Mind the Gap!
Bridging the Gap between Theory and Practice in Laboratory Assignments

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Typically, students who arrive at the laboratory classes are expected to possess the knowledge necessary to ensure safe and fruitful work. Sometimes, however, the knowledge obtained from attending the lectures and from reading course books does not quite fulfill these expectations. In this paper we have looked at what we call the "gap problem", i.e., the situation where the information, the understanding and the skills that students really fathom are not what is needed for performing the laboratory assignments. It is important to note that "the gap" is a very subjective and somewhat fuzzy term, experienced rather differently by different people.

We have done a preliminary analysis of the current situation, using a simple questionnaire to estimate how common the problem actually is, but also to discover how it is perceived by all the involved parties. We have separately interviewed students, teaching assistants and lecturers from the Department of Chemistry at Lund University. In our opinion, it is a shared responsibility of these three groups of people to make laboratory classes and lectures fit smoothly – if any of them do not fulfill their obligations, problems are bound to occur.

Despite the preliminary format of the survey and the limited number of people we have interviewed, some intriguing and rather unexpected trends can be observed in the data we have obtained. The most interesting result, in our opinion, is that all three parties have admitted that they are aware that the gap exists. However, many of them do not perceive it to be a problem, although the percentage differs significantly between the three groups, with teaching assistants being most likely to perceive the situation as problematic.

1. Introduction

This paper is based on a report from Introduction to Teaching and Learning in Higher Education course given by Roy Andersson and Anders Ahlberg. During the course we have carried out a simple survey among students, teaching assistants and lecturers in the Department of Chemistry at Lund University, i.e. the three groups which share the responsibility of making laboratory classes and lectures fit smoothly. The number of people interviewed was very small, only 26 (14 of which were students, 8 were TAs and 4 were teachers), but we have noticed several intriguing results even on such a small sample.

Our questionnaire can be seen as a preliminary analysis of the current situation, an estimate of how common the problem actually is, but also as a way to discover how it is
perceived by all the involved parties. We did not aim to solve the “gap” problem or to give a recipe for fixing it.

What we call the "gap problem" is a situation where the information, the understanding and the skills that students have are not what is needed for performing the laboratory assignments. In other words, there is some knowledge which students are supposed to have (and, often, are believed — by the teachers — to have), but which they are, in fact, missing. It is important to note that "the gap" is a very subjective and somewhat fuzzy term, experienced rather differently by different people. Of course, the severity of the problem varies significantly between the students and between the courses, but — in our opinion — it is common and serious enough to warrant some closer examination. The “gap problem” is not a field specific problem, and it can be encountered in basically all scientific areas.

There are many different ways in which “the gap” can manifest itself. In some cases, it is a simple ignorance of facts and memorised principles that makes students unable to perform satisfactorily during lab assignments. In others, the students know all the necessary material, but are unable to make use of it, either because their understanding is insufficient, or because they lack general skills of applying their existing knowledge to new problems.

In particular, we strongly believe that one of the most dangerous, but also one of the most difficult to detect, kinds of gaps is when students know enough to perform the assignment, but lack the ability to connect what they are doing with the broader picture of the domain knowledge. This makes the laboratory classes very inefficient as teaching mechanisms, because they do not fulfil their role in ensuring deep learning.

The aspects treated in the questionnaire include the gradual probing and characterisation of the problem (presence of the gap), followed by suggestions given by teaching assistants, course managers and students concerning the generating causes for the “gap” and bridging solutions for improving the situation.

In the next section we will try to highlight the most interesting parts of the questionnaire. The complete results of the survey are included in the appendix.
2. Questionnaire

Almost all the interviewed students are aware of the importance of the laboratory work and believe that the work they perform in the lab contributes to a better understanding of the knowledge given in the course (see graph A1 in the appendix). This result is consistent with both our expectations and our hopes.

