2023

Flash Observations For Improved Teaching Quality Among Graduate Teaching Assistants In Engineering Education

Sarah PLUMB
University of Sheffield, United Kingdom, sarah.plumb@sheffield.ac.uk

Joanna BATES
University of Sheffield, United Kingdom, j.bates@sheffield.ac.uk

Panos LAZARI
University of Sheffield, United Kingdom, p.lazari@sheffield.ac.uk

See next page for additional authors

Recommended Citation

Plumb, S., Bates, J., Lazari, P., & Di Benedetti, M. (2023). Flash Observations For Improved Teaching Quality Among Graduate Teaching Assistants In Engineering Education. European Society for Engineering Education (SEFI). DOI: 10.21427/5KFV-FF72

FLASH OBSERVATIONS FOR IMPROVED TEACHING QUALITY AMONG GRADUATE TEACHING ASSISTANTS IN ENGINEERING

S Plumb
The University of Sheffield
Sheffield, U.K.

J Bates
The University of Sheffield
Sheffield, U.K.

P Lazari
The University of Sheffield
Sheffield, U.K.

M Di Benedetti[1]
The University of Sheffield
Sheffield, U.K.
0000-0001-7870-1323

Conference Key Areas*: Innovative Teaching and Learning Methods*
Keywords*:* Graduate Teaching Assistants, Teaching skills, Teaching observations.

[1] *Corresponding Author*
M Di Benedetti
m.dibenedetti@sheffield.ac.uk

ABSTRACT

To maintain high quality, when teaching practical activities at scale, sufficient Graduate Teaching Assistants (GTAs) must be employed. However, their pedagogical skills are inconsistent.

This research is a pilot study to test the reliability and validity of research methods which will be scaled up in their application to the primary research to identify GTA pedagogical skills requiring further training. In the primary study, staff and GTA perspectives will be collected using surveys, and the emerging deficient skills will be further investigated using novel twenty-minute “flash” skills-based teaching observations of GTAs. Observation time will be split among the GTAs, and the focus will be on using one of the single skills identified in the surveys by GTAs across the lab rather than how an individual uses it.

This paper documents a pilot study conducted to trial a selection of three bespoke observation forms based on asking questions (i.e., the observed skills). Reflections by four observers after eighteen observations indicated that twenty minutes was sufficient time to get a fair assessment of how the observed skill was being used. The format allowed researchers to give individual feedback to GTAs who requested it and provide insight regarding the use of that skill in the lab.

The researchers identified two critical factors for the successful launch of the primary study; assessing the lab settings - to avoid significant interference with the teaching - and identifying when in the session GTAs are expected to use the observed skill– ensuring that the short observation is timed effectively.

1 INTRODUCTION

Over the years, Graduate Teaching Assistants (GTAs) have taken on a significantly larger role in higher education. As the number of enrolled students has risen, research-led universities have increasingly relied on GTAs to support undergraduate teaching. In many introductory courses and laboratory sessions, especially in STEM subjects, GTAs make up a substantial portion of the teaching staff, thus playing a critical role in educating the next generation of graduates.

This is also the case at the University of Sheffield (UoS) and, in particular, in the Multidisciplinary Engineering Education (MEE) department, as it provides engineering students with practical lab-based activities. Working at a large scale - up to a thousand students in a week for a single lab (Di Benedetti et al. 2022a) - it is necessary to employ a sufficient number of GTAs. At the same time, to retain the high-quality standard of teaching, pedagogical training is offered to all GTAs in MEE.

The current pedagogical training consists of university-wide workshops - designed to include learning theory and pedagogy in a non-subject-specific context to support GTAs across the university - and regular sessions offered departmentally specific to lab-based teaching (Di Benedetti et al. 2022b).

The faculty-wide workshops focus on introducing the GTAs to basic teaching skills: the role of a GTA in practical teaching, how to ask and answer students' questions and

how to deal with challenging situations. The lab-based training consists of specific aspects of a lab session: health and safety, learning outcomes and practical requirements for operating a specific laboratory equipment/set-up.

