colMOOC™

D5.1

Courses design and materials

Co-funded by the
Erasmus+ Programme
of the European Union

Co-funded by the
Erasmus+ Programme
of the European Union

The colMOOC:
Integrating Conversational Agents and Learning Analytics in MOOCs

D5.1 Courses design and materials

Project number:	588438-EPP-1-2017-1-EL-EPPKA2-KA
Grant Agreement No:	2017-2841/001-001
Project acronym:	colMOOC
Project title:	Integrating Conversational Agents and Learning Analytics in MOOCs
Programme, Key action, Action type, Topic:	E+ KA2: Cooperation for innovation and the exchange of good practices, Knowledge Alliances
Start date of the project:	01/01/2018
Duration:	36 months
Project web site:	https://colmooc.eu/

Deliverable type:	Report
Deliverable reference number:	D5.1
Deliverable title:	Courses design and materials
WP contributing to the deliverable:	5
Delivery date:	06/30/2019

WP Leader:	Santi Caballé
Responsible organization:	UOC
Abstract:	This deliverable presents the lesson plans of the MOOC courses catalogue devoted to support the project's education and training trials. The instructional design of each of the four courses presented in this deliverable is described in terms of learning objectives, methodology, contents, syllabus, etc. The report also presents the educational approach of the courses as

Keywords:	well as the design of the CA-based synchronous collaborative learning activities supported by the colMOOC platform. MOOC courses, course plans, instructional design, collaborative learning activities, CA, LA.

Dissemination level:	Public

Authors and Reviewers

Santi Caballé, Universitat Oberta de Catalunya (UOC), Spain, scaballe@uoc.edu
Eduardo Gómez Sánchez, Universidad de Valladolid (UVA), Spain, edugom@tel.uva.es
Konstantinos Michos, Universidad de Valladolid (UVA), Spain, kmichos@gsic.uva.es
Thrasyvoulos Tsiatsos, Aristotle University of Thessaloniki (AUTH), Greece, tsiatsos@csd.auth.gr
Giorgos Psathas, Aristotle University of Thessaloniki (AUTH), Greece, gpsathas@csd.auth.gr
Stavros Demetriadis, Aristotle University of Thessaloniki (AUTH), Greece, sdemetri@csd.auth.gr
Pantelis Papadopoulos, Aarhus University (AU), Denmark, pmpapad@tdm.au.dk
Allison Kolling, Saarland University (USAAR), Germany, allison.kolling@uni-Saarland.de

REVIEWERS

Stavros Demetriadis, Aristotle University of Thessaloniki (AUTH), Greece, sdemetri@csd.auth.gr
Armin Weinberger, Saarland University (USAAR), Germany, a.weinberger@mx.uni-saarland.de
George Palaigeorgiou, Learnworlds (LW), United Kingdom, gpalegeo@learnworlds.com

Document Change Log

Version	Date (mm/dd/yyyy)	Author (s)	Sections Changed
0.1	03/15/2019	Santi Caballé (UOC)	Table of Contents
0.2	03/31/2019	Santi Caballé (UOC)	Input Section 3.1
0.3	04/30/2019	Eduardo Gómez (UVA)	Input Sections 3.1 and 4.
0.4	04/30/2019	Stavros Demetriadis (AUTH)	Input Section 3.2
0.5	04/30/2019	Pantelis Papadopoulos (AU)	Input Section 3.3
0.6	04/30/2019	Armin Weinberger and Allison Kolling (USAAR)	Input Section 3.4
0.7	05/15/2019	Santi Caballé (UOC)	Input Sections 1, 2, 4 & 5 and revision of Section 3
0.8	05/16/2019	Santi Caballé (UOC)	Document sent to reviewers
0.9	06/15/2019	Santi Caballé (UOC)	Collection of reviewers' comments
1.0	06/30/2019	Santi Caballé (UOC)	Final document submission

Executive Summary

This report presents all preparatory work to organize the evaluation phase of the project. In particular, a catalogue of multilingual, multimodal and multidomain MOOC courses, which instructional design is based on the educational approach built in D1.3 (2018) of WP1, including an overview, learning objectives, methodology and syllabus with materials and learning activities of each course based on CA and LA components developed in D2.1(2018) of WP2 and D3.1 (2019) of WP3 and integrated in D4.2 (2019) of WP4. This work will serve as the grounds for the trial activities to be reported in the next deliverables D5.2 and D5.3 (to be submitted in 2020).

Table of Contents

List of Tables

List of Acronyms

Acronym	Description
CA	Conversational Agent
CSCL	Computer Supported Collaborative Learning
CT	Computational Thinking
DTC	Digital Teaching Competence
EACEA	Education, Audiovisual and Culture Executive Agency
FCFS	First Come First Serve
ICT	Information and Communication Technologies
LA	Learning Analytics
MOOC	Massive Open Online Course
OER	Open Educational Resources
ToC	Table of Contents
URL	Uniformed Resource Locator
WP	Work Package

1 Introduction

1.1 Purpose of this document

The objective of this deliverable is to present the plans of the MOOC courses making up the catalogue of the courses that will serve as the basis for preparing the 4 pilots and the different trials forming the evaluation phase of the project.

1.2 Document structure

The present deliverable is chiefly made up of the main Section 2 describing the general educational approach and instructional design of all courses' preparation, including the different aspects of the course design (objectives, methodology, syllabus, etc.). Section 3 presents some use case design of synchronous collaborative learning activities based on the colMOOC platform. The document ends in Section 4 by outlining the main outputs presented in this deliverable and their connection to next deliverables.

1.3 Audience

This document is open and publicly available.

2 Courses preparation

2.1 Introduction

This main section of the deliverable presents the four course plans to prepare the pilots (see Table 1 for an overview). The course plans are connected to the educational approach and instructional design developed in D1.3 (2018) and summarized in Section 2.2. In Section 2.3, for each course, an overview, learning objectives, contents, methodology and syllabus are presented. Please note that the AUTH course is planned to be offered twice during the project lifetime, so overall there are five 'trials' (MOOC runs) as promised in the project workplan.

Table 1: Overview of the ColMOOC's course catalogue

Coordinator	Course name	Language	Start date	Duration (weeks)
UOC & UVA	Educational technology to support collaboration and assessment of the virtual learning	Spanish	October 28, 2019	5
AUTH	Programming for non-programmers	Greek	Fall 2019	5
AU	Computational and design thinking	English	September 9, 2019	5
USAAR	The Orchestrated Classroom	German	Fall 2019	5
AUTH	Programming for non-programmers	Greek	Spring 2020	5

2.2 Educational approach and instructional design

The planned educational approach and a model of the instructional design of the catalogue of courses presented in this document can be found in D1.3 (2018). A short summary of this information is provided in this deliverable.