At the same time, exactly half of the students (7 out of 14) do not see any particular difficulty in applying the theoretical aspects of the course, taught during the lectures, to the practical work they do during laboratory classes (graph A2). This would be great, but unfortunately teaching assistants do not share this optimistic view. From their experience as laboratory supervisors, they almost unanimously claim that students often have difficulties in applying their theoretical knowledge to the laboratory assignments (graph B1). There are several possible explanations of this discrepancy, but an in-depth discussion of them is outside the scope of this paper and will probably require more careful study.

On the other hand, all three interviewed parties have, almost unanimously, agreed that the gap does exist (see graphs A3, B2 and C1). This came as a bit of surprise for us, and we believe it is an important point to notice. At the same time, although the opinions towards the existence of the gap were concordant, a significant majority of both students and lecturers do not perceive it as a problem (A3 and C1). To the contrary, only half of TAs believe that the gap is nothing to be concerned about (B2). We believe that this discrepancy is also important and that valuable knowledge could be acquired by studying it further. The overall conclusion is that the teaching assistants seem to be the ones most concerned about the “gap problem”, which is somewhat alarming, since they are, after all, the ones closest and best suited to evaluate seriousness of the problem.

As an anecdote, without commenting it, we would like to mention the answer one of the teachers gave. When asked about the existence of the gap, he answered “Gap exists if teaching assistants say so”.

Having established that the gap exists, we tried to analyze its causes and the possibilities to improve the situation. Among students, there was no clear agreement as to what are the causes of the gap. In particular, all three parties were “blamed” for it more or
less equally, with lecturers winning slightly (A4). Teaching assistants and lecturers offered some ideas, but there was no consensus among them either (B3 and C2). They mentioned that more information about laboratory work should be introduced during course lectures, that theoretical information concerning the laboratory experiments is sometimes given either too early or too late with respect to the lab schedule, that communication between the course manager and the teaching assistant is insufficient, that students should prepare better and that there are sometimes problems related to course planning.

When asked specifically about whether students can do anything to improve the situation, both students and teaching assistants almost unanimously agreed that better preparation, mainly by reading more, would help (A5 and B4). At the same time, when asked about the best person to improve the situation, the vast majority of students answered “lecturer” (A6). There was no agreement among teaching assistance as to what the best thing for them would be (B5), but some interesting ideas were mentioned. In particular, one TA answered that there is a lot of things that could be improved, but there is no incentive to try harder – the teaching assistants do not get any rewards for doing their work better. We believe it is a very important observation.

One surprising fact is that although the course managers considered the course planning problems as one of the important reasons for the “gap”, when they were asked to mention possible solutions for the situation, their answers have only been focused on organizing laboratory discussions and giving the students tests to be answered before starting the work. One interesting note from the course planners has been that “the students like to see the teachers being involved in the laboratory work”. By doing so, the teacher — who knows what he has told the students during the lectures — can simply direct students’ attention to the things he wants them to learn.

All course planners claim that they communicate, one way or another, the information about the course plans to the teaching assistants (C5). Half of the teaching assistants admit that this communication exists, but the other half considers this communication to be not satisfactory (B6). Our questionnaire is not sufficient to understand the reasons for those impressions, but we believe that it indicates an important problem and that follow up research of this issue would be beneficial.
3. Conclusions

Despite the preliminary format of the survey and the limited number of people we have interviewed, some intriguing and rather unexpected trends can be observed in the data we have obtained. The most interesting result, in our opinion, is that all three parties have admitted that they are aware that the gap exists, but that most of them do not perceive it to be a problem. At the same time, the percentage of people who are concerned with “the gap” differs significantly among the three groups, with *teaching assistants* being, by far, most likely to perceive the situation as problematic.

In this paper we have only pointed out a problem and done very preliminary analysis of its causes. A bigger and more formal study needs to be carried out before categorical conclusions can be reached. Even in their current form, however, our results seem to indicate that the problem is real and that it is to large extent misunderstood by many participants of the student-TA-lecturer interactions. Due to the great importance of laboratory classes in higher education, it is definitely worthwhile to study the “gap problem” in more depth.

