Pilot Course Curriculum and Intervention Plan for Distributed Systems (BMU)

“Improving the quality and sustainability of learning using early intervention methods based on learning analytics”

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1 General course information

Course name	Distributed Systems
Institution	Belgrade Metropolitan University (BMU)
Course level	Undergraduate
Teaching model	Hybrid – face to face teaching with online resources and assignments
Course learning objectives	● Understand the concepts of distributed systems ● Master communication protocols TCP/IP, UDP, and middleware. ● Understand the concepts of coordination and consistency in distributed systems ● Understand fault tolerance and reliability ● Understand security principles in distributed systems. ● Apply concepts of distributed systems in the real world ● Evaluate system performance ● Master awareness of emerging trends in distributed systems.

2 Motivation and purpose (Why)

Goal of the inquiry	
What do you want to learn about the teaching and learning process?	● Gain insights into student engagement and progress in mastering distributed systems concepts and techniques. ● Improve student engagement in the course and their learning. ● Investigate the evolution of students’ self-regulation throughout the course?

3 Defining more precisely what to explore (What)

Specific questions of interest	
Key inquiry questions	• Which activities students find engaging? • How student engagement correlates with learning outcomes? • How students progress through assignments and projects? • How much students engage in course activities? • What is the evolution of students’ self-regulation throughout the course?
Data sources	• Engagement with the lectures • Exercise/assignment submission and grades • SRL weekly survey • Discord conversation data

4 Data collection strategy (How)

<table>
<tr><td colspan="2">Data sources</td><td colspan="2">• Learning Management System (LMS)
• Quizzes and assignments
• Discord student discussions
• SRL surveys</td></tr>
<tr><td colspan="2">Data aggregation</td><td colspan="2">Data will be collected in xAPI format and integrated into Learning Locker either directly from the LMS plugin or through the csv2xAPI tool developed within the ISILA project</td></tr>
<tr><td colspan="4">Detailed methods for data collection</td></tr>
<tr><td>Week#</td><td>Topic</td><td>Learning activities and materials</td><td>Data source(s) and collection method(s)</td></tr>
<tr><td>1</td><td>Introduction to distributed systems</td><td>• Slides and teaching materials for the topics:
o Computer networks
o Centralized, decentralized and distributed systems
o Designing distributed systems
o Common mistakes when designing distributed systems
• Self-assessment quizzes
• Exercises for understanding needed software and environment for developing distributed applications
• Homework assignment 1</td><td>• Interaction with teaching materials in the course LMS
• Filling out SRL survey
• Assignment submissions
• Assignment grades</td></tr>
<tr><td>2</td><td>Distributed systems architecture</td><td>• Slides and teaching materials for the topics:
o Architecture styles of distributed systems</td><td>• Interaction with teaching materials in the course LMS
• Filling out SRL survey
• Assignment submissions
• Assignment grades</td></tr>
</table>

		○ Middleware in distributed systems ○ Layered distributed systems ○ Symmetrical architectures ○ Hybrid architectures ● Self-assessment quizzes ● Exercises in Python ● Homework assignment 2 ● Discord discussion about assignment 2	● Discord student discussion
3	Processes and threads	● Slides and teaching materials for the topics: ○ Processes ○ Threads ○ Multithreading in distributed systems ● Self-assessment quizzes ● Exercises in Python ● Homework assignment 3 ● Discord discussion about assignment 3	● Interaction with teaching materials in the course LMS ● Filling out SRL survey ● Assignment submissions ● Assignment grades ● Discord student discussion
4	Virtualization	● Slides and teaching materials for the topics: ○ Principles of virtualization ○ Containers ○ Virtual machines vs containers ○ Applying virtual machines in distributed systems ● Self-assessment quizzes ● Exercises in virtualization software ● Homework assignment 4 ● Discord discussion about assignment 4	● Interaction with teaching materials in the course LMS ● Filling out SRL survey ● Assignment submissions ● Assignment grades ● Discord student discussion
5	Clients and servers	● Slides and teaching materials for the topics:	● Interaction with teaching materials in the course LMS

		○ Networked user interfaces ○ Virtual environments ○ Client software ○ Server design ○ Object servers ● Self-assessment quizzes ● Exercises in Python ● Homework assignment 5 ● Discord discussion about assignment 5	● Filling out SRL survey ● Assignment submissions ● Assignment grades ● Discord student discussion
6	Communication in distributed systems	● Slides and teaching materials for the topics: ○ Basics of communication in distributed systems ○ RPC ○ Message-based communication ○ Multicast communication ● Self-assessment quizzes ● Exercises for distributed systems development ● Homework assignment 6 ● Discord discussion about assignment 6	● Interaction with teaching materials in the course LMS ● Filling out SRL survey ● Assignment submissions ● Assignment grades ● Discord student discussion
7	Coordination in distributed systems	● Slides and teaching materials for the topics: ○ Clock synchronization ○ Logical clocks ○ Mutual exclusion ○ Election algorithms ○ Coordination algorithms ● Self-assessment quizzes ● Exercises for distributed systems development ● Homework assignment 7 ● Discord discussion about assignment 7	● Interaction with teaching materials in the course LMS ● Filling out SRL survey ● Assignment submissions ● Assignment grades ● Discord student discussion

