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Master of Cyber Physical Systems

International Master of Science on Cyber Physical Systems

Training on teaching methodologies and documentation

D2.9

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Disclaimer

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1 Executive Summary

Partners at the University of Hertfordshire organised and delivered a two-day virtual training for the teaching staff of the MSCPS project partners which took place on the 14th and 15th September 2020. All the training material is available online at the project repository. This report provides additional information of how to apply the information from the virtual training for the curriculum development of *International Master of Science on Cyber Physical Systems* within the MSCPS project.

Due to its length, the teaching material itself of the virtual training is not duplicated in this report, but rather is available online for all project partners on the MSCPS SharePoint portal at the following address:

https://erasmus_mscps.teams.uni-siegen.de/meetings/_layouts/15/start.aspx#/SitePages/Home.aspx?RootFolder=%2Fmeetings%2FShared%20Documents%2F2020%2D09%2D14%2D15%2DStaff%2DTraining%2Fpresentations&FolderCTID=0x012000CFA28561AE92284198EBADA8D9526FCD&View=%7

2 Virtual Training by University of Hertfordshire

Originally, the partner training, organised by University of Hertfordshire was planned as a physical face-to-face project meeting from 17th to 19th of March 2020, with the training added as extra training sessions. Due to the further outbreak of the COVID-19 pandemic, the face-2-face meeting had to be cancelled on short notice. With no end of the pandemic in sight, it was decided to shift the training towards two-days of virtual training, which was delivered on 14th and 15th of September 2020.

The agenda of the 2-day virtual training was as follows:

Day 1: 14th September Chair Dr Raimund Kirner

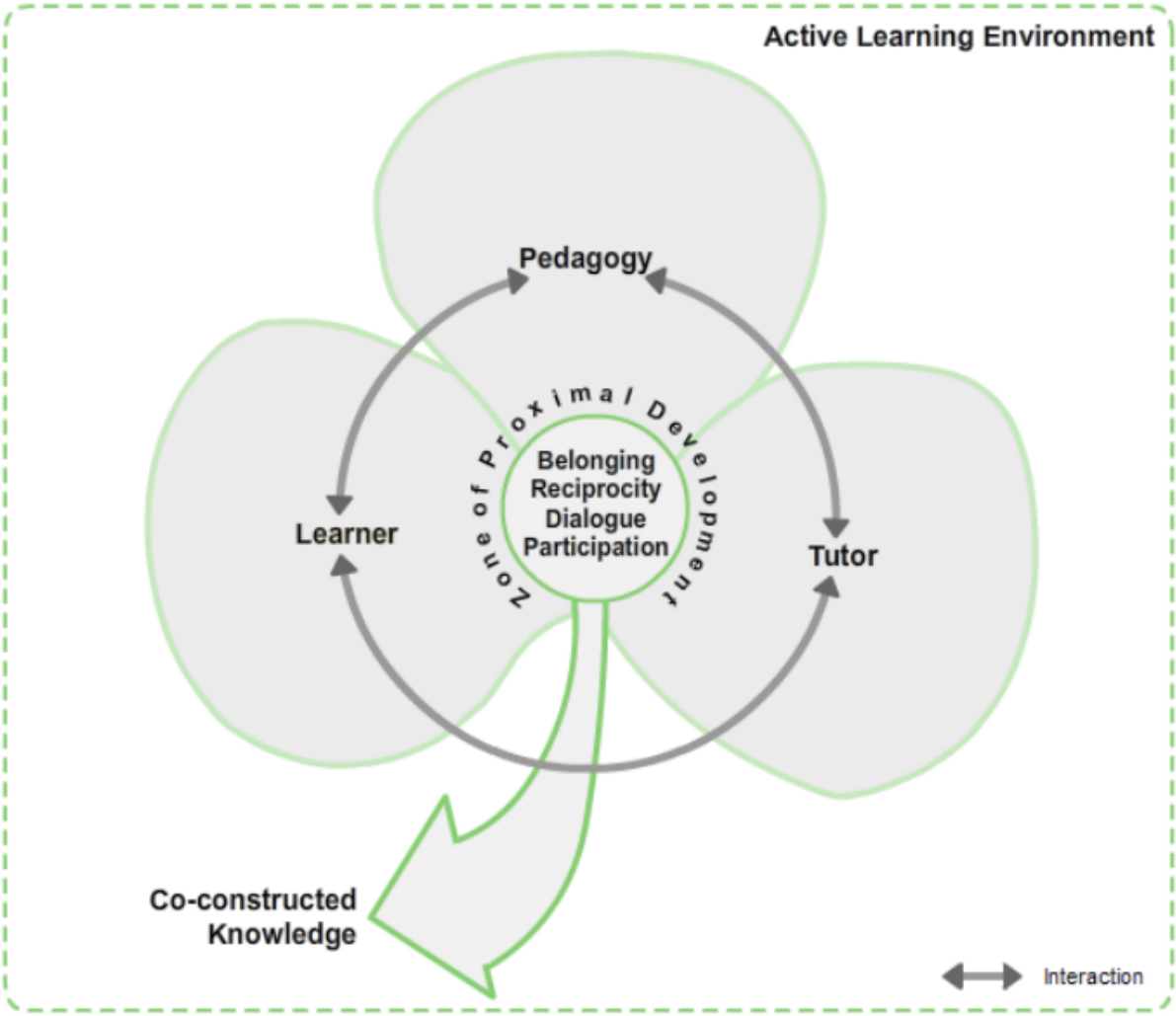
Time	**Subject**	**Presenter**
09:30	Welcome and Introduction	Dr Raimund Kirner
09:45-10:45	Blended Learning Teaching Methodologies: Using Technology to Enhance Collaborative Learning	Dr Martina A. Doolan
10:45 - 11:00	Comfort Break	
11:00-12:00	Lecture on Robotics	Dr Mick Walters
12:00-12:30	Questions and Answers Close	Dr Raimund Kirner

