

Syllabus **Teaching Geometry and Measurement**



A. General Information

1. Academic Unit	Facultad de Educación					
2. Program	Pedagogía en Educación Básica Mención Inglés					
3. Code	EBI416					
4. Location in the curriculum	4 th year, 7 th semester					
5. Credits	10					
6. Type of course	Mandatory	x	Elective		Optional	
7. Duration	Bimonthly		Semi-annual	x	Annual	
8. Modules per week	Theoretical	1	Practical	1	T.A.	1
9. Class hours	Classes	68	Teaching Assistance			34
10. Prerequisites						

B. Contribution to the Graduate's Profile

This subject seeks that the future teacher of Primary Education develops the essential pedagogical competences to manage and lead a teaching process that promotes different types of geometric thinking. It is expected that, through the implementation of different pedagogical actions, the future teacher orients and guides their primary Education students to explore, manipulate, build, and experiment with the environment, central aspects of spatial sense.

In this course, special attention will be given to the planning of teaching units that contemplate the development of resources and learning goals for the medium term. The future teacher will acquire the necessary tools to simulate and implement sections of said plans, obtaining evidence that will allow you to make decisions about your own professional work.

Likewise, it will promote relationships and connections between topics related to geometry and measurement (essential mathematical actions - such as comparing, ordering, classifying, decomposing, or completing - arise naturally when schoolchildren have to measure magnitudes, for instance).

The subject pays tribute to the generic competences of Ethics, Analytical Vision and Efficiency, and to the following competences of the graduate profile:

- Competency 1. Engages all students in their learning process through challenging and purposeful learning experiences in both English and Spanish, demonstrating disciplinary mastery.
- Competence 2. Systematically assesses, analyses, and communicates students' progress based on evidence, and uses the data to improve the teaching-learning process.
- Competence 5. Demonstrates professionalism in teaching, for the benefit of student learning.

It is part of the curricular axis of Disciplinary Pedagogical Training of the Mathematics. The subject is located in the Bachelor's degree cycle.

C. Competencies and Learning Outcomes from the Course

Generic Competencies	General Learning Outcomes
Ethics	1.1. Demonstrates the mathematical knowledge for teaching involved in the teaching of geometry and measurement, in order to demonstrate a high domain of disciplinary and pedagogical knowledge (Sub competence 1.1). 1.2. Uses different types of mathematical representations (manipulatives, pictures, symbolic, digitals) considering: its relationship with the comprehension of concepts and procedures involved in geometry and measurement; and the diversity of students (Sub competence 1.2). 1.3. Critically analyzes the progression of the contents referred to geometry and measurement in the mathematical curriculum of primary Education (Sub competence 1.3). 1.4. Designs mathematical tasks for the promotion and development of geometric thinking and measurement, as well as to develop skills of argumentation and communication, in order to provide meanings and connect mathematical ideas (Sub competencies 1.3 and 1.5). 1.5. Plans learning goals for a class, including the necessary resources that contribute to these goals, in order to promote geometric thinking (Sub competence 1.3. And 1.6). 1.6. Creates a planning by didactic units, demonstrating coherence, significance and relevance for mathematical learning and its diversity (Sub competence 1.3). 1.7. Explains and models mathematical ideas and procedures when teaches, considering the whole-group students as well as small-group students, ensuring access to equitable learning for all students (Sub competence 1.4.)
Analytical Vision	
Efficiency	
Specific Competencies	
Competency 1. Engages all students in their learning process through challenging and purposeful learning experiences in both English and Spanish, demonstrating disciplinary mastery.	
Competence 2. Systematically assesses, analyses, and communicates students' progress based on evidence, and uses the data to improve the teaching-learning process.	
Competence 5. Demonstrates professionalism in teaching, for the benefit of student learning.	

