Developing a discipline specific educational programme to professionalize teaching assistants in science and engineering within the 2020 context

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Abstract
In this paper, the specific needs of Teaching Assistants at the Science and Engineering Faculties of KU Leuven were analysed through a survey and three focus groups. These TAs are typically PhD students with a teaching assignment who take care of practice sessions. Based on the results of the survey and hearings, specified guidelines and recommendations to reform the existing educational training program for TAs emerged based on which new materials will be developed.

Introduction

At KU Leuven, practice sessions are traditionally the responsibility of teaching assistants (TAs), typically PhD students with an additional teaching assignment (Alpay & Verschoor, 2013; Van Hemelrijck, Peeters & Van Soom, 2012). The Faculty of Engineering attaches great importance to the role of the TAs since practice sessions are an indispensable tool in a student's learning process (Nikol & Rummler, 2013). After all, these additional contact moments serve as the necessary bridge between the theory taught during the lectures and the practice these students will face during their exams and in their future careers. Since about 220 new teaching assistants are awarded with a teaching assignment each year and a lot of these TAs struggle with coaching these practice sessions (Kálmán, 2013), the Faculty of Engineering at the KU Leuven introduced an educational training program for PhD students in 2005.

During the past decade, however, educational insights have changed significantly and this trend is likely to continue in the future (Tambuyser & Vandeput, s.d.). The improved flexibility and internationalization within the educational context result in heterogeneous groups of students. New technologies are introduced in the learning environment and the learning objectives have been reformulated and finalized. An integrated program with a focus on design and problem solving (Van der Hoeven & Peeters, 2013), as well as on sustainability is crucial for future engineers. Although the training program at the Faculty of Engineering evolved throughout the years (Van Hemelrijck et al, 2012), it no longer fits the changed training needs for the TAs involved.

Since the existing educational training for teaching assistants needed a thorough revamp, the PRIMA (Professionalization in Engineering Science: the Millennium Assistant) project was brought to life. The aim of this project is to revise the current training program and to adapt it to the present needs and expectations of the TAs at the Faculty of Engineering Science. In order to identify the priority needs of TAs with an educational assignment and to evaluate the existing training program, a large scale questionnaire was organized in 2013 among the teaching

assistants at the Faculties of Engineering, Science, Bioscience Engineering and Engineering Technology, combined with focus groups with seventeen TAs of five deliberately chosen courses at the Faculty of Engineering. These revealed the specific needs of these teaching assistants that will constitute the building blocks of the new training program.

Although the TAs at the Faculties of Science, Bioscience Engineering and Engineering Technology were included in the survey, the focus of the PRIMA project is on the TAs at the Faculty of Engineering. Since the TAs at these other faculties fulfill similar assignments, however, their opinions were valuable as well to get better insight in the most common pitfalls and needs. The results of both the survey and the hearings will be presented in this paper.

Method

1. Questionnaire

During the academic year 2013-2014, about 220 new teaching assistants were hired at the Faculty of Engineering alone, one of four Faculties participating in the questionnaire. Most of these are PhD students who are employed at one of the departments and receive an additional teaching assignment at their Faculty. The questionnaire was designed using Monkey Survey and distributed through the various department chairpersons. The target population consisted of all the teaching assistants (TAs) who are assigned with a teaching assignment at the Faculties of Engineering, Science, Bio Engineering and Engineering Technology at the KU Leuven.

The survey consisted of five parts in which questions about specific themes were included. In the first part, respondents were identified through a set of questions concerning the Faculty and department they are working at and the courses they are coaching. Subsequently, the TAs who perform teaching duties at the Faculty of Engineering Science were asked to evaluate the current TA training sessions they already attended. In the third part, the respondents had to answer some questions on their current teaching assignment. The questions in this part of the survey concerned the working language during their contact with the students, the average number of students attending, the time the TA spends on preparing and coaching students and an evaluation of their task. These questions were followed by two questions about the motivation and load with respect to their assignment. In the fifth part, finally, the respondents were asked to elaborate on their expectations and wishes for the future TA training.