Day 2: 15th September Chair Dr Martina A. Doolan

Time	**Subject**	**Presenter**
09:30	Welcome and Introduction	Dr Martina A. Doolan
09:45-10:45	Contemporary Issues Professional Ethical and Legal	Dr Mike Pickup
10:45 - 11:00	Comfort Break	
11:00-12:00	Decision Making and Planning	Dr Raimund Kirner
12:00-12:30	Questions and Answers Close	Dr Martina A. Doolan

3 Blended Learning Teaching Methodologies: Using Technology to Enhance Collaborative Learning

In this session Dr Doolan's focus was on developing a Blended Learning (BL) curriculum to promote collaborative learning amongst students. When devising a BL curriculum, teachers were encouraged to consider whether e-learning opportunities are intended to be supplementary, complementary, used to replace or an alternative to class-based learning. Different possibilities for BL was presented for example, online learning and teaching of recorded lectures and use of online virtual classrooms such as zoom. Online student collaborations can be undertaken via discussion forums or virtual classrooms, small group discussions are complemented by using a wiki or online meeting room (Zoom, MS Teams), resources can be created and shared by students and teachers using a wiki. Group created work can be undertaken by students using wiki and blogs. These can be blended with F2F learning and teaching activities in a lecture, tutorial, lab, seminar, workshop and study groups. F2F student collaboration such as small group work, group discussion, debate, role play, and project work can be blended with online student collaborations. The dialogic shamrock framework as shown was presented as a pedagogical model to support teachers in blending online and F2F student collaborative learning activities.



Model© Doolan, M. A. (2011) Dialogic Shamrock Pedagogical Framework

The emphasis is on designs for learning that encourage student engagement, participation, reciprocity, dialogue and mutual engagement whilst learners are situated in an active learning environment, in this way knowledge is socially constructed and skills are developed after which, this development is internally built upon. Hence, learning is not a solo activity, or a spectator sport rather is by means of active participation, is social and situated in an active learning context. Examples of using the dialogic shamrock framework were presented across different countries and disciplines and in various learning and teaching contexts.

4 Lecture on Robotics

In this session the focus was on teaching students also the real-life implications that cyber-physical systems can bring to our society. To balance the future development into a positive direction, not only the aspect of technical possibility is of importance, but also the political decisions about the usage of such technology. At the same time, the psychological aspect in robot-human interaction is an important factor to consider in order to provide meaning enrichment of human life.