	1.8. Critically analyzes current technological resources (software, for instance) that promote the development of geometric thinking and measurement, responding to the immediate needs of the environment (Sub competence 1.6). 1.9. Understands the different difficulties or errors in learning geometry and measurement and propose different strategies to address them (Sub competence 1.7). 2.1. Designs deliberate questions to assess and improve their students' geometric reasoning, as well as to make sense of important mathematical ideas and relationships (Sub competence 2.1). 2.2. Designs activities and different instruments to evaluate the ability to solve problems related to topics linked to the teaching of geometry and measurement (Sub competence 2.1). 2.3. Adapts teaching based on evidence of their students' thinking, justifying the decisions made (Sub competence 2.2). 5.1. Prepares its personal or collaborative works with stringency, demonstrating quality, neatness, order and academic honesty (Sub competence 5.3).
--	--

D. Units, Content and Learning Outcomes

Units and Content	Competency	Learning Outcomes
Unit 1: Disciplinary knowledge of geometry and measurement (assistantship, transversal to the course) - Intuitive geometry and deductive geometry. - Elementary geometry of the plane. - Geometry of space. - Geometric movements in the plane.	<i>Ethics</i> <i>Efficiency</i> <i>C1. Engages all students in their learning process through challenging and purposeful learning experiences in both English and Spanish,</i>	1.1. Demonstrates the mathematical knowledge for teaching involved in the teaching of geometry and measurement, in order to demonstrate a high domain of disciplinary and pedagogical knowledge. 1.2. Uses different types of mathematical representations (manipulatives, pictures, symbolic, digitals) considering its relationship

	<i>demonstrating disciplinary mastery</i>	to understanding the concepts and procedures involved in geometry and measurement; and the diversity of students.
Unit 2: Teaching and learning geometry - The development of geometric thinking (spatial sense and geometric thinking / The van Hiele levels of geometric thought). - Learning about shapes and properties; transformations; location; visualization. - Difficulties and errors in learning geometry. - Materials, resources and tasks for the work of geometry. - Curricular progression. - Technological tools that promote visualization (e.g. Geogebra).	Ethics <i>Analytical Vision</i> <i>Efficiency</i> <i>C1. Engages all students in their learning process through challenging and purposeful learning experiences in both English and Spanish, demonstrating disciplinary mastery</i> <i>C2. Systematically assesses, analyses, and communicates students' progress based on evidence, and uses the data to improve the teaching-learning process</i> <i>C5. Demonstrates professionalism in his/her teaching for the benefit of student learning</i>	1.1. Demonstrates the mathematical knowledge for teaching involved in the teaching of geometry and measurement, in order to demonstrate a high domain of disciplinary and pedagogical knowledge. 1.2. Uses different types of mathematical representations (manipulatives, pictures, symbolic, digitals) considering: its relationship to understanding the concepts and procedures involved in geometry and measurement; and the diversity of students. 1.3. Critically analyzes the progression of the contents related to geometry and measurement in the mathematical curriculum of primary Education. 1.4. Designs mathematical tasks for the promotion and development of geometric thinking and measurement, as well as to develop skills of argumentation and communication, in order to provide meanings and connect mathematical ideas. 1.5. Plans learning goals for a class, including the necessary resources that contribute to these goals, in order to promote geometric thinking. 1.6. Creates a planning by didactic units, demonstrating coherence, significance and relevance for mathematical learning and its diversity. 1.7. Explains and models