2. Focus Groups

To further clarify the findings from the survey, three hearings were organised with TAs from different departments at the Faculty of Engineering. These interviews lasted approximately two hours, during which an educational developer took note while another led the conversation to direct the group discussion and to keep it going. The participants were attached to five different courses, namely:

- Building Physics   (Department of Architecture)
- Information Transfer & Processing   (Department of Electrical Engineering)
- Computer Architecture & System Software   (Department of Computer Science)
- Applied Mechanics 3   (Department of Mechanical Engineering)
- Strength Theory 3/Structural Mechanics   (Department of Architecture)

Respectively seven, six and four TAs participated in the hearings. Six of them were employed at the Department of Architecture, six at Computer Science, three at Mechanical Engineering and two at Electrical Engineering. Two of the participants were foreign TAs, the remaining fifteen were Dutch speaking. After a brief identification, they were asked some questions about a number of subjects in order to get the discussion started and to gain insight into a number of topics from the survey.

Findings

1. Questionnaire

Identification

A total of 400 respondents responded to the invitation to participate in the survey, 230 (58%) of these completed the entire questionnaire. 306 of the original respondents chose the Dutch questionnaire, which indicated that their mother tongue was Dutch. The other 94 opted for the English version, which leads us to believe that they are non-native and presumably graduates from a foreign university.

Of the respondents, more than half (64%) performed a teaching assignment at the Faculty of Engineering and approximately a quarter (26%) do so at the Faculty of Science. 9,5% of the TAs cooperating in the survey were charged with an educational task at the Faculty of Engineering Technology, which goes for 6% of the TAs at the Faculty of Bio Engineering. The sum of these percentages exceeds 100%, which is explained by a minority of respondents (5,5%) who perform teaching duties at multiple faculties.

Since the focus of the research is on the TAs at the Faculty of Engineering (FoE), these were further subdivided according to the department to which they are employed. These results can be found in Table 1.

Table 1: Share of the TAs from the various departments at the Faculty of Engineering (n=210)

Department	Number of TAs	% FoE
Architecture	7	3%
Civil Engineering	15	6%
Chemical Engineering	20	8%
Computer Science	45	19%
Electrical Engineering	47	20%
Mechanical Engineering	48	20%
Metallurgy and Materials Engineering	23	10%
Other	5	2%
Total	*210*	*98%*

Current TA training

The currently existing educational training for TAs consists of a number of sessions hosted by educational developers and each treat one of the following four topics: teaching exercise sessions, coaching a master's thesis, activating students and giving feedback. Each of these sessions is provided both in Dutch and in English, except for the sessions on the master's thesis which only exists in English.

In order to obtain their doctoral degree, the PhD students at the Faculty of Engineering are obliged to attend at least two of these sessions. The first one, on teaching exercise sessions, is mandatory for everyone. Their second session can be any of the other three or they can choose to have their teaching practice evaluated by their students and discuss these results with an educational developer.

In the questionnaire, the respondents were asked to evaluate the training sessions they attended so far by scoring seven statements on a 6-point scale ("I strongly disagree" to "I strongly agree"). The overall evaluation of the various training sessions was quite positive. Although the TAs rated the statement that "the information from the session was adapted to the modern technological devices I use whilst preparing and hosting exercise sessions, practicals, ..." only with 3,8 on average, even this isn't an alarmingly low score. The other sessions got an average evaluation of between 4,1 and 4,6 (Table 3). Since two of the statements were rescaled so they were all positively formulated, these scores reflect an average opinion of "I rather agree" to "I agree".