Nevertheless, the pedagogical skills of the employed GTAs remain inconsistent. This is because the team of GTA is fluid, with more experienced ones leaving and newer ones with different prior teaching experience - if any - being recruited every semester. When teaching, this inconsistency is typically tackled by pairing more experienced GTAs with newer ones. In addition, the current departmental training could be enhanced by identifying the GTAs' need for further development and incorporating them into the training content.

An ongoing research project in MEE aims to identify the GTA skills requiring further training by looking at multiple lenses. The perspectives of both staff and GTAs are collected through surveys to have insights into the skills that are perceived as important but that are currently lacking or insufficient. GTA skills are also assessed using teaching observation to identify strengths and common deficiencies.

By using these different lenses, the research aims to gain a comprehensive understanding of the skills that GTAs need to develop further to be effective in their teaching roles. By considering the perspectives of both staff and GTAs, as well as systematically observing teaching practices, the study can provide valuable insights into the areas where training and support are most needed to improve the quality of teaching provided by GTAs.

This study is part of the aforementioned research and specifically focuses on the initial pilot study carried out to investigate the use of a novel, "flash" skills-based teaching observation format.

2 METHODOLOGY

Pilot studies are recommended to identify any potential problems with the methods or ideas before being applied at a larger scale (Jairath et al. 2000). In this case, the validity and reliability of the new teaching observation method were tested. In particular, the focus areas for the pilot study were: 1. To ensure that the categories in the observation templates were clear, unambiguous and easy to complete in the time frame and environment of the lab; 2. Which position would be optimal for the observer to take to minimise the impact on behaviours by their presence; 3. To ensure that the data collected was fit for informing follow-up training; 4. To identify any other practical issues. Guidance into the effective use of pilot studies suggests running the pilot with approximately 10% of the expected number of participants (Connelly 2008). It is also advised that participants are representative of those who will take part in the actual study (Cohen et al. 2018). 11 GTAs were observed in this first instance who were selected because they work in the labs which would be used as part of the main study. To ensure an adequate level of experience for the observers, all observers were Senior Fellows of the Higher Education Academy (SFHEA).

To evaluate an isolated pedagogic skill across a cohort of GTAs, the traditional teaching observation templates used at UoS, which are designed to give feedback on individual teachers' performance rather than an isolated skill, were rejected. Instead, new teaching observation forms were designed which could be used to record the use of the single skill of "asking questions" by a small selection of teachers across 20 minutes of a lab session.

2.1 The Skill: Asking questions

This skill was chosen as it is frequently identified in discussions over key skills used by GTAs in supporting teaching and learning in labs (Deacon et al 2017) and due to the agency GTAs have over question design. The impact of effective questioning on student learning is also widely recognised among educators. Rather than exclusively being a means to monitor student understanding and knowledge, the effective use of questioning by the teacher has also been proven to facilitate learning and memory retention. Even operating at the lowest level of Bloom's cognitive domain (Bloom, 1984), Roediger and Butler (2011) assert that recalling information has a greater impact on learning and memory retention than studying. For "recall" to be effective for learning, feedback needs to be available to ensure the correct information is being learnt. In this way, recall questioning from teacher to student or with the teacher present to be able to correct misinformation is an important aspect of an effective learning environment and one over which GTAs have agency in the lab. Roediger and Butler's study also found that recall had more impact on long-term memory when it required "effortful processing" rather than straightforward rote learning underpinning the use of a range of questioning techniques in the lab.

Teacher questioning also provides a model to students to help them to develop an inquiry-based approach to learning (McTighe and Wiggins, 2013). Asking students questions not only promotes recall, interpretation and explanation of knowledge, it also models a reflective skill where students are encouraged to interrogate their understanding and critically reflect on how they have reached their conclusions, "a key long-term goal of education is for students to become better questioners because in the end— with much knowledge made quickly obsolete in the modern world— the ability to question is central to meaningful learning and intellectual achievement at high levels."

Studies by Black and Wiliam (1998) and McTighe and Wiggins (2013) both found that teacher questions are often based on eliciting factual recall of knowledge or were leading in the way they were framed meaning that the "effortful processing" required by the student in answering them is reduced. This research aims to see whether this assertion is true of the GTAs in the MEE labs.

