Teaching Scenario

Students taking the Physics programme at the Science faculty, Lund University, have a mandatory course on nuclear physics their last semester of the second year. Complementary to the theoretically focused lectures, experimental laboratory exercises comprise a mandatory graded part of the course examination. The spring of 2017 I was supervising one of the course labs, called γ-*spectroscopy*[1]. On the lab the students are examined with written reports that are performed in groups of two or three.

An important part of the examination is, what is denoted, *data analysis*. The data analysis constitutes reading in experimental data, calculate specific properties and perform a statistical analysis on the obtained results. It is most preferably achieved with a programmed script. As opposed to the course in general and large parts of the lab itself, which have a knowledge/understanding learning focus, the data analysis is a skill to be learned. Additionally, the students need to independently acquire the skill while the rest of the course is more teacher supported. At the point in the lab session when the students realised what was about to come, they presented their worries. One example from an email conversation is the following: "We are having a bit of trouble with the data analysis for the gamma lab, in that we think we know what we're supposed to be doing, but have no clue how to do it." A template example code and a hand-out giving an introduction to statistical analysis was provided via the course web page for the purpose of giving the students an extra push to the independent data analysis. In the process of completing the report several students turned to me (see quotation above) for detailed descriptions of what code to implement. It resulted in that I was practically giving them the solution at once. I realised something was not right.

Problem formulation: Students can be interpreted to show a resistance towards performing the independent data analysis. A consequences is; students have more difficulties reaching the intended lab and course learning outcomes.

Analysis

The analysis is limited to three perspectives; *constructive alignment*, *zone of proximal development* and an individualistic customer approach to education.

One perspective of the teaching scenario indirectly relates to *constructive alignment* [1]. The purpose of learning data analysis is not presented in either of the documents handed out in conjunction to the lab. It is merely conveyed orally at certain occasions during the lab. The intended course learning outcomes are generally not familiar to the students[2]. In fact the data analysis activities, which are clearly presented to the student in one of the documents, are very constructive and directly aligned to the intended learning outcomes of the lab. However, the students are not aware of the alignment, the data analysis flies

[1] http://www.fysik.lu.se/english/education/courses/basic-level/fysc01-course-package/nuclear-physics/laboratory-exercies/

[2] http://kursplaner.lu.se/pdf/kurs/sv/FYSC12

under the students' radar and its importance is not understood. A consequence is that they do not see the data analysis as meaningful and motivation and engagement drops [2] and this could explain some of the resistance.

Several students point out that they do not have sufficient knowledge to complete the data analysis. These students can be positioned in some phase of the *zone of proximal development* [2, 3] and consider themselves unable to complete the tasks on their own. For some students the situation constitutes a substantial challenge for the student and in combination with the limited support they retreat [4].

The theory of individualistic customer education might play a role for the native swedish students [5]. In this theory students see themselves as customers and assume that the teacher provides the services needed for the product; their learning. In the teaching scenario this corresponds to students asking for detailed explanations and me as a teacher giving the students solutions.

Proposed improvements:

1. Increasing the student awareness of the data analysis early on should be able to clarify its importance, e.g. via the title of the lab, at the lab introductory meeting, specifically in the learning outcomes and as part of the experimental procedure. The teacher can make connections to real-life applications of data analysis in academia and industry. Through this, the student should hereby better comprehend the meaningfulness of the data analysis [2].

2. Provide some background theory to the data analysis, encourage peer-to-peer discussions and clearly express the possibilities to reach out to the supervisor. This could be done either on the introductory lab meeting or in the beginning of the lab. With such an approach the student might not perceive the task unfeasible and instead embrace the challenge [2, 3, 4].

3. Clarify a process which helps the student on the way towards this independent learning. For instance, ask the students in pair to discuss an approach, in steps, of how to complete the data analysis [2, 3].

4. Clarify what is expected of the student to complete the lab, both orally and in text, and clearly present the task as difficult and that it requires a lot of work. By making this clear the student recognises their role and a customer-service relation is not established [5].

References

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[4] L. A. Daloz. *Mentor: Guiding the journey of adult learners*. 2nd edition, San Francisco: Jossey-Bass, 1999.

[5] Cecilia Arensmeier and Ann-Sofie Lennqvist Lindn. Studenter som kunder och konsten att vara lrare. *Statsvetenskaplig tidskrifts arkiv*, 2014.