The four courses are based on best practices for online learning and specifically MOOCS. The videos are all short and focused on a single topic allowing learners to follow their own schedules and learning routines. Learners receive immediate feedback on their understanding of key course concepts through the self-assessment quizzes and can regulate their own study habits and methods. Finally, as we know that collaboration and interaction with peers is not only motivating but often improves understanding, the CA agent is being used to facilitate discussion among peers. This should promote transactivity and collaborative knowledge building (Tegos & Demetriadis, 2017).

2.3 Course "Educational technology to support collaboration and assessment of the virtual learning" (UOC and UVA)

2.3.1 Overview

Designing and implementing ICT-mediated activities that include collaboration and assessment is a challenge for pre-service and in-service teachers in face to face and online contexts. It requires a good understanding of social learning and hands-on experiences enhanced by ICT-based educational tools. This course targets primary pre-service and in-service school and higher

education teachers and instructors who are interested in learning how to design and implement ICT activities using collaboration and assessment as part of their everyday practice.

In particular, the participants will learn about collaborative learning and assessment with educational technologies within a Digital Teaching Competence framework. They will be able to engage students in discussion and evaluate educational tools for collaboration and assessment purposes. Additionally, the course will give educators the chance to reflect on the challenges and benefits of introducing educational technologies into the classroom.

2.3.2 Learning objectives

- Reflect on the importance of Digital Teaching Competence framework in all areas.
- Get familiar with well-known strategies for structuring Collaborative Learning situations.
- Reflect on the design of "non-trivial" Collaborative Learning situations with the help of purpose-specific ICT-based educational tools.
- Reflect on concepts and methods for Assessment of learning.
- Get introduced to how the use of educational technology can contribute to the Assessment of learning.

2.3.3 Content

Each course module spans a whole week. The course starts in "Week 0" with an initial module with information about the course and the teachers, as well as a set of preliminary small tasks to be completed before starting with the subsequent modules. The course closes with a final module in "Week 5" with conclusive remarks.

- Initial module: Course information and preliminary steps
- Module 1: Teaching and learning in the Digital Age
- Module 2: Pedagogy and strategies in collaborative learning
- Module 3: Educational Technology to support collaborative learning
- Module 4: Concepts and methods for assessment in virtual learning environments
- Module 5: Tools to support formative assessment in virtual learning environments
- Final module: Conclusion of the course

2.3.4 Methodology

The course will follow a traditional MOOC design, yet with the introduction of several activities in which learners will be required to participate actively, like discussion forums, debates mediated by a Conversational Agent, and quiz-based formative self-assessment activities.

The course is entirely on-line, and participants can access it from anywhere, however some synchronous sessions are required, and this may be a challenge for some participants to schedule. In particular, the only synchronous activity will be the CA-mediated debate (Tegos & Demetriadis, 2017; D2.1, 2018), in which one student will need to be interacting synchronously with another student, but students will meet in a waiting room based on a FCFS basis (Rebedea, Dascalu, Trausan-Matu, Armitt & Chiru, 20011). The course lasts five weeks and participants can expect to commit to spending from three to five hours a week on the course. Each module is scheduled to last one week with intermediate and ending formal assessments. While some deadlines are flexible others are strict in order to enable synchronous activities to be feasible. Participants will be assessed

by their participation in discussions, and their self-assessment quizzes (minimum of 50% correct). Next, a summary of the main aspects of the course is provided.

Target audience	Pre-service and in-service teachers and lecturers in primary, secondary and higher education
Language	Spanish
Certificates for participants	Certificates of course completion from Miriadax
Keywords	Digital competence, ICT, educational technologies, collaboration, assessment, teachers and learners.
Platform for the MOOC	MiriadaX
Facilitators	Instructors: Santi Caballé and Jordi Conesa (UOC) Eduardo Gómez, Sara Villagrá, Sara García Sastre (UVa) Facilitators: Juan I. Asensio (UVa) and David Gañán (UOC)
Dissemination	Targeted at in-service, pre-service teachers and lecturers, September 2019.
Start and duration of the MOOC	October 28, 2019, for 5 weeks.

2.3.5 Syllabus

Initial module: Course presentation			
Tag	Activity	Type of resource	Coordinator
M0V0	Presentation of the course and the instructors	Video (1-2 min)	UOC & UVA

Module 1: Teaching and learning in the digital age

Tag	Activity	Type of resource	Coordinator
M1V0	Presentation of the module	Video (1 min)	UOC
M1V1	Education and ICT (I): Where do we come from?	Video (5 min)	UOC
M1V2	Education and ICT (II): Where are we now and where are we heading?	Video (6 min)	UOC
M1V3	Digital teaching competence (I): Digital instrumental competence	Video (6 min)	UOC
M1V4	Digital teaching competence (II): Methodological digital competence	Video (6 min)	UOC
M1CA	Chats in 2-member groups, each sharing and discussing real teaching experiences with learning technologies that somehow have supported the teaching-learning process. The expected output of the course will be a brief report on the main issues and challenges faced during those experiences and the solutions proposed during the discussion. This report will be peer reviewed by 2 other groups chosen randomly.	ColMOOC	UOC
M1EV	Intermediate (after each video) and final evaluations of the module	Quiz	UOC

Module 2: Pedagogy and strategies in collaborative learning			
Tag	Activity	Type of resource	Coordinator
M2V0	Presentation of the module	Video (1 min)	UVA
M2CA1	As a warming up activity, students should agree in two benefits and two challenges of collaborative learning (in their view)	ColMOOC	UVA
M2V1	What is and what is not collaborative learning? What are your benefits?	Video (5-6 min)	UVA

M2V2	What are the challenges to implementing collaborative learning?	Video (5-6 min)	UVA
M2V3	How to plan to achieve "good interactions"?	Video (5-6 min)	UVA
M2V4	Group and role design	Video (5-6 min)	UVA
M2V5	Collaborative task design	Video (5-6 min)	UVA
M2V6	Proven patterns for structuring collaboration	Video (5-6 min)	UVA
M2CA2	An educational problem is given with three alternative collaborative learning designs. Students must discuss which approach is better and why.	ColMOOC	UVA
M2EV	Intermediate (after each video) and final evaluations of the module	Quiz	UVA