The following example shows the research robot Kaspar, developed at the University of Hertfordshire. Kaspar is an example of interdisciplinarity, covering the field of technology and psychology. Kaspar has been developed as a therapeutic tool in the help of children:

robot Kaspar, curtsy of the Adaptive Systems Group, University of Hertfordshire

The overall of the training session has given useful information to teach students about the following topics:

- Technical revolution - promising future due to the use of robotic life assistance
- Robots as assistants to humans
- Robots as therapist
- Threat of artificial intelligence
- Ethical challenges in the use of robots
- Probability of job replacement
- Sustainability of future societies

- Affordability of robotic for living for the general public, given the distribution of wealth

The session gave a comprehensive picture of societal influence by future cyber-physical systems. This topic could be taught to students in order to give them a better understanding of the impact their future work might have on society and what are challenges that come along with that changes of our society.

5 Contemporary Issues Professional Ethical and Legal

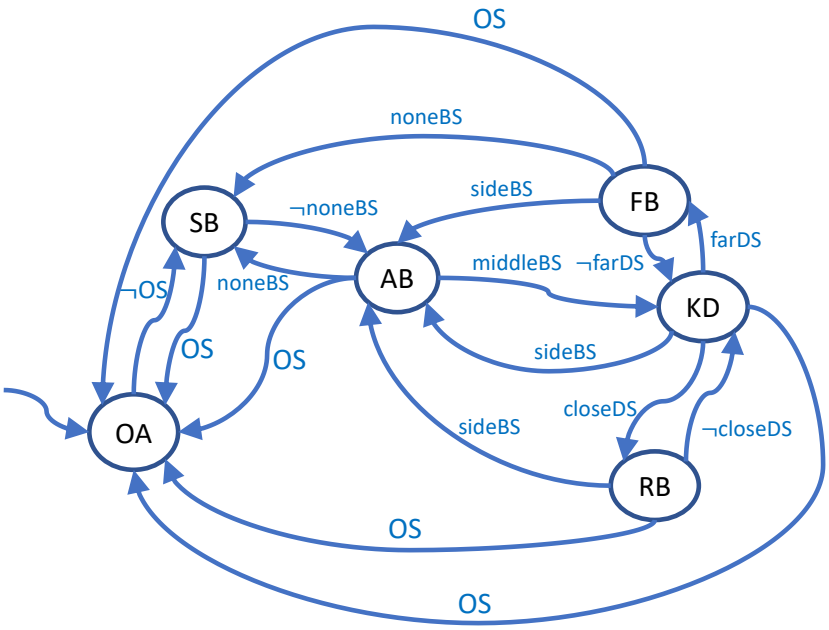
In this session the focus was on teaching students about ethics relating to moral principles; in this context human character or behaviour which is considered as good or bad, making distinction between right and wrong choices. The session gave a comprehensive picture of the importance of ethics and ethical systems considering new emerging technologies such as robotics and Artificial Intelligence (AI) which raises the fundamental need for students to learn to address ethical as well as legal, societal, and economic issues in advance of the development of such systems. Bias and gender in facial recognition systems was also presented alongside liability. Deliberate bias, accidental bias and implicit bias is in AI data sets and systems and the importance for students to consider ways to address machine learning bias was also presented.

This topic could be taught to students to give them a better understanding of the importance of ethical, legal and societal issues in emerging technologies in view of developments in AI. If Information Technology is to be good for society it must be ethical failing this, it may be rejected by the public.

6 Decision Making and Planning

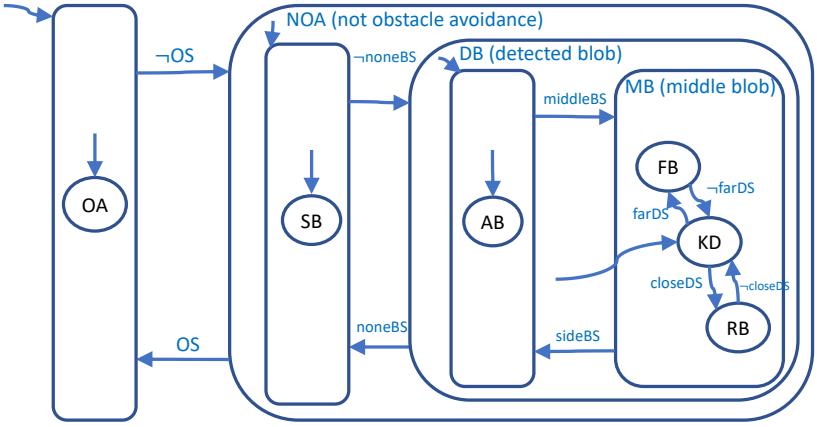
The training session on Decision Making and Planning focused on multiple issues.