Table 3: Overall assessment of the TA training (n=247)

	Peer learning	Diverse content	Practical advice	Approachable host	Modern technology	Should be mandatory	Group discussion
Average	4,6	4,4	4,1	4,6	3,8	4,2	4,1
Median	5	5	4	5	4	4	4
Standard deviation	0,92	0,90	1,04	1,26	1,01	1,34	1,07

Teaching assignment

In order to find out what problems the TAs are regularly confronted with in their teaching practice, they were provided with a list of common problems they can encounter during their classes and with students. They were asked to choose the five problems on the list that hindered them most during their educational assignment for each way they are coaching students (exercise sessions, practicals and labs, Project-Based Learning and coaching a master thesis). When the answers for the different counselling forms are compared, it is striking how the problems the TAs encounter can be almost entirely reduced to their relationship with the students. The most 'popular' problems indicate that the students do not master the required theory sufficiently, they do not prepare their class moments with the TAs and they aren't motivated to cooperate actively.

The respondents were also asked to evaluate their experiences in the context of their teaching assignment with the help of six statements that vary slightly depending on the nature of their contacts with the students. The third statement had to be rescaled in order to obtain an all-positive list of statements. Statements 3 and 4 didn't have to be evaluated by the TAs coaching a master thesis, since they do not apply here. The results for these statements are solely based on the answers of TAs coaching exercise sessions, practicals, labs and Project-Based Learning. The overall results of the evaluation are quite positive, as can be derived from the results in Table 4. The average scores range between 4,1 and 5,2 which implies that the respondents "rather agree" tot "agree" with the provided statements. In more concrete terms, this means that the respondents assume their teaching experience may provide added value on the labour market and in their future research careers. On top of that, they feel like the students they coach actually achieve something as a result of their guidance and this gives them satisfaction. Finally, they feel that their commitment is appreciated by the didactical team and that it may be beneficial to their future academic career.

Table 4: Overall evaluation of the teaching assignment by TAs (n=451)

	Experience added value on labour market	Experience added value in research practice	Students achieve something	Satisfaction when students make progress	Commitment appreciated by professor	Commitment beneficial to academic career
Average	4,4	4,1	4,7	5,2	4,5	4,1
Median	5	4	5	5	5	4
Standard deviation	1,08	1,29	1,08	0,87	1,07	1,13

Motivation and workload

Based on five statements, the respondents were asked about the motivation to bring their educational mission to a successful conclusion. They were requested to evaluate these statements by scoring them on the 6-point scale that was used to assess the TA training. Statements 2 and 4 were rescaled in order to obtain an all-positive list of statements.

The results of this evaluation (Table 5) do not indicate any major problems concerning the motivation of the TAs. Statement 3 was assessed slightly more negatively than the other four, which suggests that the respondents perceive their teaching assignment as an obligation. This result doesn't come as a surprise since they are, as PhD students, indeed required to perform these tasks. The other statements were on average scored between 4,0 and 4,8, which indicates that the respondents "rather agreed" to "agreed" with them.

Table 5: Evaluation of the motivation with regard to the teaching assignment (n=236)

	Satisfaction from coaching	Use of my teaching job	No obligation	No alternative task	Didactical team motivation
Average	4,6	4,8	3,6	4,5	4,0
Median	5	5	4	5	4
Standard deviation	1,00	1,08	1,27	1,14	1,05

The respondents were also asked to evaluate the workload they experience as a consequence of their educational tasks, again by scoring four statements on the same 6-point scale. Statement 1 was rescaled so all the statements are formulated positively.

The overall evaluation of the workload wasn't predominantly positive (Table 6), since none of the statements received an average score of 4 ("I rather agree") or higher. The statements indicate that the TAs feel like they don't get enough support from the professor teaching the course (statement 2) and that the time spend on their teaching assignment is detrimental to the time spend on their PhD research (statement 1). On top of that, they feel that the load isn't distributed evenly between the assistants (statement 3), more specifically between the Dutch speaking and foreign TAs (statement 4).