2.2 The Teaching Observation

New templates were designed to observe GTA for 20 minutes and assess their "asking questions" skills. A structured approach to recording principally quantitative data with an opportunity for comments was chosen as the most appropriate for the context of the study as it generates numerical data which can then be used to identify patterns

and trends and can be used to easily make comparisons between different settings (Cohen et al. 2018). Quantitative data can also be captured more quickly than written notes, facilitating the process for observers to record more information more quickly and whilst moving around the lab than if they were recording primarily qualitative comments. However, an option for additional comments, which either could explain some of the quantitative data or which could be particularly helpful to feed into the resulting training, was also included as part of the observation forms to allow for confounding factors and additional context also to be captured.

For this initial trial of the study, three forms were created to measure how questions were asked across the lab by different teachers. Each form required the name of the observer, the session, the date, the start time of the observation, the number of students and the number of GTAs. GTA names were recorded so that collected data could be given to the observed GTA if requested. Each observation began one hour after the start time of the lab to allow time to pass for the group to settle and to have started the experiment before the observers arrived. The GTAs were informed in advance about the observation taking place during their lab session, along with the name of the person observing and the form being used. The three forms were used on rotation for different labs. Each observer assigned themselves labs to observe, and several labs had more than one observer to allow for the moderation of results. Observers who were also lab leaders as part of their job only observed labs which were not their own to mitigate the impact of GTAs feeling judged or that the results from their observation would impact future work assignments to them. This approach also avoided bias on the part of the observer, which may have arisen through knowing the observed GTA. As GTAs work across labs, this was not always possible but was implemented wherever it could be.

The first form (Fig.1, top) required the observer to write the question posed by the observed GTA and also to record if the question required an immediate response (IR) or if the GTA allowed one minute or more for students to think about the answer (TT). Data were also recorded on whether the question was posed to the whole group or an individual. If it was to an individual, then the gender of the respondent was also recorded (Male/Female/Gender Neutral). Before the observation started, the observer(s) would meet the lab lead, who would tell each observer the name of the GTAs, and any other relevant details needed by the observer to carry out the study reliably.

The second form (Fig.1, centre) was a frequency analysis of the types of questions being asked in the lab. Questions were coded by the type of information sought. These included checking progress (CP), seeking analysis (SA), seeking links (SL), checking for understanding (CU), and checking prior knowledge (CPK) (The University of Sheffield 2019). The cognitive domain of Bloom's Taxonomy (1984) was consulted as a guide to creating the code to categorise the questions. For example, "Checking prior knowledge" (CPK) is linked to recall and "seeking analysis" (SA) is linked to analysis. Observers tallied the types of questions using these categories they heard during observation. This form also required the gender of the person asked to be recorded.

Form Three (Fig.1, bottom) recorded the sequence of questions asked based on the same type categories as Form Two. In form three, the observer used the codes to record which type of questions were asked during each five-minute segment of the 20-minute observation. Gender was not recorded on this form.

Form One

Name/ number	Questions asked	Think time (TT) given or immediate response (IR) expected	To whole group	To an individual (M/W/GN/None of the above)	Other comments
Example	• How are you getting on? • What do you think? • Why do you think that happened?	IR, IR, TT	/	M W	

Form Two

Name/ number	Checking progress	Seeking knowledge	Seeking explanation	Seeking analysis	Seeking links	To whole group	To an individual (M/F/GN/NA)	Other comments
Example	///	//	///		/	///	M, M, , GN,	

Form Three

name/number	1-5 mins	5-10 mins	10-15 mins	15-20mins
Example	SA, SL, CPK	CU, CU, CP	CP	SA

Fig. 1. Relevant extracts of observation Form One (top), Two (centre), and Three (bottom).

A total of eighteen sessions were observed over one month by the four observers. At the end of this period, individual reflections were independently submitted by each observer of their experience of the process. An inductive thematic analysis of the free text was then conducted to identify the strengths of the process and aspects which needed revision before the final study.