8	Names, identifiers and addresses	• Slides and teaching materials for the topics:
		  o Simple naming
		  o Structured naming
		  o Attribute-based naming
		  o Networking with named data
		• Self-assessment quizzes
		• Exercises for distributed systems development
		• Homework assignment 8
		• Discord discussion about assignment 8
			• Interaction with teaching materials in the course LMS
			• Filling out SRL survey
			• Assignment submissions
			• Assignment grades
			• Discord student discussion

9	Consistence in distributed systems	• Slides and teaching materials for the topics:
		  o Consistence models
		  o Data-based models
		  o Client-based models
		  o Consistence protocols
		• Self-assessment quizzes
		• Exercises for distributed systems development
		• Homework assignment 9
		• Discord discussion about assignment 9
			• Interaction with teaching materials in the course LMS
			• Filling out SRL survey
			• Assignment submissions
			• Assignment grades
			• Discord student discussion

10	Replication in distributed systems	• Slides and teaching materials for the topics:
		  o Replication
		  o Managing replication
		  o Replication and content storage
		  o Content distribution
		  o Content management
		  o Caching and replication in the Web
		• Self-assessment quizzes
		• Exercises for distributed systems development t
			• Interaction with teaching materials in the course LMS
			• Filling out SRL survey
			• Assignment submissions
			• Assignment grades
			• Discord student discussion

		• Homework assignment 10 • Discord discussion about assignment 10	

11	Fault tolerance in distributed systems	• Slides and teaching materials for the topics:
		  o Basic fault tolerance concepts
		  o Fault models
		  o Fault masking
		  o Fault tolerance
		• Self-assessment quizzes
		• Exercises for distributed systems development
		• Homework assignment 11
		• Discord discussion about assignment 11
			• Interaction with teaching materials in the course LMS
			• Filling out SRL survey
			• Assignment submissions
			• Assignment grades
			• Discord student discussion

12	Reliable communication in distributed systems	• Slides and teaching materials for the topics:
		  o Reliable client-server communication
		  o Point-to-point communication
		  o Reliable group communication
		  o Distributed commit
		  o Rollback
		• Self-assessment quizzes
		• Exercises for distributed systems development
		• Homework assignment 12
		• Discord discussion about assignment 12
			• Interaction with teaching materials in the course LMS
			• Filling out SRL survey
			• Assignment submissions
			• Assignment grades
			• Discord student discussion

13	Security in distributed systems	• Slides and teaching materials for the topic:
		  o Cryptography
		  o Authentication
		  o Trust in distributed systems
		  o Authorization
		• Self-assessment quizzes
			• Interaction with teaching materials in the course LMS
			• Filling out SRL survey
			• Assignment submissions
			• Assignment grades
			• Discord student discussion

		• Exercises for distributed systems development • Homework assignment 13 • Discord discussion about assignment 13	
14	Intro to Java enterprise edition	• Slides and teaching materials for the topic: o Introduction to servlets o Servlet creation o Servlet lifecycle o Servlets and sessions o Asynchronous servlets • Self-assessment quizzes • Exercises for distributed systems development • Homework assignment 14 • Discord discussion about assignment 14	• Interaction with teaching materials in the course LMS • Filling out SRL survey • Assignment submissions • Assignment grades • Project grades • Discord student discussion
15	Intro to blockchain technology	• Slides and teaching materials for the topic: o Blockchain technologies o Distributed ledgers o Consensus mechanisms • Self-assessment quizzes • Exercises for distributed systems development • Homework assignment 15 • Course project assignment • Discord discussion about the project	• Interaction with teaching materials in the course LMS • Filling out SRL survey • Assignment submissions • Assignment grades • Project grades • Discord student discussion

5 Data analysis and interpretation (So What)

Sense making and interpretation context	Use dashboards to visualize engagement levels. Analyze correlations between activities and outcomes. Identify students that are in the bottom quartile of activity and self-regulation. Compare results with course goals and prior expectations.

6 Interventions plan (Now What)

Potential interventions	Face-to-face interventions: - devote more time to the topic/assignment, - arrange additional learning activities, - address challenges, - extend deadlines if students are struggling. Internet-based interventions: - email class-wide reminders, - recommendations, - personalized email offering 1-to-1 tutorial or additional support, - share additional resources on Discord. Content adjustments: - revise content or format for topics with low engagement (e.g., simplify lecture slides, add examples).