Table 6: Evaluation of the workload as a result of educational tasks (n=237)

	Time commitment	Sufficient guidance by professor	Evenly spread workload between TAs	Evenly spread load between Dutch speaking and non-native
Average	3,4	3,8	3,3	2,6
Median	3	4	3	2
Standard deviation	1,28	1,24	1,51	1,45

The fourth statement (concerning the unfair distribution of the workload between natives and non-natives) was evaluated far worse by the Dutch speaking respondents (Charts 1 and 2) which might indicate that the Dutch speaking TAs are assigned with more or heavier educational tasks.
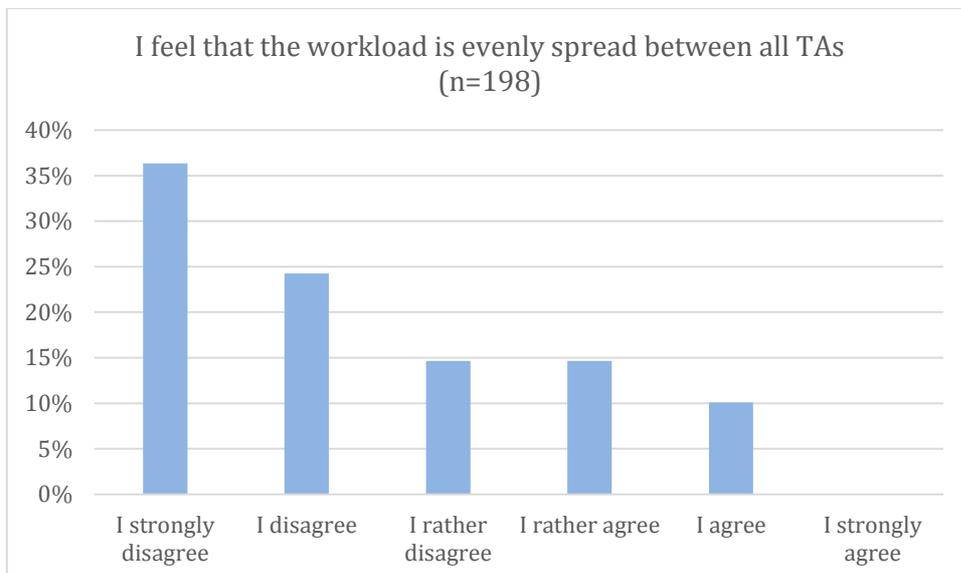
I feel that the workload is evenly spread between all TAs (n=198)

Chart 1: Answer distribution statement 4 (workload) – Dutch speaking TAs

I feel that the workload is evenly spread between all TAs (n=39)
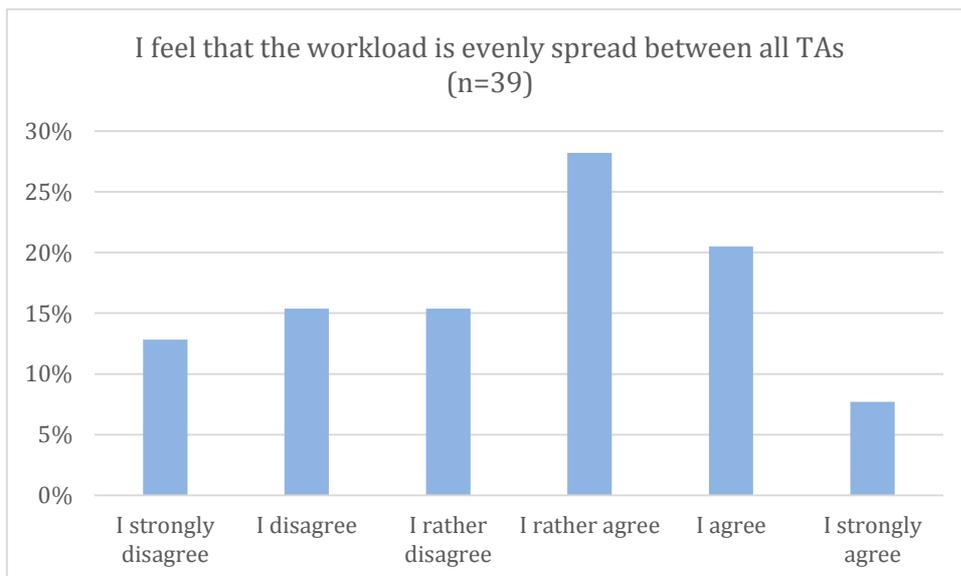
Chart 2: Answer distribution statement 4 (workload) – Non-native TAs