		mathematical ideas and procedures when teaches, considering the whole-group students as well as small-group students, ensuring access to equitable learning for all students. 1.8. Critically analyzes current technological resources (software, for instance) that promote the development of geometric thinking and measurement, responding to the immediate needs of the environment. 1.9. Interpret the different difficulties or errors in learning geometry and measurement and propose different strategies to address them. 2.1. Designs deliberate questions to assess and improve their students' geometric reasoning, as well as to make sense of important mathematical ideas and relationships. 2.3. Adapts teaching based on evidence of their students' thinking, justifying the decisions made. 5.1. Prepares its personal or collaborative works with stringency, demonstrating quality, neatness, order and academic honesty.
Unit 3: Teaching and learning of magnitudes and their measurement. - The meaning and process of measurement. - Teaching and learning of the measurement of quantities. - Calculation and estimation. - Difficulties and errors in learning magnitudes and their measurement. - Design of mathematical	<i>Ethics</i> <i>Analytical Vision</i> <i>Efficiency</i> <i>C1. Engages all students in their learning process through challenging and purposeful learning experiences in both English and</i>	1.1. Demonstrates the mathematical knowledge for teaching involved in the teaching of geometry and measurement, in order to demonstrate a high domain of disciplinary and pedagogical knowledge. 1.2. Uses different types of mathematical representations (manipulatives, pictures, symbolic, digitals) considering: its relationship to understanding the concepts and

tasks. Asking deliberate questions.	<i>Spanish, demonstrating disciplinary mastery</i> <i>C2. Systematically assesses, analyses, and communicates students' progress based on evidence, and uses the data to improve the teaching-learning process</i> <i>C5. Demonstrates professionalism in his/her teaching for the benefit of student learning</i>	procedures involved in geometry and measurement; and the diversity of students. 1.4. Designs mathematical tasks for the promotion and development of geometric thinking and measurement, as well as to develop skills of argumentation and communication, in order to provide meanings and connect mathematical ideas. 1.5. Plans learning goals for a class, including the necessary resources that contribute to these goals, in order to promote geometric thinking. 1.6. Creates a planning by didactic units, demonstrating coherence, significance and relevance for mathematical learning and its diversity. 1.7. Explains and models mathematical ideas and procedures when teaches, considering the whole-group students as well as small-group students, ensuring access to equitable learning for all students. 1.8. Critically analyzes current technological resources (software, for instance) that promote the development of geometric thinking and measurement, responding to the immediate needs of the environment. 1.8. Interpret the different difficulties or errors in learning geometry and measurement and propose different strategies to address them. 2.2. Designs activities and different instruments to evaluate the ability to
--	---	--

		solve problems related to topics linked to the teaching of geometry and measurement. 2.3. Adapts teaching based on evidence of their students' thinking, justifying the decisions made. 5.1. Prepares its personal or collaborative works with stringency, demonstrating quality, neatness, order, and academic honesty.
--	--	---

E. Teaching Methods

This course seeks to expose, articulate and model different methodological strategies that highlight the active role of teachers in training with their learning. We consider different methodological strategies that favour a mathematical discussion, promoting a critical interaction with the topics of the subject. Therefore, the teaching methodology has a strong emphasis on practice, so the development of practical work (individual or in group) and active participation become essential elements. Specifically, the structure course based on various methodologies, which include:

- 1) Group work and debates among the same students.
- 2) Work guides developed in classes.
- 3) Simulated practices that promote decision-making.
- 4) Modeling of certain mathematical contents through the use of manipulative materials.
- 5) Analysis activities and cases critiques (real and supposed) during most of the classes.
- 6) Analysis and contrast of disciplinary and didactic information sources.
- 7) Conferences supported with technologies such as Power Point, Prezi, Geogebra, among others.
- 8) Extended Realities: This methodology is part of experiential learning, achieved through simulation exercises that extend the student's learning experience into spaces of virtual reality, augmented reality, mixed reality, among others.
- 9) Use of specific and cutting-edge software utilized by the discipline and profession for data and information processing.

F. Evaluation

The learning assessment is organized into:

- Tests.
- Disciplinary workshops.
- Planning of teaching units.
- Final exam.

G. Learning Resources

Mandatory:

- Clements, D. H., Swaminathan, S., Zeitler, M. A. y Sarama, J. (1999). Young Children's Concepts of Shape. *Journal for Research in Mathematics Education*, 30(2), 199-212.