The main part of this session was to teach students a systematic way of how to describe the behaviour of cyber-physical systems as complex state machines and how to break it down into structured components with reduced complexity. For example, a student project using programmable robot cars can be described as the following state transition program:



Smart Car Coursework © Kirner, R. (2016) State Transition Diagram

Using the decomposition presented in the training material, the very same transition system can be represented by nested state transition systems, with significantly reduced complexity of the individual state transition systems, which makes it much easier for students, to analyse their design and make sure that all required behaviour is covered:



Smart Car Coursework © Kirner, R. (2016) Hierarchical State Transition Diagram

The structure of the above nested state transition system can then be directly taken and translated into the control-flow structure of the program implementation:

```
stateMB = <inactive>; // nested state not active
while (forever) {
   if (OS) {
      // [OA] out: stop car
   } else {
      if (noneBS) {
         // [SB] out: search blob (refine)
      } else {
         if (sideBS) {
            stateMB = <inactive>; // nested state not active
            // [AB] out: turn to adjust facing
         } else {
            distanceState = ... // use distance to determine state
            switch (distanceState) {
            case tooclose:
                // [RB] out: drive car reverse to reduce distance
                break;
            case toofar:
                // [RB] out: drive car forward to get more distance
                break;
            case distok:
                // [KD] out: stop car in order to keep distance
            }
         }
      }
   }
} // while
```

Smart Car Coursework © Kirner, R. (2016) Implementation of State Transition Diagram

The above specification, simplification, and transformation technique can be used in practical modules where students have to design a control algorithm themselves and provide an implementation of it on some robot system.

The other aspect of this session demonstrated how to use intuitive examples from the basic world understanding to visualise for students initially challenging topics, like the difference between concurrency and parallelism.

7 Equality, Diversity and Inclusion (EDI)

In this session the focus was on ways to advance and promote EDI. This is an important topic for students in understanding the importance of equality in status, rights and opportunities and of ensuring that every individual has an equal opportunity to make the most of their lives and talents. Equality initiatives aims to promote fairness and the belief that no one should have poorer life chances because of how they were born, where they come from, what they believe, or whether they have a disability. Given students engage in a global nation it is key that students acknowledge, respect and celebrate differences within and between groups of people. Furthermore, ways in which people are disadvantaged by multiple sources of oppression: their race, class, gender identity, sexuality orientation, religion and other identity markers was presented as well as the importance of inclusion – a sense of belonging, inclusive cultures help people to feel respected and valued for who they are as an individual or group. An operational example was provided based on the workings of the Equality Office at the University of Hertfordshire (UH) to showcase how to help an organisation become more inclusive and a fairer place, where staff and students feel valued and respected. Advancing equality of opportunity is demonstrated in UK Universities thorough charter mark schemes such as Athena SWAN see: https://www.advance-he.ac.uk/equality-charters/athena-swan-charter

8 Conclusion

In this report we have documented the agenda of the virtual training organised by the University of Hertfordshire for the teaching staff of the project partners. The teaching material of the virtual training is available online for all project partners on the MSCPS SharePoint portal at the following address:

https://erasmus_mscps.teams.uni-siegen.de/meetings/_layouts/15/start.aspx#/SitePages/Home.aspx?RootFolder=%2Fmeetings%2FShared%20Documents%2F2020%2D09%2D14%2D15%2DStaff%2DTraining%2Fpresentations&FolderCTID=0x012000CFA28561AE92284198EBADA8D9526FCD&View=%7

This report provided an overview of presentations and further information of how to use the provided information in the virtual training for the curriculum development of International Master of Science on Cyber Physical Systems within the MSCPS project.

9 Acknowledgements

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