However, when the results regarding the time participants spend on contact moments with students during an average week are looked at again (Charts 3 and 4), there appears to be no difference between the Dutch speaking and the foreign-language teaching assistants that participated in the study. In fact, the non-native TAs indicate that they spend more time on coaching Project-Based Learning on a weekly basis. On exercise sessions, practicals and lab sessions, they spend about as much time as their Dutch speaking counterparts.

One possible explanation for the absence of any noticeable differences might be a different division of duties. It is not necessarily the case that the foreign TAs with a similar educational assignment are spending less time and effort on their teaching duties. It is more likely that a smaller proportion of these teaching assistants is taxed with such tasks than is the case with the Dutch speaking TAs, possibly due to a language barrier in some didactical work forms. A

pattern of this nature possibly emerges from the results of the survey: 82% of the non-native TAs indicated that they coach students in the context of their teaching assignment, compared to 94% of the Dutch speaking TAs. It is not clear, however, whether these percentages reflect the true proportions in the broader assistant population.
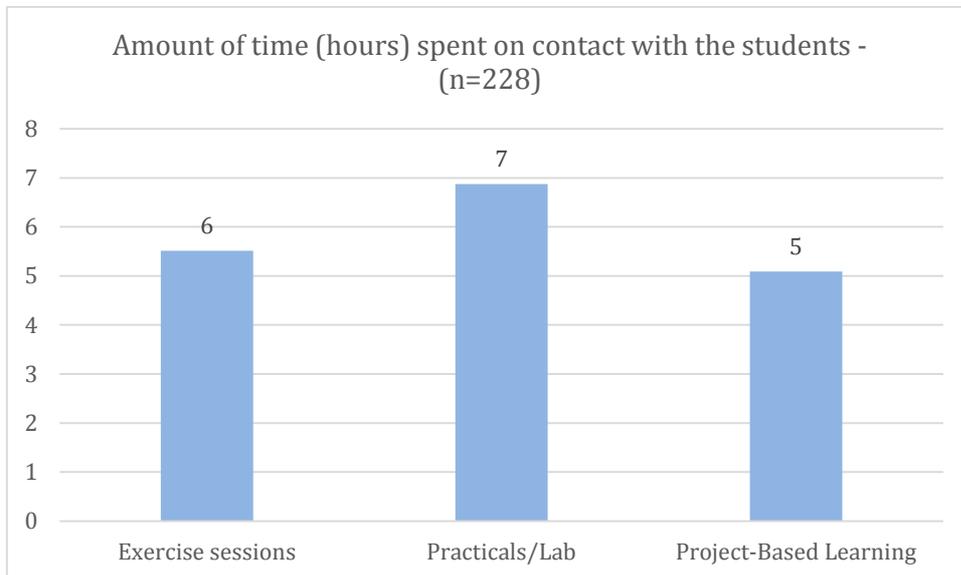
Amount of time (hours) spent on contact with the students - (n=228)

Chart 3: Average weekly time spent on direct contact with students by Dutch speaking TAs