- Gravemeijer, K., Figueiredo, N., Feijs, E., Van Galen, F., Keijzer, R., & Mulder, G. (2016). *Measurement and Geometry in Upper Primary School*. Países Bajos: Sense Publishers.
- Howse, M. E. y Howse, T. D. (2015). Linking the Van Hiele theory to instruction. *Teaching Children Mathematics*, 21(5), 304-313.
- Reyes, C., Disset, L., Gormaz, R. (2013). *REFIP Matemática: Geometría para futuros profesores de Educación Básica*. Santiago: Ediciones SM. Open access: <http://www.smconecta.cl/refip/>
- Sack, J. & Vazquez, I. (2016). A 3D visualization teaching-learning trajectory for elementary grades children. Países Bajos: Springer. doi: 10.1007/978-3-319-29799-6
- Jurdak, M. (2016). Learning and teaching real world problema solving in school mathematics. The Netherland: Springer.

Supplementary:

- Aldon, G. & Trgalova, J. (Eds.). (2019). *Teachnology in mathematics teaching*. The Netherlands: Springer.
- Andreassen, J. B. & Haciomeroglu, E. S. (2014). Engaging geometry students through technology. *Mathematics Teaching in the middle school*, 19(5), 308-310.
- Chapin, S., O'Connor, & Anderson, N.C. (2005). Classroom discussions: Using math talk in elementary classrooms. Recuperado en http://mail.mathsolutions.com/documents/978-1-935099-01-7_L.pdf
- Chick, L., Holmesn, A. S., McClymonds, N., Musick, S., Reynolds, P. y Schultz, G. (2008). Geometry and measurement. *Teaching Children Mathematics*, 14(7), 408-409.
- Godino, J. D. (2004). Didáctica de las matemáticas para maestros. España: Departamento de Didáctica de las Matemáticas, University of Granada, Spain. Open acces: https://www.ugr.es/~jgodino/edumat-maestros/manual/9_didactica_maestros.pdf
- Gonzato, M., Godino, J. D. y Neto, T. (2011). Evaluación de conocimientos didáctico-matemáticos sobre la visualización de objetos tridimensionales. *Educación Matemática*, 23, (3), 5-37.
- Hede, J. T., & Bostic, J. D. (2014). Connecting the Threads of Area and Perimeter. *Teaching Children Mathematics*, 20(7), 418-425. <https://doi.org/10.5951/teacchilmath.20.7.0418>
- Herbst, P., Cheah, U. H., Richard, P. R., & Jones, K. (Eds.). (2018). *International perspectives on the teaching and learning of geometry in secondary school*. Países Bajos: Springer.
- International association for the evaluation of educational achievement (2009). Released ítems. Mathmatics – Forth Grade. Chestnut Hill, MA: IAE. Recuperado en: <http://timssandpirls.bc.edu/timss2007/items.html>
- Larraín, M. & Chandía, E. (2012). *La enseñanza de la geoemetría en la formación inicial de profesores de educación básica: una propuesta metodológica*. Santiago: Universidad del Desarrollo.
- Ministerio de Educación (2012). Bases Curriculares para la Educación Básica. Santiago, Chile: Unidad de Currículum y Evaluación.
- National Council of Teachers of Mathematics. (2011). Teaching geometry. *The Mathematics Teacher*, 105(4), 244.
- Oldknow, A. & Knights, C. (2011). *Mathematics Education with digital Technology*. New York, NY: Continuum.
- Porkess, R. (Editor) (2014). Geometry and measures. Reino Unido: Hodder Education.
- Schettino, C. (2011). Teaching Geometry through Problem-Based Learning. *The Mathematics Teacher*, 105(5), 346-351. <http://www.jstor.org/stable/10.5951/mathteacher.105.5.0346>.
- Usiskin, Z. (2010). *Future Curricular Trends in School Algebra and Geometry: Proceedings of A Conference*. Charlotte, NC: Information Age Publishing.