

How key concepts can make students cope with liminality

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To carry out long calculations, often 3-4 pages and not knowing at all how to judge whether the answer is right or even reasonable, makes students hesitate to do the calculations, or even skip them. In this paper we show how it is possible to change the tasks so that the students as well learn what to expect, as become willing to do the hard work.

By studying video-recordings of students doing lab-work in an electric circuit course we found that one of the 'lingering gaps' or 'stuck places' was related to the students' comment: "Is this good enough for the report", a statement all groups gave after each of the four tasks in our old version of the course. How should this be interpreted?

In the old course calculations were done in traditional problem-solving sessions, and labs were carried out in separate sessions. In addition, although not explicitly told, the students were expected to do calculations as homework. The notes from these sessions were not consulted during the lab, so even if the students had done calculations, they did not bring the results, or use it as any help to interpret the task - to make a calculated graph fit a measured graph. Without the calculations, it is not possible to know which function to use for the calculation of the graph, so one important change in the course had to be to make the students do calculations.

The changes were twofold – one change was to integrate the problemsolving sessions with the labs, the other was to introduce systematically varied problems, which would facilitate students' interpretation of the results. There were some differences in how students dealt with the tasks, some students started with simulations, and some with calculations. In this paper we will discuss this variation in students' ways of entering the liminal space, and how this variation changed their 'lived object of learning'. Thus we show that entering the liminality transforms the students ways of approaching the tasks, but also their opportunities to integrate their learning, and to make links between the theory/model world and the object/event-world. Giving students keys to opening up the liminal space is transformative as well to students ways of approaching troublesome knowledge as to the understanding of the complex concepts involved.

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