Criteria:** Accuracy of Assignment Answers	2 X 50			20%
9	Analyze the concept of mathematical thinking according to Semiotic Theory based on various credible sources.	Describe the concept of mathematical thinking according to Semiotic Theory	**Criteria:** Suitability and accuracy of case solutions, depth of understanding of cases, critical thinking and analytical skills, creativity in problem solving	Collaborative assignments, presentations, and class discussions 2 X 50	□ Asynchronus or Synchronus uses Vinesa LMS or other platforms. □ Introductions, agreements, and lecture targets. □ Interactive discussion (brain storming) about Case 8: How to differentiate knowledge acquisition based on Semiotic theory vs Embodied Cognition theory? 2 x 50‘	**Material:** Thinking Based on Semiotic Theory **References:** *Carpenter, TP, Franke, ML, & Levi, L. 2003. Thinking mathematically: Integrating arithmetic and algebra in elementary school. Hanover Street, Portsmouth: Heinemann*	3%
10	Analyzing the concept of problem solving according to several contemporary experts	Describe the concept of Problem Solving (problem solving)	**Criteria:** Suitability and accuracy of case solutions, depth of understanding of cases, critical thinking and analytical skills, creativity in problem solving	Collaborative reciprocity and class discussion 2 X 50	□ Asynchronus or Synchronus uses Vinesa LMS or other platforms. □ Introductions, agreements, and lecture targets. □ Interactive discussion (brain storming) about Case 9: Are problem solving steps static or dynamic? 2 x 50‘	**Material:** Mathematical Problem Solving **Bibliography:** *Mason, J., Burton, L., & Stacey, K. 2011. Thinking mathematically. Pearson Higher Ed.*	3%
11	Analyze the concept of Problem Posing according to the latest views	Analyzing the concept of Problem Posing	**Criteria:** Suitability and accuracy of case solutions, depth of understanding of cases, critical thinking and analytical skills, creativity in problem solving	Collaborative assignments, presentations, and class discussions 2 X 50	□ Asynchronus or Synchronus uses Vinesa LMS or other platforms. □ Introductions, agreements, and lecture targets. □ Interactive discussion (brain storming) about Case 10: Which is more effective in problem posing or problem solving? ‘ 2 x 50	**Material:** Problem Posing **Bibliography:** *Booker, G. 2005. Thinking mathematically–making sense and solving problems. The Mathematics Education into the 21th Century Project Universiti Teknologi Malayasia, Reform, Revolution and Paradigm Shift in Mathematics Education, Johor Bahru, Malaysia, Nov 25th-Dec 1th .*	3%
12	Analyzing mathematical thinking concepts in various types of reasoning such as statistical, algebraic, covariational, critical, or creative reasoning in mathematics education	Comparing statistical, algebraic, or covariational reasoning in mathematics education	**Criteria:** Suitability and accuracy of case solutions, depth of understanding of cases, critical thinking and analytical skills, creativity in problem solving	Collaborative reciprocity and class discussion 2 X 50	□ Asynchronus or Synchronus uses Vinesa LMS or other platforms. □ Introductions, agreements, and lecture targets. □ Interactive discussion (brain storming) about Case 11: Which is more effective statistical, algebraic, or covariational reasoning? 2 x 50	**Material:** Statistical, Algebraic and Covariational Thinking **References:** *Thompson, PW, & Carlson, MP 2017. Variation, covariation, and functions: Foundational ways of thinking mathematically. Compendium for research in mathematics education, 421-456.*	4%

13		Analyzing types of analogical and probabilistic reasoning in mathematics education.	**Criteria:** Suitability and accuracy of case solutions, depth of understanding of cases, critical thinking and analytical skills, creativity in problem solving	Collaborative assignments, presentations, and class discussions 2 X 50	□ Asynchronus or Synchronus uses Vinesa LMS or other platforms. □ Introductions, agreements, and lecture targets. □ Interactive discussion (brain storming) about Case 12: Which is more effective analogical or probabilistic reasoning? 2 x 50'	**Material:** Analogical and Probabilistic Reasoning References **:** *Thompson, PW, & Carlson, MP 2017. Variation, covariation, and functions: Foundational ways of thinking mathematically. Compendium for research in mathematics education, 421-456.*	4%
14		Applying mathematical thinking concepts in various types of reasoning to design solutions to mathematics education problems.	**Criteria:** Suitability and accuracy of case solutions, depth of understanding of cases, critical thinking and analytical skills, creativity in problem solving	Collaborative assignments, presentations, and class discussions 2 X 50	□ Asynchronus or Synchronus uses Vinesa LMS or other platforms. □ Introductions, agreements, and lecture targets. □ Interactive discussion (brain storming) about Case 13: Which is more effective in critical thinking or creative thinking? 2 x 50'	**Material:** Critical Thinking and Creative Thinking **References:** *Blitzer, R., & White, J. 2011. Thinking mathematically. Pearson Prentice Hall.*	4%
15	Apply several mathematical thinking concepts to design a theoretical framework for a dissertation plan	Designing a dissertation theoretical framework using several mathematical thinking concepts	**Criteria:** Suitability and accuracy of case solutions, depth of understanding of cases, critical thinking and analytical skills, creativity in problem solving **Form of Assessment** : Project Results Assessment / Product Assessment	Collaborative assignments, presentations, and class discussions 2 X 50	Asynchronus or Synchronus uses Vinesa LMS or other platforms. □ Introductions, agreements, and lecture targets. □ Interactive discussion (brain storming) about the Project: Project Preparation of Dissertation Theoretical Framework Articles 2 x 50'	**Material:** Mathematical Thinking as a Theoretical Framework for Dissertation **Bibliography:** *Mason, J., Burton, L., & Stacey, K. 2011. Thinking mathematically. Pearson Higher Ed.*	4%
16		Final Semester Examination (UAS) - Dissertation Theoretical Framework Article Preparation Project	**Criteria:** 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%)				30%

Evaluation Percentage Recap: Case Study

No	Evaluation	Percentage
1.	Project Results Assessment / Product Assessment	4%
		4%

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.