Module 3: Educational Technology to support collaborative learning			
Tag	Activity	Type of resource	Status and Links
M3V0	Presentation of the module	Video (1 min)	UVA
M3V1	Introduction to 2.0 Tools	Video (5-6 min)	UVA
M3V2	Tools for the co-publishing of texts, presentations and videos	Video (5-6 min)	UVA
M3V3	Tools for the creation of advanced materials and for gamification	Video (5-6 min)	UVA
M3R1	Read a document briefly describing several educational technologies	PDF document	UVA
M3PR1	Read a design of a collaborative learning activity for a face to face setting. Individually, propose technology to enhance it. Peer review the contributions of others	Any embedded text editor a peer review tool	UVA

M3EV	Intermediate (after each video) and final evaluations of the module	Quiz	UVA

Module 4: Concepts and methods for assessment in virtual learning environments			
Tag	Activity	Type of resource	Status and Links
M4V0	Presentation of the module	Video (1 min)	UOC
M4V1	Electronic learning assessment (e-assessment)	Video (6 min)	UOC
M4V2	Categories and processes of electronic learning assessment	Video (6 min)	UOC
M4V3	Innovative strategies to enhance e-learning assessment	Video (6 min)	UOC
M4V4	Practical approximations to the formative electronic assessment (I): Knowledge and competences	Video (6 min)	UOC
M4V5	Practical approximations to the formative electronic assessment (II): Collaborative Learning	Video (7 min)	UOC
M4CA	Chats in 2-member groups, each sharing and discussing an interesting e-assessment activity, either real or simulated from the materials studied in this module. The expected output of the course will be a brief report on the main benefits, problems and lessons learned from the chat. This report will be peer reviewed by 2 other groups chosen randomly.	ColMOOC	UOC
M4EV	Intermediate (after each video) and final evaluations of the module	Quiz	UOC

Module 5: Tools to support formative assessment in virtual learning environments

Tag	Activity	Type of resource	Status and Links
M5V0	Presentation of the module	Video (1 min)	UOC
M5V1	Standards for electronic assessment (I): Specifications	Video (6 min)	UOC
M5V2	Standards for electronic assessment (II): Data formats	Video (6 min)	UOC
M5V3	Technologies of support to the formative electronic assessment (I): Tools to assess knowledge	Video (6 min)	UOC
M5V4	Technologies of support to the formative electronic assessment (II): Tools to assess competencies	Video (7 min)	UOC
M5V5	Technologies of support to the formative electronic assessment (III): Tools for the monitoring of the assessment	Video (8 min)	UOC
M5CA	Chats in 2-member groups, each sharing and discussing a real or simulated e-assessment activity specifically enriched with learning analytics elements. The expected output of the course will be a brief report on the main benefits, problems and lessons learned from this discussion. This report will be peer reviewed by 2 other groups chosen randomly.	ColMOOC	UOC
M5EV	Intermediate (after each video) and final evaluations of the module	Quiz	UOC

Final module: Conclusion of the course			
Tag	Activity	Type of resource	Status and Links
M6V0	Course conclusions	Video (1-2 min)	UOC & UVA
M6EV	Final evaluation	Quiz	UOC & UVA

2.4 Course "Programming for non-programmers" (AUTH)

2.4.1 Overview

Programming skills in the 21st century have become significant also for non-programmers, that is, students and professionals who do not major in programming but need to develop basic programming skills as a toolset for advancing their study, research and deeper understanding of their specific scientific field. The "Programming for non-Programmers" colMOOC course promotes a 'toolset' approach to programming, familiarizing learners with key computational ideas and Python-based programming patterns necessary to operationalize scientific problem representation and solving.

2.4.2 Learning Objectives

Course goals (in general):

- Understand key computational ideas and structures
- Become familiar with basic Python programming code
- Write code to process data and solve common scientific problems

This course focuses on helping non-programmers (that is, students who do not major in Computer Science and/or Programming focused studies) to: a) understand important key ideas of computational representation and thinking, and b) develop introductory level Python-based programming skills to represent and solve common scientific problems.

By the end of the course participants should be able to:

1. Understand the key concepts of algorithm building such as: variable, control/decision structure, iteration/loop structure, properties and methods of data structures (list, directory, indexing, assignment, slicing), modularity principles, functions operations and file handling, and
2. Write Python code to read input date from a file, write appropriate algorithm to implement a scientific solution to a data processing problem, and storage output data back to another file.

The learners need not have any programming background as this colMOOC course will introduce them gently into the programming domain by providing also example applications across various scientific disciplines demonstrating both numeric and text data processing. Finally, the course will guide participants to approach the Python programming language as a domain-independent computational thinking operationalization tool that adds value to their scientific skills and future professional profile.

2.4.3 Course Participants

Target audience:

- University students non majoring in Computer science
- Post-Grads
- Researchers

The course target audience is university students, postgraduates and researchers who do not major in Computer Science and/or Programming focused studies. Also, amateurs who would like to get introduced in Python programming could benefit from attending the course. Learners may choose this course because it is offered entirely online, or because it is offered as a vital supplement of their on-campus work.

2.4.4 Course Expectations

Participants can expect to commit to spending approximately 10-12 hours a week for five weeks completing this course. There is a starting date and learners must complete each week's session within that time frame. However, we will also explore the possibility of offering the course in a completely self-paced mode for all those interested. Learners are assessed by their responses to quizzes and the code they produce. Additionally, learners are expected to have one collaborative agent-based chat session per week.

2.4.5 Content

Each course module spans a whole week. The course starts in "Week 0" with an initial module with information about the course and the teachers, as well as a set of preliminary small tasks to be completed before starting with the subsequent modules. The course closes with a final module in "Week 5" with conclusive remarks.