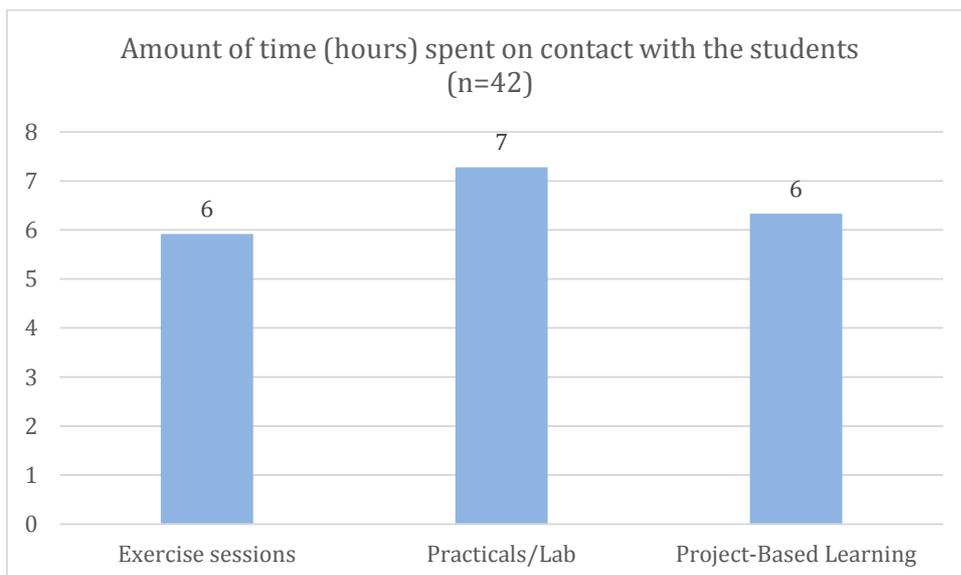**Amount of time (hours) spent on contact with the students (n=42)**

Chart 4: Average weekly time spent on direct contact with students by non-native TAs

Overall, these results concerning the motivation and workload of the TAs as a result of their teaching assignments suggest that they understand the importance of their teaching duties and that they try to perform them as well as possible. Nevertheless, many respondents feel that these tasks are at the expense of their research and that the teaching staff isn't always sufficiently supportive with regards to their duties. The main problem, however, lies in a sense of a disproportionate burden that seems to live especially among the Dutch speaking TAs.

Future TA training

In order to find out what the respondents expect from the new TA training and which subjects certainly need to be addressed, one open-ended and three closed-ended questions were designed. The three closed-ended multiple choice questions respectively gauge their preferences concerning online information (Table 7), available tools (Table 8) and the topics to be covered in the new training (Table 9). The open-ended question addresses their preferred working method for the new training sessions.

In the first and third multiple choice question, the respondents were asked to indicate their three preferred options. Regarding the second closed-ended question, they could pick their five most favourite suggestions. The results are listed in the following tables, ranked by popularity.

Table 7: Preferences regarding the new training: online information (n=252)

Type of information	Demand
Tips 'n tricks	29%
FAQ section	24%
Contact with experienced TA	14%
Backgroudn literature	14%
Form on lesson plans	12%
Filmed interviews with experienced TAs	5%
Other	2%

Table 8: Preferences regarding the new training: tools (n=225)

Tool	Demand
Tips 'n tricks	15%
Consultation with teaching staff	13%
Session for each working method	11%
Solutions to specific problems	11%
Evaluation by students	10%
1 session on exercise sessions + 1 on practicals/lab	7%
Presence of didactic expert	7%
Standard form on lesson plans	6%
1 general training session	6%
Footage of experienced TAs	2%
Other	2%

Table 9: Preferences regarding the new training: topics (n=228)

Topic	Demand
Activating students	21%
Motivating students	17%
Dealing with different types of students	16%
Preparing teaching assignment	13%
Giving feedback	12%
Classroom management	11%
Dealing with disruptive students	10%
Other	1%

At the end of the survey, the respondents were asked which working method they preferred for the future Teaching Assistant training through an open-ended question The answers of the TAs could be reduced to 22 different methods, each of which was in turn housed in one of nine overarching categories. The demand of the respondents for any of the methods for the new TA training is shown in Table 10, ranked by popularity of the broader categories.