References


Appendix A – Student Questionnaire

A1: Do you think your laboratory work helps you better understand the theory given during lectures?

Yes | Not all the time | No, since lectures are always clear
--- | --- | ---
12 | 1 | 1

A2: Is it difficult to apply the theory you learn during lectures to the laboratory work?

Yes | No | Sometimes | No comparison
--- | --- | --- | ---
3 | 7 | 3 | 1

A3: Is there a gap between "lecture knowledge" and "laboratory knowledge"?

No gap | Gap exists, but it is not a problem | Gap exists | Gap is a serious problem
--- | --- | --- | ---
0 | 10 | 4 | 0

A4: Who is responsible for the gap between "lecture knowledge" and "laboratory knowledge"?

Students | TAs | Lecturers
--- | --- | ---
6 | 4 | 8

A6: Who do you think is the best person to improve the situation?

Lecturer | Student | TA | No answer
--- | --- | --- | ---
12 | 2 | 4 | 2
Appendix B – Teaching Assistant Questionnaire

B1: Is it difficult for students to apply the theory they learn during lectures to the laboratory work?

- Yes: 7
- No: 1
- Sometimes: 1
- No comparison: 0

B2: Is there a gap between "lecture knowledge" and "laboratory knowledge"?

- No gap: 1
- Gap exists, but it is not a problem: 3
- Gap exists: 4
- Gap is a serious problem: 1

B3: If, in your opinion, there is a gap, what are the main causes for this situation?

- No Lab info during lectures: 2
- Theory after/before lab schedule: 2
- No guidance: 1
- No communication between T & TA: 1
- Easy lab work, no need for theory: 2

B4: Do you think there is something the student could do to improve the situation?

- "could do a lot": 1
- Read more: 4
- Study more: 1
- Be prepared: 1

B5: What can TA do to improve the situation?

- Guide, supervise: 1
- Discuss with S&T: 1
- Be prepared, make quizzes: 2
- Check, correct, refresh and give info: 1
- "A lot", but there are no rewards: 1
- Be approachable, available, and knowledgeable: 1

B6: How do you see opinion exchange and communication between course managers and teaching assistants?

- Works well, depending on course manager: 1
- Follow up and planning meetings: 2
- "should always be": 4
- No, not effective, poor, not satisfactory: 1

B7: How much authority do you have over the laboratories?

- No authority at all: 0
- Too little authority: 3
- Enough authority: 4
- Too much authority: 1
- No clear answer: 0
Appendix C – Lecturer Questionnaire

C1: Is there a gap between "lecture knowledge" and "laboratory knowledge"?

Number of persons

<table>
<thead>
<tr>
<th>Gap exists</th>
<th>Gap exists, &quot;if TAs say so&quot;</th>
<th>Gap is a problem</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

C2: If, in your opinion, there is a gap, what are the main causes of this situation?

Number of persons

<table>
<thead>
<tr>
<th>No student preparation</th>
<th>course planning problems</th>
<th>teachers give OVER/5VS not SPECIFIC SOLUTIONS</th>
<th>TEACHERS no practical things, TAs no theory in the lab</th>
<th>No pre- and post-course meetings between teachers &amp; TAs</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

C3: If, in your opinion, there is a gap, what are the possible solutions for this situation?

Number of persons

<table>
<thead>
<tr>
<th>Lab discussions</th>
<th>Pre-lab report or evaluation of students’ preparation</th>
<th>Teachers serve as part-time TAs</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>

C4: How does a teacher/course manager in a course plan usually implement strategies for recognizing/rewarding student performance in course laboratory?

Number of persons

<table>
<thead>
<tr>
<th>Grading lab reports</th>
<th>Questions in final exam</th>
<th>There is &quot;No Carrot, No stick&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

C5: How often and in what ways do teachers communicate their course plans to students and TAs?

Number of persons

<table>
<thead>
<tr>
<th>General description of the course</th>
<th>Written description where to find literature</th>
<th>Preparation of Planning TA</th>
<th>Pre- and post-course load and course meetings for T &amp; TA</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>