- Module 0: Course information and preliminary steps
- Module 1: Computational Thinking, Algorithm & Data Type
- Module 2: Program control flow structures
- Module 3: Data structures
- Module 4: Functions
- Module 5: Files
- Final module: Conclusion of the course

2.4.6 Methodology

Course methodology:

- Duration: Five weeks
- Commitment: 15 hrs/week
- Collaborative activities: one collaborative session/week
- Assessment activities: quizzes and code writing tasks

2.4.7 Syllabus

Initial module: Course information and preliminary steps			
Tag	Activity	Type of resource	Duration / Details
T0.1.1	Presentation of the course material & requirements	Text	Text
V0.1.2	Welcome message	Video	2:12

Module 1: Computational Thinking, Algorithm & Data Type

Tag	Activity	Type of resource	Duration / Details
V.1.1.1	CT key ideas, introduction to algorithms with flowcharts and pseudo-code	Video	About 30 min
Q1.1.1	Questions on V1.1.1	Quiz	Closed-Type
V1.2.1	Names, Expressions, & Operators	Video	15:37
Q1.2.1	Questions on V1.2.1	Quiz	Closed-Type
V1.2.2	Input & print	Video	7:37
Q1.2.2	Questions on V1.2.2	Quiz	Closed-Type
V1.2.3	Data types & Integer numbers	Video	11:15
Q1.2.3	Questions on V1.2.2	Quiz	Closed-Type
V1.2.4	Float numbers	Video	11:42
Q1.2.4	Questions on V1.2.2	Quiz	Closed-Type
V1.2.5	Strings / Alphanumerics - len() & type() functions	Video	8:25
Q1.2.5	Questions on V1.2.2	Quiz	Closed-Type
V1.3.1.1	Example: Area of circle with radius r	Video	6:48
V1.3.1.2	Examples: Euclidean distance, Polar coordinates & Characters & ASCII codes	Video	8:55
C1	Debate task relevant to Module 1 content	colMOOC Chat	

Module 2: Program control flow structures			
Tag	Activity	Type of resource	Duration / Details

V.2.1.1	Control structures visualization, pseudocode, and examples	Video	About 20 min
Q2.1	Questions on V2.1.1	Quiz	Closed-Type
V2.2.1	Program control flow with if..elif..else	Video	8:12
V2.2.2	Examples with if	Video	7:22
V2.2.3	Boolean operators	Video	10:02
Q2.2	Questions on V2.2	Quiz	Closed-Type
V.2.3.1	Loop structures While visualization, pseudocode, and examples	Video	About 10 min
Q2.3	Questions on V2.3	Quiz	Closed-Type
V2.4.1	Looping with while	Video	9:30
V2.4.2	Examples with while	Video	7:12
Q2.4	Questions on V2.4	Quiz	Closed-Type
V.2.5.1	Loop structures FOR visualization, pseudocode, and examples	Video	About 10 min
Q2.5	Questions on V2.5	Quiz	Closed-Type
V2.6.1	Looping with for..range	Video	7:25
V2.6.2	Examples with for..range	Video	8:45
Q2.6	Questions on V2.6	Quiz	Closed-Type
V2.7.1	Problems	Video	13:25
C2	Debate task relevant to Module 2 content	colMOOC Chat	

Module 3: Data structures

Tag	Activity	Type of resource	Duration / Details
V.3.1.1	Key CT constructs visualization, and examples: List	Video	About 15 min
Q3.1	Questions on V3.1	Quiz	Closed-Type
V3.2.1	Lists: Sequence & Indexing	Video	13:11
V3.2.2	How to construct a list	Video	9:04
V3.2.3	Iterative structure in for loop	Video	11:27
V3.2.4	Operators and Slices	Video	14:15
V3.2.5.1	Example 1: Average & standard deviation	Video	7:40
V3.2.5.2	Example 2: Tokenization	Video	6:45
Q3.2	Questions on V3.2	Quiz	Closed-Type
V3.4.1	Dictionaries: General concepts	Video	12:17
V3.4.2	How to construct a dictionary. Using for & in operator with dictionaries	Video	10:08
V3.4.3	Complex structures with lists & dictionaries	Video	9:58
Q3.4	Questions on V3.4	Quiz	Closed-Type
V3.4.4.1	Problem to solve 1: Numbers written in full	Video	7:26
V3.4.4.2	Problem to solve 2: Periodic table	Video	7:04
C3	Debate task relevant to Module 3 content	colMOOC Chat	

Module 4: Functions			
Tag	Activity	Type of resource	Duration / Details

V.4.1.X	Key CT constructs visualization, and examples: Dictionary	Video	About 15 min
Q4.1	Questions on V4.1	Quiz	Closed-Type
V4.2.1	What is a function	Video	7:21
V4.2.2	Parameters & arguments	Video	6:53
V4.2.3	Unspecified number of parameters	Video	11:01
V4.2.4	Scope	Video	11:24
V4.2.5	Problems to solve with functions	Video	9:06
V4.2.6	Generators	Video	8:09
V4.2.7	Problems to solve with generators	Video	8:12
V4.2.8	Functions and methods	Video	10:54
V4.2.9	Problems to solve with functions & methods	Video	8:42
Q4.2	Questions on V4.2	Quiz	Closed-Type
C4	Debate task relevant to Module 4 content	colMOOC Chat	

Module 5: Files			
Tag	Activity	Type of resource	Duration / Details
V.5.1.X	Key CT constructs visualization, and examples: File handling	Video	About 15 min
Q5.1	Questions on V5.1	Quiz	Closed-Type
V5.2.1	What is a file – Text files	Video	7:21
V5.2.2	With open: file handling in Python	Video	6:53

V5.2.3	How to read data from text files	Video	11:01
V5.2.4	How to control your code with try..except commands	Video	11:24
V5.2.5	Saving data structures: The pickle and json files	Video	9:06
V5.2.6	Problems to solve using files	Video	8:42
Q5.2	Questions on V5.2	Quiz	Closed-Type
C5	Debate task relevant to Module 5 content	colMOOC Chat	

2.5 Course "Computational and design thinking" (AU)

2.5.1 Overview

Computational thinking is a systematic and creative approach to problem solving. It involves analysis and formalization of complex problems, understanding and designing algorithms, as well as divergent and convergent ways of thinking. Computational thinking has been marked as a fundamental 21st Century skill that is essential for everyone in any field.

The course participants will learn how to apply the four basic steps of computational thinking in problem solving: decomposition (breaking down a complex problem into smaller ones), pattern recognition (identifying patterns in data and sub-problems), abstraction (focusing only on the essential), and algorithm design (creating a solution "recipe"). Specifically for algorithms, the participants will learn to analyse and compare different algorithms and create their own using natural language, flowcharts, and pseudocode. As such, the course can also be seen as a preparatory course for participants that want to continue their education in programming. Finally, the course will also contribute to the participants' general knowledge and education on educational technology and distance learning.

2.5.2 Learning objectives

By the end of the course, participants should be able to:

- Apply computational thinking steps on problem-solving tasks.
- Analyse and compare the complexity of different algorithms.
- Design and represent their own problem-solving algorithms using natural language, flowcharts, and pseudocode.