3 RESULTS

3.1 Observers' Reflections

All observers struggled to ensure that the observation process did not interfere with the teaching. This was a trade-off between the observer's distance from the observed GTA, the voice level of the GTA, and the background noise. In addition, it was noted that some GTAs were observed more frequently than others; this is possibly due to the limited period the pilot study was carried out and the fact that the main factor in selecting sessions was the observers' availability. Moving forward, a more strategic/inclusive approach should be adopted.

In general, all agreed that the twenty-minute duration was sufficient to observe up to four GTAs and that the short duration made the observation task "light and quick" without adding a significant workload on the staff. On the other hand, observing only a portion of a lab session meant that, at times, the skill under observation was not used. This could be seen as a lack of such skill, but it could also be that it was not necessary as part of the tasks the GTA needed to complete. To avoid misinterpretations in the future, observers should always have a prior understanding of the lab activity and correctly set their expectations regarding the required skills.

The observers agreed that all types of formats to assess "asking questions" were well structured. Form Three required additional time before the observation to gain more

familiarity with the different codes. In all cases, more context about the session should be reported, and also elements perceived as pedagogically important but not strictly related to the observed skill should be noted down for feedback to the GTAs. Observers also noted that Form Three was more open to personal interpretation and harder to review, and it did not offer an insight into the “level” of questioning (the latter was also a problem for Form Two). Form One, on the other hand, offered a richer set of data from which codes and tallies can be extrapolated in post-processing. Conversely, none of the current formats was suitable to capture the appropriateness of the asked question (i.e., was that the right kind of question to ask?).

In Form One, it was possible to write down the meaning of most of the questions and to note down everything the forms asked for. The IR / TT split was useful for describing broad or targeted questions. However, observers should consider adding if a question is appropriate (i.e., was a broad question relevant for that part of the lab?). One comment on Form Two was that GTAs, who do not have many tallies, spent most of the time talking to the students during the observation, compared to GTAs, who asked a good variety of questions, from checking for progress to checking for understanding. Which questions are asked can underline the GTAs' confidence in the subject and give a good idea of the GTAs' background knowledge. In Form Three, the third form, the 5-minute intervals were useful to time the observation, making sure to observe all the GTAs within the time slot. However, the coding forms do not capture the good level of questioning by the GTAs, and some questions didn’t fit any of the codes, e.g. “Do you want to try?”. In general, the ‘other comment’ box was useful for including points of note which fell outside the direct skills the form was measuring but which were still adequate for the training.

3.2 Forms Analysis

Combining the three forms, we can detect some preliminary data, which shows scalable patterns regarding GTAs’ skill in asking questions to students. In Form One, the students gave an immediate response to a question more frequently (IR, 29 out of 30 questions) compared to thinking time questions (TT, 1 out of 30 questions). There was an equal divide between questions asked to a group or an individual. The questions asked were mostly focused on analysis and comparison of results.

The results of Form Two and Form Three are summarised in Fig.2. When looking at the questioning techniques, the GTAs are more confident asking questions related to the analysis of data or methods (SA, 24 out of 68 questions) compared to questions that make connections and links to the different parts of learning (SL, 8 out of 68 questions), check students’ previous knowledge (CPK 6 out of 68 questions) or students understanding (CU, 11 out of 68 questions). Additionally, students were often asked to describe their progress so far (CP, 19 out of 68 questions). However, this distribution may be influenced by the limited duration of the lab observation and the specific timing of the observation within the lab session (e.g., at the start, middle, etc.). Preliminary findings also suggest a variation in the distribution of question types across

different lab activities. These nuances warrant further exploration in the final study to provide a more comprehensive understanding of GTAs' questioning techniques.

