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CONTRASTING THEORETICAL APPROACHES TO THE ANALYSIS OF CLASSROOM DATA

Studying Students' Creative Development of New Mathematical Knowledge

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Creative activity accompanied by high positive affect (‘flow’) can occur when people spontaneously set challenges and develop new skills in order to overcome them (Csikszentmihalyi, 1992). Creative thinking during flow specific to mathematical problem solving can occur when students discover a mathematical complexity of which they were previously unaware, and decide to explore it. Flow conditions include spontaneously setting an intellectually challenging question about the mathematical complexity, and exploring this question using non-routine mathematics (Williams, 2005). The thinking framework to study cognitive activity (Williams, 2005) was formulated by integrating aspects of thought processes identified by others (Krutetskii, 1976; Dreyfus, Hershkowitz, & Schwarz, 2001). The construct of student spontaneity was elaborated by subcategorising social elements of the abstracting process (Dreyfus, Hershkowitz, & Schwarz, 2001) into flow from internal and external sources (Williams, 2005). Undertaking such activity involves moving from what is known to what is unknown, and there can be many failures before success is achieved. Some students are not inclined to undertake such activity (Seligman, 1995).

Flow activity during mathematical problem solving is illustrated through the activity of a Year 8 student, Eden (Williams, 2007), who found he could not position linear equations to ‘shoot’ ‘globs’ on a Cartesian plane in a computer game. Eden was not aware of connections between algebraic forms of linear functions and their positions on graphs. He observed and reflected on a dynamic visual display as it was generated by another student. This display showed a family of parallel lines appearing one after another on the screen as the student undertook a trial and error process to try to hit the balls. Eden identified a pattern between the x and y values of co-ordinates of each line on the same line. He thought he saw a link between this pattern and the algebraic equation at the bottom of the screen. He returned to his own computer, and experimented. After seven minutes of intense activity, he left his computer screen and spoke softly to himself. He had confirmed that his patterns were expressed by the algebraic equation. He had developed new conceptual understanding that linked algebraic, numerical, verbal, and graphical expressions for linear functions (conceputal knowledge novel to Eden). Eden recognized patterns, and built with them expressing them verbally and algebraically, and then experimenting to see whether there was always a link between the pattern and the equation. He synthesised to gain when he realised that all of the information he had found about the graph could be ‘held’ in the linear equation and ‘unpacked’ as needed.
In his interview, Eden described how he problem solved in mathematics. He perceived failure to understand as temporary and able to be overcome with effort.

You just have got to sort of think out the answers in your head (pause) occasionally you have got to write down on paper what you are thinking about (pause) and eventually get the answer (Williams, 2006b, p. 397).

My insights into Eden’s creative thinking relied upon analysis of the teacher video to find what the students were told at the start of the lesson, the focus student video to find whether other students provided mathematical input to Eden’s exploration, the whole class camera to determine that Eden was not interacting with others during his seven minutes of exploration, and all three videos in the next lesson to make sure others had not contributed to Eden’s understanding prior to his interview after the lesson. The video-stimulated interview assisted Eden to remember detail, and communicate his thoughts in class. This interview drew attention to the parts of the lesson when Eden had developed new knowledge, and provided indicators of his inclination to explore. The LPS data collection processes were crucial to this study.