Better Use Pedagogical Content Knowledge for Threshold Concept Research in Computer Science? We Don't Think So.

Bert Zwaneveld, Open University; **Jacob Perrenet** and **Roel Bloo**, Eindhoven University of Technology; The Netherlands

Fincher and Shinners-Kennedy, researchers in computer science education, give an overview of threshold research within computer science [1]. Although many threshold concepts have been identified, they argue that this kind of research has come to a dead end. They criticize the retrospective methods. Asking students to look back to what they did not previously know, would be an unreliable activity (hindsight bias) and emotionally laden events would be least likely to be recalled accurately. As a new direction for threshold research, they plea for investigating pedagogical content knowledge (PCK) to construct individual teacher's concept representations (CoRe's).

Their reasoning did not convince us. Hindsight bias refers to prediction of events in the past with known outcome and overestimating its probability; impaired memory because of emotional load refers to severely traumatic experiences. Our experience with PCK and construction of CoRe's with groups of teachers [2] leads us to the conclusion, that this is an interesting research method, uncovering many aspects of teaching within a discipline, but time consuming if only directed at the threshold phenomenon. Also, focusing on teachers as a source, gives only indirect information.
We used students (about 60) as well as their teachers (about 20) from Computer Science. The student task, digital paper-and-pencil, was presented at the end of the BSc programme as a compulsory reflection assignment. The threshold-concept was explained, including the characteristics based on [3] and with some non-Computer-Science examples. Students were asked for examples from their experience and to indicate the applicability of the characteristics.
We will summarize our preliminary results. Almost all students explained 1 to 3 concepts and declared the characteristics applicable most of the times. So, at least, the threshold concept has proved to be fruitful to stimulate reflection by students. We used the list of 27 computer science threshold concepts from [1] for comparison. Our results showed much more variety compared to this list. Only 50% of the time concepts were mentioned that were on the list from [1] with 'object orientation' most frequent (15%). Outside the list of [1] 'logics' was most frequent (10%). We will look for an explanation by analyzing the differences between computer science curricula. Another aspect for further investigation is the variation in specificity level in the threshold examples.
Next we will show the teachers the student task and ask them for concepts they think students mentioned. The teachers' results and the (expected) difference with the students' results will be presented at the conference.

[1] Shinners-Kennedy & Fincher (2013*).* Identifying Threshold Concepts: From Dead End to a New Direction. Paper ICER '13, San Diego,
[2] Saeli, Perrenet, Jochems & Zwaneveld (2012). Programming: Teachers and Pedagogical Content Knowledge in the Netherlands. Informatics in Education, 11 (1): pp 81-114.
[3] Meyer & Land (Eds.) (2006). Overcoming Barriers to Student Understanding: Threshold Concepts and Troublesome Knowledge; Routledge, New York.