2.5.3 Content

The course is organized in four modules, each one lasting one week. An additional introductory module will be available from the beginning of the course until its ends to guide participants to the course, the learning environment that will host the course, and the activity structures in the course.

- Introductory module: Information on the course, the teacher, the learning environment, and the structure of the activities in the course.

- Module 1 (Week 1): Computational thinking.
- Module 2 (Week 2): Algorithms.
- Module 3 (Week 3): Algorithm complexity.
- Module 4 (Week 4): Pseudocode.

2.5.4 Methodology

The course is a teacher-led MOOC organized in four modules, each one lasting one week. Each week, a series of videos, slides, and texts will present different aspects of the computational thinking method, while optional material and practice activities will be available, to give the participants an opportunity to further their knowledge and exercise their skills. An example of such an optional activity is the weekly quiz that will test their knowledge on the terms and concepts introduced during the week. The participants will have as many tries as they want in the weekly quiz since the quiz will be used as a tool for self-assessment and will not affect participants' assessment in the course.

At the end of each week, the participants will have to complete successfully (pass/fail) three assignments. First, they will have to work individually and submit a weekly assignment. This will be, for example, the design of a mind map or of an algorithm. Second, they will have to review the assignment of at least one other course participant and to make this task easier, detailed instructions, guides, and examples will be available to the participants for each step of the process. Finally, the participants will have to participate in a chat session and discuss a topic with another course participant. This chat session will include the conversational agent as described in the project .

The MOOC will be available to two audiences: Bachelor's students in the Faculty of Arts at Aarhus University what will participate in the MOOC as part of the "Programming for the Humanities" elective course, and online participants at large interested in computational thinking. As such, there will be some flexibility regarding the three assignments the participants need to complete each week, but this flexibility will be limited for the chat activity to increase the possibility that more people will be online at the same time to participate to the chat.

The participants will have to achieve passing grades in at least 75% (estimation) of the assignments in the course.

Target audience	Bachelor's students in the Faculty of Arts at Aarhus University and online participants at large interested in computational thinking.
Language	English.
Certificates for participants	Certificates of course completion from colMOOC.
Keywords	Computational thinking, algorithms, algorithm complexity, flowcharts, pseudocode.

Platform for the MOOC	eClass from GUNet.
Facilitators	Instructors: Pantelis M. Papadopoulos Facilitators: Christian Winther Bech (to be confirmed)
Dissemination	AU network and GUNet network. Mid-July.
Start and duration of the MOOC	9 September 2019 - 6 October 2019

2.5.5 Syllabus

Introductory module	
Overview	
Information on the course, the teacher, the learning environment, and the structure of the activities in the course.	
Resources	Type
Welcoming video: Information on the course, the teacher, the learning environment, and the structure of the activities in the course.	Video (4 min)
Guide to the course.	Text
Guide to the eClass	Text/Slides

Module 1 (Week 1): Computational thinking
Overview

Topics: Computational thinking, examples, mind maps. Vocabulary: Abstraction, algorithm, algorithm design, automation, data analysis, data collection, data representation, decomposition, parallelization, pattern recognition. Practice: Drawing diagrams with draw.io. Self-assessment quiz. Assignments Decompose a complex problem and create its mind map. Peer assessment: assess each other's mind map. Chat activity: given a problem, discuss its algorithm, through CT steps.

Resources	Type
What is Computational Thinking?	Video (10 min)
A closer look at Computational Thinking	Text
Week vocabulary	Text
Drawing diagrams with draw.io	Text
Weekly quiz	Audience Response System
Wing, (2006). Computational Thinking. Communications of the ACM 49(3), 33–35.	Article
Junk Charts	URL

Module 2 (Week 2): Algorithms
Overview

Topics: Search algorithms (linear, jump, binary), sort algorithms (bubble sort, merge sort). Vocabulary: Linear search, jump search, binary search, bubble sort, merge sort. Practice: Self-assessment quiz. Assignments Create a description of an algorithm in natural language. Peer assessment: assess each other's algorithm. Chat activity: given a problem, discuss the best and most efficient algorithm.

Resources	Type
Search algorithms	Video (10 min)
Sorting algorithms	Text
Week vocabulary	Text
Bubble sort with Hungarian ("Csángó") folk dance	Ext. video
Merge sort with Transylvanian-saxon (German) folk dance	Ext. video
Weekly quiz	ARS

Module 3 (Week 3): Algorithm complexity
Overview
Topics: Algorithm complexity, flowcharts. Vocabulary: Algorithm complexity, constant, exponential, factorial, flowchart, linear, linearithmic, logarithm, logarithmic, quadratic, square root. Practice: Describe a known algorithm through a flowchart. Self-assessment quiz. Assignments Write an algorithm and describe it through a flowchart. Peer assessment: assess each other's flowcharts Chat activity: given a problem, discuss the algorithm represented through a flowchart. Discuss variations and characteristics of the flowchart and the respective algorithm.

Resources	Type
Algorithm complexity	Video (10 min)
Merge sort complexity	Text
Designing a flowchart	URL
Week vocabulary	Text
The bubble sort flowchart	Text
Visualization and Comparison of Sorting Algorithms	Ext. video
Weekly quiz	ARS

Module 4 (Week 4): Pseudocode	
Overview	
Topics: Pseudocode, conditional statements, repetition statements. Vocabulary: IF, IF…ELSE IF, FOR, WHILE. Practice: Describe an algorithm through pseudocode. Self-assessment quiz. Assignments Write an algorithm and describe it through pseudocode. Peer assessment: assess each other's pseudocode. Chat activity: discuss the algorithm represented through pseudocode. Discuss variations and characteristics of the pseudocode and the respective algorithm.	
Resources	Type
Pseudocode: Conditional Statements	Video (6 min)
Pseudocode: Repetition Statements	Video (6 min)

A guide to pseudocode	Text
Week vocabulary	Text
Complete vocabulary	Text
Google: Computational Thinking for Educators	URL
PENCIL Code	URL
Weekly quiz	URL
End of the course	Video (4 min)
Course evaluation	Form

2.6 Course "The Orchestrated Classroom" (USAAR)

2.6.1 Overview

The Micro-MOOC is designed to introduce the subjects of orchestration and scripting in the classroom. The course provides theoretical background and information about technological tools currently in use. In addition, it gives participants the chance to discuss several case studies and react to authentic learning scenarios.