Table 10: Desired methods for the new TA training (n=200)

Categorie	Demand	Method	Demand
Interactive	31%	Interaction	16%
		Group discussion	10%
		Peer-learning	5%
Practice-based	28%	Method-based	10%
		Practical/active	8%
		Case-studies/scenarios	6%
		Practical exercise + evaluation	3%
		Workshop	2%
Class	13%	Classical class/lecture	13%
Current form	7%	Current TA training all right	6%
		Lunchmeeting	2%
Assignment	5%	Assignment	3%
		Being assessed themselves	2%
		Feedback session	1%
Experienced TAs	5%	Experienced TAs	3%
		Interview/observation of experienced TAs	2%
Self-paced	4%	Online	3%
		Optional	1%
Timing	4%	Short training session	2%
		Multiple training sessions	2%
		One entire day of training	1%
Small groups	3%	Training in smaller groups	3%
	100%		**100%**

2. Focus Groups

During the three hearings with TAs, some questions were asked and statements were posited to gauge the opinions of the participants. These questions could be subdivided in three broad themes, namely their impression of the currently existing educational TA training hosted by the Faculty of Engineering, the kind of problems they encounter most often while taking care of their teaching duties and how the current training could be improved towards the future. The views of the TAs were written down and were used to determine the 'hot topics' of each of the three issues discussed.

Current TA training
- **Timing**: The majority of the TAs think a preparatory session before the start of the actual TA training certainly makes sense (but might suffice), while others are very keen to get the option of a come-back session as well. The proposed timing from the blueprint for the new training is approved by all participants, which might serve as a solution.

- **Positive aspects**: Useful and practical tips 'n tricks, evaluation forms, peer-learning.
- **Negative aspects**: They expect to learn how to handle their teaching assignment but are often asked how they would do it themselves. Too little real didactics.
- **Content**: Cases should be provided with a conclusion after peer-discussion, ready-made scenarios.
- **Link between research and educational assignment**: Often absent, although this would be a strong motivation to provide quality education. At times 'political game' within departments whereby TAs aren't assigned the course closest to their domain of research.

Problems with the teaching assignment
- **Activation, preparation and basic knowledge of students**: The students often don't cooperate, although they know the answer to the question asked. The TAs do not agree on whether this falls under their responsibility and if the TA training can tackle this problem. The same goes for making them prepare a class. On top of this, the basic knowledge of the students simply doesn't seem to suffice in some cases.
   ⇨ **Sanctions** are a possible solution when students didn't prepare, but this wouldn't benefit the informal setting of the contacts between TAs and students.
- **Communication to students**: Students need to be reminded of an assignment multiple times and everything has to be put down on paper. The communication doesn't go smoothly.
- **Motivation of the TA**s: The core problem, according to the participants. The educational assignment doesn't always match their domain of research, the supervisor attaches no importance to the teaching quality and there is no incentive since they aren't sanctioned for poor teaching.
- **Interaction with the didactic team**: Communication with the professor isn't obvious. Some TAs do not know what is expected from them (or from the students) or do not know which materials are at their disposition.
   ⇨ Framework or general guidelines for professor, get-together at the start of the semester.

Points of attention for the new training
- **Timing**: The proposed, more concentrated timing is welcomed. Come-back session more popular than preparing a training session.
- **Interaction with the didactic team**: Clarity about what is expected of the students. (Formalized) contact with more experienced TAs and more initiative from the professor.
- **Feedback**: From fellow-TAs or students. Interested in a survey among the students, but the TAs don't want to put too much effort into it themselves. Experienced TAs could be involved in the training.
- **Materials**: Evaluation forms to score students, tips 'n tricks, ready-made user friendly solutions, scenarios for teaching.
- **Online**: Proper website indispensable, materials for sessions should be available in advance.
- **Motivation**: Real-life cases, skills training which can be used outside the classroom as well.
- **Format**: Moment of reflection in small groups, training sessions for each department that can be designed more concretely, practicals and labs incorporated in one session.

