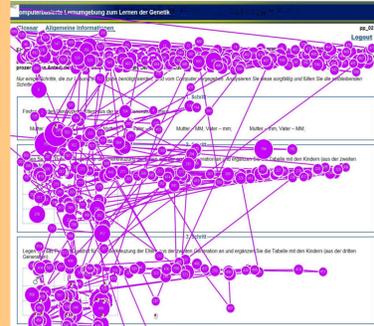


## PROJECT OBJECTIVES AND THEORETICAL BACKGROUND

- Research has revealed that students need to possess specific self-regulated learning (SRL) abilities in order to successfully learn with computer-based learning environments (CBLEs; Azevedo, 2009).
- The use of SRL processes in CBLEs (i.e., planning, goal setting, monitoring, evaluating progress towards goals) is influenced by different characteristics of the students (i.e., prior knowledge) and of the environment (e.g., provided instructional support; Winne & Hadwin, 1998).
- Prior knowledge is one of the key factors influencing SRL (Winne & Hadwin, 1998), because it is essential for advanced planning and monitoring processes, and hence for better performance (Ericsson & Charness, 1994).
- An increased amount of support tend to impede deeper cognitive processing and limit students' self-regulation (Pintrich & Schunk, 1996).

When students have to study in a self-regulated way, they allocate their time and effort on the basis of subjective perceptions about fluency of processing (e.g., Kornell & Bjork, 2009) → cognitive biases affect the accuracy with which students assess their own performance due to the wrong kind of cues used (Bjork, 1999).

This study investigated the effects of (1) different types of instructional support (i.e., worked-out examples - WE, completion problems - CMP and conventional problems - CVP), (2) students' prior knowledge and (3) the interaction between these two factors on performance, time-on-task, cognitive load, cognitive biases and SRL processes.

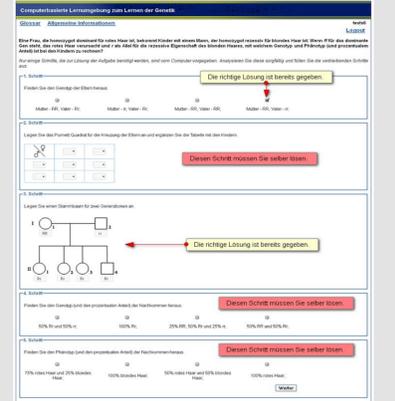


Tobii T60 XL eye tracker

## METHOD

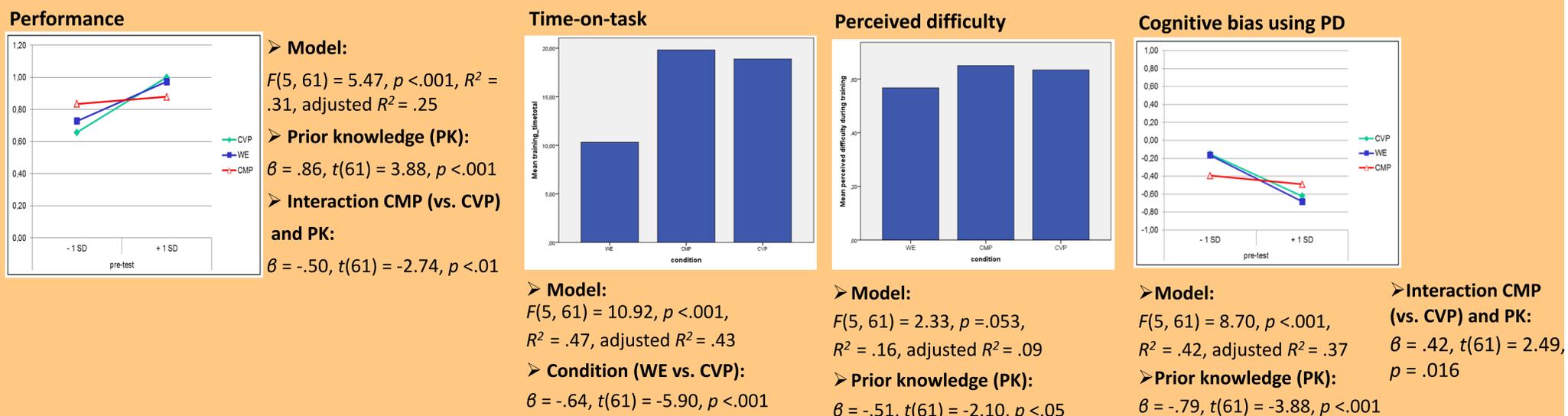
- The participants were 67 university students ( $M$  age = 22,79 years;  $SD$  = 2.66); 55 female, 12 male.
- They were randomly assigned to one of the three conditions: WE ( $n$  = 23), CMP ( $n$  = 22), and CVP ( $n$  = 22).
- In the computer-based learning environment designed for this study according to the 4C/ID model (van Merriënboer, 1997), five genetics tasks were presented in a predetermined, simple-to-complex sequence. Each task was characterized by (a) different difficulty levels and (b) varying surface features.

- Pre-and post-test: 10 multiple-choice questions on the subject of heredity (i.e., Mendel's laws)
- Measures of cognitive load: invested mental effort and perceived difficulty (5-point scale)
- Measures of cognitive biases: (a) based on perceived difficulty (PD): judgments of difficulty – performance and (b) based on invested mental effort (ME): judgments of mental effort - performance
- Cued-retrospective reporting: used to capture students' SRL processing - verbal protocols are analyzing using a coding scheme which contains as main categories the core self-regulatory processes according to Winne & Hadwin's SRL model (1998): (1) task definition, (2) goal setting and planning, (3) monitoring, (4) metacognitive control, and (5) evaluation.



Screen shot of a CMP, difficulty level 2

## RESULTS



## DISCUSSION

- The effect of different types of instructional support on performance and cognitive biases depends on students' prior knowledge
- low prior knowledge students (-1 SD) achieved higher performance in CMP condition, whereas high prior knowledge students (+ 1SD) performed better in CVP condition, which is in accordance with the expertise reversal effect (Kalyuga et al., 2003). This expertise reversal effect was not found for WE condition.
- Blocked examples are less accessible (Trafton & Reiser, 1993) → examples must be used during solving process for being beneficial.
- Testing effect of worked-out examples (van Gog & Kester, 2012)
- No differences between different support levels in terms of performance or cognitive load, except for time-on-task (WE condition < CVP condition) were found.
- in CMP condition, students' prior knowledge was less related to cognitive biases compared to CVP condition. In other words, CMP reduce the overestimation of low prior knowledge students' performance (e.g., Dunning et al., 2003) → providing CMP instead of CVP may be a promising way to support effective monitoring (and SRL in general), especially for low prior knowledge students (Dunlosky et al., 2005)
- Students' self-regulatory processes are dominantly characterized by monitoring = refers to the continuous control of the quality of performance (Moos & Azevedo, 2009).
- Further analyses will be done to investigate the possible effects of different types of support on students' use of SRL processes, and how these processes change as students' knowledge level increases.

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