The micro-MOOC on orchestration in the classroom is intended for current University of Saarland educational technology students, as well as those completing their teaching certification at the university. The course is however open to all those interested in the topic and may be of particular interest to current teachers as well as those studying education at other German universities. The Micro-MOOC will be held in the German language.

2.6.2 Learning objectives

By the end of the course the learner will be able to:

- Define orchestration and explain the metaphor of the classroom as an orchestra
- Compare and contrast the differences in learning forms (ie. Cooperative, collaborative, formal and informal etc.)
- Provide examples of learning scripts and explain how technology can be used to support scripting
- Identify and describe key forms of technology supported learning (ie. Micro, MOOCs, OER, Blended, Flipped Classroom etc.)
- Evaluate different forms of technology supported orchestrated learning arrangements

2.6.3 Methodology

This course relies on a series of video lectures, self-assessment quizzes and peer- discussions. The course is five weeks long with a module per week. Each week consists of the following elements: a getting started question in the forum, knowledge input, self-assessment, and further resources. In addition, weeks two to four also include a synchronous discussion with a peer.

Getting started question: This activity is designed to encourage participation in the forum and activate prior knowledge. Learners are asked to reflect on their own experiences and relate them to the course content. While two-way exchange is not required learners are encouraged to read and comment on the posts from others.

Knowledge input: Each week features at least one video lecture (average video time between 10-15 minutes total-see overview below) with the theoretical content of the course. These videos provide information about the scientific research and theories as well as practical examples.

Self-assessment: A short closed-answer quiz follows each video in order for learners ts to check their understanding and direct their attention to the most important points in the lecture. In order to complete the course learners should score at least 60% on each self-assessment quiz. Learners can retake the quiz if they choose to.

Further resources: Each unit will contain at least two articles of recommended reading for learners to reference if they choose. This allows highly-motivated learners to dig deeper into the scientific studies that the lectures are based on.

Peer-discussion: For the three core units learners are asked to participate in a synchronous discussion with a peer. The discussion is based on a case-study and learners are asked to examine the case, and together craft a response and recommendations based on what they learned in the video lectures. The discussion is guided by the colMOOC conversational agent. This course aspect is examined in more detail in section 2.4.2.

2.6.4 Syllabus

Unit 1: An Introduction to Orchestration

Unit Goals: At the end of the unit the learner will be able to:

- Explain how a classroom is like an orchestra
    - The role of the director/teacher
    - The music/Learning arrangements
    - The role of the musicians/Students
    - Creation of melodies

Unit Activities:

1. Getting Started: create a profile page and introduce yourself in the forum.
2. Profile: Name, location, occupation, goal for the course etc.
3. Forum: Complete the sentence: Teaching is like…. because…. Include a picture of Gif and briefly explain your metaphor.
4. Knowledge input: Watch Video 1- Orchestration (slides 1-11)
5. Self-assessment: take the short quiz to assess your understanding
6. Additional Resources:

- Dillenbourg, Pierre. "Design for classroom orchestration" https://edisciplinas.usp.br/pluginfile.php/2745230/mod_resource/content/7/Dillenbourg-CE-A8Extra.pdf
- Carell and Schaller Orchestrierung von Web 2.0-Anwendungen im Kontext hochschulischer Lehr-/Lernprozesse. https://dl.gi.de/bitstream/handle/20.500.12116/15020/gi-proc-132-003.pdf?sequence=1&isAllowed=y

Unit 2: formal v. non-formal learning and Learning Communities

Unit 2 Goals: At the end of the unit the learner will be able to:

- Identify the difference between formal, non-formal and informal learning.
  - Give an example of each
  - Explain how informal and formal learning are connected, and which role each plays
- Define "learning communities" and name characteristics of learning communities
- Describe the roles within the community of practice and how an individual may move from one role to another
- Summarize the main ideas, goals, and results of the project Fostering a Community of Learners.
- Provide at least one example of a technology supported learning community in schools

Unit 2 Activities:

1. Getting Started: In the forum answer the question- What did learning look like when you were 3, 10, 18, and what do you expect it to look like when you are 70? Use text and images to briefly describe your learning process at different ages.
2. Knowledge input: Watch Video 2- Formal and informal learning (slides 12-15) and Video 3- Learning Communities (slides 16-22)
3. Self-assessment: take the short quiz to assess your understanding of the two videos
4. CA-based collaborative activity (Week 2 discussion in German language):

Stellen Sie sich folgendes Szenario vor: Ihr Kollege Herr Winter beklagt sich bei Ihnen: er habe neuerdings, und für ihn zum ersten Mal, die allseits beliebte Methode der Gruppenarbeit in seinem Biologie-Unterricht in den letzten Wochen regelmäßig angewandt. Die letzte Klassenarbeit jedoch war eine Katastrophe. Er ist sehr schockiert darüber und hat nun beschlossen, keine Gruppenarbeiten mehr durchzuführen, da sie anscheinend sinnlos seien und die Schüler nichts dabei lernten. Auf Ihre Rückfrage, wie die Gruppenarbeit genau ausgesehen habe, erklärt er, dass er die Gruppen nach dem Zufallsprinzip zusammengestellt und ihnen jeweils einen Arbeitsauftrage gegeben habe. Sonst habe er sich völlig rausgehalten und die Schüler einfach machen lassen, um die Dynamik nicht zu stören. Da Sie durchaus denken, dass Gruppenarbeit Potential hat, wenn man es richtig anstellt, raten Sie Herrn Winter, es doch noch einmal zu probieren, aber gewisse Prinzipien und Rahmenbedingungen für erfolgreiche Gruppenarbeit zu beachten, die Sie ihm nun erklären wollen.

Beschreiben Sie Herrn Winter, wie man Gruppenarbeiten sinnvoll, auch unter Zuhilfenahme von Technologien, unterstützen kann!