Discussion

1. Questionnaire

Both the survey as the focus groups with TAs were designed in the context of the PRIMA-project to gain more insight into the problem areas of the current TA training of the Faculty of Engineering and to specify the needs and expectations regarding the new training. First of all, the survey revealed that the current training was positively evaluated in general. On average, the sessions were assigned a score between 3,8 and 4,6, indicating that they 'rather agreed' to 'agreed' with the statements provided.

When participants were asked to indicate which problems they encounter most often during their educational assignment, it appeared that many TAs have a hard time making the students prepare their classes and activating them in class. Nevertheless, they evaluate their teaching duties mainly positively and the average scores for the statements varied between 4,1 and 5,2. Even though the workload as a consequence of their teaching assignment was only scored 3,3 on average, the motivation to properly perform this task was evaluated with an average of 4,3. It has to be noted, however, that this isn't a very high score either, which was confirmed in the focus groups.

With regards to the renewed TA training, the following points of attention emerged: the classical 'classroom-format' should be retained, though there must be attention to a more practical approach that departs from the working method of the TA. The number of TAs attending a session may be lower and the focus should be on practical advice they can incorporate in their teaching practice. Moreover, they want more appreciation of the professor and a smoother communication with the rest of the didactic team. Experienced TAs could contribute both by giving training sessions and by coaching new TAs. There seems to be no consensus on the timing of the training sessions but there appears to be a general demand for an evaluation of their teaching practice by the students, albeit one that costs the TAs themselves as little effort as possible.

2. Focus Groups

During the hearings with the TAs, a few criticisms came up. Many of them indicated that the communication with the professor and the entire didactic team doesn't always go smoothly. Moreover, a lot of the TAs are responsible for coaching a course that has little to do with the research field of their PhD or even their own training, which doesn't benefit the motivation of these TAs. As in the survey, there is a general interest in an evaluation of their teaching practice by the students.

In the current TA training, the hands-on tips 'n tricks are appreciated, as well as the evaluation forms and the peer-learning from group discussions. the cases discussed in the training sessions should be provided with a conclusion in order to clarify how the participants should deal with a particular problem.

3. Summary

The renewed TA training should depart from the working method of the TAs (according to the "Teach as you preach"-principle), thus enabling the sessions to closely match the teaching practice of the participants who will get as much hands-on advice as possible that can be applied to the contact moments with students. A session on safety in the lab should only be provided for the TAs who effectively benefit from it and should focus on how to keep a bunch of youngsters in line. A decent website is indispensable as well and most TAs feel stronger about a come-back session than in the preparation of a training session. With regards to the timing, most would welcome a training that would take place in a couple of concentrated weeks throughout the year.

Lastly, some work needs to be done on the support of the didactic team. An alarmingly big number of TAs has no idea which level of knowledge they can expect from the students, what the content of the course looks like, which materials they have at their disposition and which agreements the professor has made with the students. On top of that, many TAs feel like their supervisors don't support their teaching duties since they attach more importance to the research the TAs conduct for their PhD. As a consequence, the TAs indicate that they would be more motivated if they would feel supported by the didactic team, if their supervisor would take account of their teaching assignment and if they would be coaching a course that relates to their research field.

Practical implications

The results of the survey and focus groups will be the foundations for a renewed educational training program for TAs at the Faculty of Engineering at KU Leuven. The primary needs and expectations of the teaching assistants will be translated into new materials and tailor-made training sessions. On top of that, there is ongoing contact with sister faculties at the university who might one day use our findings to expand and improve the way they are coaching their TAs to become better educators. With the results presented in this paper, we hope to inspire other institutions as well to support their teaching assistants or student coaches within the framework of quality management.

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