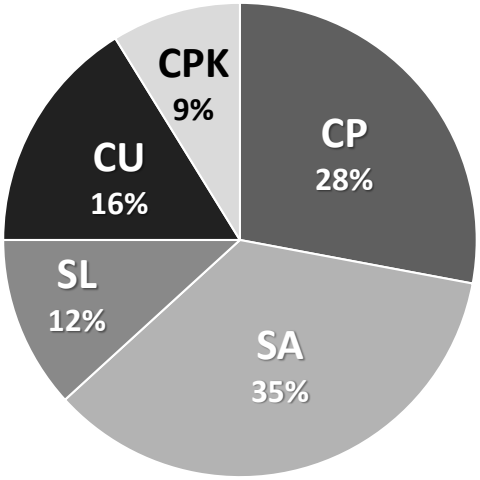

Fig. 2. Distribution of the techniques used when asking questions

4 SUMMARY

It can be concluded that the observation forms used in this pilot study have effectively recorded the use of an isolated teaching skill used by multiple GTAs in a lab context. The pilot has shown that the observation forms are a useful and effective tool to study and monitor GTAs' pedagogic skills as they capture various elements contributing to effective questioning by GTAs. For example, the level of confidence in asking questions by the observed GTAs can be deduced to some degree by the frequency of use of different types of questions. Further, GTAs' subject knowledge of the lab and competency in evaluating the student's understanding of the session and the lab procedures can be evidenced through the type of questions being asked, which were accurately captured in the forms.

The limitations of the data collected through the observation forms identified by this pilot study are mostly due to the short one-month timescale of the observations leading to only initial indications of emerging patterns, lack of strategy in the selection of labs to observe and the use of a single timeframe for the start of every observation meaning that the progression of questioning throughout the course of the whole lab could not be documented. A better understanding of the lab content by the observer will avoid the chosen focus of the observation being a skill that is not relevant to the observed lab. This knowledge will also inform the selection of the start time of the observation to ensure that the segment of the lab observed would be the time frame where the isolated skill to be observed would be most appropriate to be in use.

The pilot has proven the forms to be fit for purpose, and the manageability and improved accuracy of recording full questions are favourable to type coding in the session. Codes can be applied at a later date when more thought can be given to the appropriateness of the categories. The implications for the primary study include the necessity for a more strategic approach to ensure that they are used to the best advantage to collect an accurate overview of skills used across the full duration of the labs.

REFERENCES

Black, P. and Wiliam, D. 1998. “Assessment and Classroom Learning.” *Assessment in education : principles, policy & practice*, 5(1), pp. 7–74. doi:10.1080/0969595980050102.

Bloom, B. S. 1984. *Taxonomy of educational objectives: The classification of educational goals*. New York: Longman.

Cohen, L., Manion, L. and Morrison, K. 2018. *Research methods in education.* Eighth edition / Louis Cohen, Lawrence Manion and Keith Morrison. London ; New York: Routledge, Taylor & Francis Group.

Connelly, L.M., 2008. “Pilot studies.” *Medsurg Nursing*, 17(6). 411.

Deacon, C., Hajek, A., and Schulz, H. 2017. “Graduate teaching assistants’ perceptions of teaching competencies required for work in undergraduate science labs.” *International Journal of Science Education*, 39(16), 2189-2208.

Di Benedetti, M., Day, H. and Archibald, S. 2022a. “Scaling up practical teaching. The one-thousand student week.” *In SEFI 50th Annual Conference Proceedings: Engaging Engineering Education, Barcelona (Spain),19-22 September 2022.* doi:10.5821/conference-9788412322262.1286

Di Benedetti, M., Plumb, S., and Beck, S.B. 2022b. “Effective use of peer teaching and self-reflection for the pedagogical training of graduate teaching assistants in engineering.” *European Journal of Engineering Education.* 48(1). 59-74 https://doi.org/10.1080/03043797.2022.2054313

Jairath, N., Hogerney, M. and Parsons, C., 2000. “The role of the pilot study: A case illustration from cardiac nursing research.” *Applied Nursing Research*, 13(2), 92-96.

McTighe, J. and Wiggins, G.P. 2013. “Essential questions [electronic resource] : opening doors to student understanding.” Alexandria, Va.: ASCD.

Roediger, H.L. and Butler, A.C. 2011. “The critical role of retrieval practice in long-term retention.” *Trends in cognitive sciences*, 15(1), 20–27. doi:10.1016/j.tics.2010.09.003.

The University of Sheffield. 2019. “The Behaviour in Teams Project.” Accessed on 3rd May 2023. https://www.sheffield.ac.uk/iwp/behaviour-teams-bit-project