5. Additional Resources:

- *Winkler and Mandl.Wissensmanagement in Communities: Communities als zentrales Szenario der Weiterbildungslandschaft im dritten Jahrtausend* https://epub.ub.uni-muenchen.de/750/1/Praxisbericht27.pdf
- *Eshack*: Bridging In-school and Out-of-school Learning: Formal, Non-Formal, and Informal Education. https://link.springer.com/article/10.1007/s10956-006-9027-1

Unit 3: Cooperative vs. Collaborative Learning and Scripting

Unit 3 Goals: At the end of the unit the learner will be able to:

- Describe the difference between traditional teaching and learning and cooperative learning arrangements
- Identify the main differences between cooperative and collaborative learning explain how they encourage horizontal learning relationships
- Summarize the positive and negative effects of cooperative learning.
- Explain how scripts work and how they can be supported by technology
- Give an example of a popular script and show how it is used
- Identify challenges/disadvantages of using scripts

Unit 3 Activities:

1. Getting Started: In the forum describe a positive and a negative experience you have had working in groups. What made the experience particularly good or bad?
2. Knowledge input: Watch Video 4- CSCL and Scripts (slides 23-44)
3. Self-assessment: take the short quiz to assess your understanding of the video
4. CA-based collaborative activity (Week 3 discussion in German language):

Stellen Sie sich folgendes Szenario vor:

Im Kollegium berichtet ihr Kollege Herr Lehmann von einer neuen Herangehensweise, die er mit seinen Schülern seit geraumer Zeit bei Diskussionen ausprobiert. Statt einer offenen Diskussion erhält jeder Schüler individuelle Anweisungen, welche „Rolle" er in der Diskussion einnehmen soll, z.B. soll einer besonders viel Kritik üben, um Schwachstellen in der Argumentation zu entdecken, ein anderer soll hingegen die Struktur der Lernergebnisse übernehmen. Die Schüler jedoch langweile dies immer mehr, was Herrn Lehmann wundert, weil die Schüler die Methode am Anfang sehr wohl mochten, nur mit der Zeit eine Abneigung entwickelt haben, obwohl er die Rollen immer durchwechseln ließe. Die Kollegin Frau Vogel wiederum hält die gesamte Methode überhaupt nicht für neuartig und auch viel zu einschränkend für die Schüler. Sie meint, so können sich gar keine natürlichen Rollen ausbilden, was natürlich die Schüler langweilen würde. Außerdem würden die Schüler so nie lernen, auch ohne Skript erfolgreiche Diskussionen zu führen. Nun denken Sie, dass Sie Informationen zu dieser Problematik beitragen können, die Sie vor kurzem in einem wissenschaftlichen Artikel gelesen haben…

Was spricht für, was gegen die Vorgehensweise von Herrn Lehmann? Was meint wohl Frau Vogel und könnte sie damit Recht haben? Argumentieren Sie dafür, wie man es besser machen könnte!

5. Additional Resources:
    - *Weinberger, Fischer, Mandl. Gemeinsame Wissenskonstruktion in computervermittelter Kommunikation: Wirkungen von Kooperationsskripts auf den Erwerb anwendungsorientierten Wissens.* https://epub.ub.uni-muenchen.de/261/1/FB_153.pdf

- Dillenbourg, Pierre. Over-scripting CSCL: The risks of blending collaborative learning with instructional design. https://telearn.archives-ouvertes.fr/hal-00190230/document

Unit 4: Technological supported learning forms

Unit 4 Goals: At the end of the unit the learner will be able to:

- List and describe several uses of mobile learning (situated learning, Augmented reality, micro learning etc.)
- Create an example of how mobile devices can be used in an orchestrated classroom
- Identify the meaning of the acronym MOOC
- Describe at least two models of MOOCS
- Evaluate the potential of and critics of MOOCs
- Define and give examples of OER
- Define blended learning and explain how it is used in universities
- Differentiate between blended learning and flipped classroom
- Explain the advantages and disadvantages of video learning
- Describe the steps needed to create a flipped classroom
- Explain the advantages of using social media for learning
- Give examples of how social media has been used to promote learning
- Explain what a teacher needs to keep in mind/be cautious of when using social media as a tool

Unit 4 Activities:

1. Getting Started: In the forum describe your experiences with technology supported learning. Which tools have you used as students, which have you tried as a teacher? What do you want to try next? (Tools could include: online quizzes, ie. kahoot, learning apps, ie. Duolingo or flashcards, social media communities, MOOCs, Video, ie. youtube, khan academy etc.
2. Knowledge input: Watch Video5-10 (slides 45-50 and 54-83)
3. Self-assessment: take the short quiz to assess your understanding of the videos
4. CA-based collaborative activity (Week 4 discussion):

You have been asked to design a course on modern pedagogy and interactive learning for adult learners who have limited time to invest. The class is scheduled to meet once a week, but many of the learners will not be able to come each week. You want to not only explain the topic but allow learners to experience some best practices. Discuss with your co-teacher(partner) what tools and methodologies you want to incorporate into your class. How can you ensure learners get the most out of the course and what theories support your ideas?

5. Additional Resources:
    - Staker and Horn. Classifying K-12 Blended Learning: https://www.christenseninstitute.org/wp-content/uploads/2013/04/Classifying-K-12-blended-learning.pdf
    - Koachev et. al. Learn-as-you-go: New Ways of Cloud-Based Micro-learning for the Mobile Web. http://dbis.rwth-aachen.de/cms/staff/klamma/papers/CAKJ11.pdf

- Dabbagh and Kitsantas. Personal Learning Environments, social media, and self-regulated learning: A natural formula for connecting formal and informal learning. https://www.sciencedirect.com/science/article/pii/S1096751611000467
- Bishop and Verleger. The Flipped Classroom: A Survey of the Research. https://www.asee.org/public/conferences/20/papers/6219/view

Unit 5: Conclusion and assessment

Unit 5 goals: At the end of the unit the learner will be able to:

- Explain the importance of orchestration in the classroom
- Give examples of how orchestration can be implemented with the help of technology
- Discuss the potential and possible dangers of using technology in the classroom

Unit 5 Activities:

1. Getting Started:
2. Knowledge input: Watch Video 11- The Orchestrated Classroom (slides 84-99)
3. Knowledge input: Watch Video 12- Conclusion
4. Self-assessment: take the short quiz to assess your understanding of the videos
5. Final Assessment: Complete the quiz on the course content and respond to the following writing prompt (in German language): "*Die Saarbrücker Zeitung sucht engagierte Lehrer, die jede Woche in einer speziellen Kolumne über Themen der Bildung referieren sollen. Diese Woche soll es um Bildungstechnologien im Klassenzimmer gehen. Sie als Experte wollen nun ein Statement zu den Potentialen und / oder Gefahren von Bildungstechnologien im Klassenzimmer abgeben. Stellen Sie Ihr diesbezügliches Wissen möglichst informativ und umfassend dar! (Länge: ca. 500 Wörter)*".

Write an article for the local newspaper outline the potential and dangers of using technology in the classroom. (approximately 500 words).

2.6.5 Materials

Next the details of the video materials of the course are shown:

Unit	Video Name	Corresponding Slides	Time
1	Willkommen	To be defined	To be defined
1	Orchestrierung	1-11	4:00
2	Formles und Informelles Lernen	12-15	2:41
2	Learning Communities	16-22	7:33
3	CSCL	23-44	15:16

4	Mobiles Lernen	45-50	7:37
4	MOOCs	54-56	4:20
4	OER	57-58	0:53
4	Blended Learning	59-62	1:39
4	Sozialen Medien	63-72	6:54
4	Flipped Classroom	73-83	8:17
5	The Orchestrated Classroom	84-99	9:25
5	Conclusion	To be defined	To be defined

3 Integration of colMOOC-based collaborative activities into the courses

For each of the courses presented in Section 3, students are requested to follow a sequence of video-lessons followed by intermediate and/or final a quiz-based formative assessment activity. In addition, at scheduled points of the course, students will participate in synchronous collaborative activities where they will be asked to discuss on the module concepts within the colMOOC environment (see Syllabus of each course plan in Section 2).

As a use case of synchronous collaborative activities, next a brief proposal of the design of a **2-step colMOOC-based activity** is explained to be carried out in the MOOC course "Educational technology to support collaboration and assessment of the virtual learning" (see also D2.1, 2019):

- The **first step of CA-mediated activity** (Tegos & Demetriadis, 2017) will take place at the beginning of the module on "Pedagogies and strategies in collaborative learning". This learning task aims to involve students in an open discussion about the benefits and problems of collaborative learning. The learning task is a preparatory activity aiming to elicit students´ prior experiences with collaborative learning. In it, teachers-students are asked to describe two main benefits and two main problems/challenges of collaborative learning based on their previous experiences with students and negotiate with a partner a common answer to the task. Thus, the agent will react on concepts expressed in common language, and not domain specific jargon that will be introduced later by the videos in the model. The interventions will mostly follow the "Verify" and "BuildOn" patterns to give students hints and ideas on potential benefits and problems to discuss (D2.1, 2018).
- The **second step of the CA-mediated activity** will happen by the end of the same module on "Pedagogies and strategies in collaborative learning". In this case, students will have a broader knowledge on collaborative learning and strategies from the videos seen in the module. The learning task includes two parts: one is individual part and the other is collaborative to be carried out in pairs with the colMOOC environment, as follows:
    - In the individual part, students should read a case in the domain of teaching basic economics (keep in mind that the students in this MOOC will be pre- or in-service teachers). In this case, three alternative collaborative learning scenarios which are designed based on three collaborative learning flow patterns (Jigsaw, Pyramid, Brainstorming) (Gómez-Sánchez, Bote-Lorenzo, Jorrín-Abellán, Vega-Gorgojo, Asensio-Pérez & Dimitriadis, 2009) will be presented to students. After reading the three designs, students should answer two questions (which collaborative strategy would be more appropriate and why; and how would they propose to evaluate the success of the selected design). The individual answers to the questions will not be graded but be required to prepare students for the collaborative activity.
    - In the collaborative part, students should discuss with their partner and provide answers to the same questions included in the individual part. They can start by sharing their previous ideas, but they need to discuss and explain their arguments in the way to reach a consensus. The agent will ask some domain-related questions when students discuss about the key concepts related to the two questions. This agent will react on concepts that explicitly appeared in the videos, using the jargon of the domain. It has been created using all the available types of intervention patterns. The "AddOn" pattern has been used extensively, to foster transactivity.

4 Conclusions

This report has presented all preparatory work to organize the evaluation phase of the project. In particular, a catalogue of multilingual, multimodal and multidomain MOOC courses was presented based on the educational approach built in D1.3 (2018) of WP1, including an overview, learning objectives, methodology and syllabus with materials and learning activities of each course based on CA and LA components developed in D2.1(2018) of WP2 and D3.1 (2019) of WP3 and integrated in D4.2 (2019) of WP4.

This work will serve as the grounds for the trial activities to be reported in the next deliverables D5.2 and D5.3 (to be submitted in 2020).

References

D1.3 (2018). colMOOC (Integrating Conversational Agents and Learning Analytics in MOOC) project, Deliverable 1.3 "Educational approach and framework", project co-funded by the European Commission within the program Erasmus+ Knowledge Alliances: Cooperation for innovation and the exchange of good practices (2018-2020), Ref.: 588438-EPP-1-2017-1-EL-EPPKA2-KA).

D2.1 (2018). colMOOC (Integrating Conversational Agents and Learning Analytics in MOOC) project, Deliverable 2.1 "CA model design", project co-funded by the European Commission within the program Erasmus+ Knowledge Alliances: Cooperation for innovation and the exchange of good practices (2018-2020), Ref.: 588438-EPP-1-2017-1-EL-EPPKA2-KA).

D3.1 (2019). colMOOC (Integrating Conversational Agents and Learning Analytics in MOOC) project, Deliverable 3.1 "LA modules analysis and configuration", project co-funded by the European Commission within the program Erasmus+ Knowledge Alliances: Cooperation for innovation and the exchange of good practices (2018-2020), Ref.: 588438-EPP-1-2017-1-EL-EPPKA2-KA).

D4.2 (2019). colMOOC (Integrating Conversational Agents and Learning Analytics in MOOC) project, Deliverable 4.2 "Integrated colMOOC platform 1st version and applications", project co-funded by the European Commission within the program Erasmus+ Knowledge Alliances: Cooperation for innovation and the exchange of good practices (2018-2020), Ref.: 588438-EPP-1-2017-1-EL-EPPKA2-KA).

Gómez-Sánchez, E., Bote-Lorenzo, M.L., Jorrín-Abellán, I.M., Vega-Gorgojo, G., Asensio-Pérez, J.I. & Dimitriadis, Y. (2009). Conceptual framework for design, technological support and evaluation of collaborative learning. International Journal of Engineering Education. 25(3), 557-568.

Rebedea, T., Dascalu, M., Trausan-Matu, S., Armitt, G., Chiru, C.G. (2011). Automatic Assessment of Collaborative Chat Conversations with PolyCAFe. In: Kloos, C.D., Gillet, D., Crespo García, R.M., Wild, F., Wolpers, M. (eds.) EC-TEL 2011. LNCS, vol. 6964, pp. 299–312. Springer, Heidelberg.

Tegos, S. & Demetriadis, S. (2017). Conversational Agents Improve Peer Learning through Building on Prior Knowledge. Educational Technology & Society, 20 (1), 99–111.