ACADEMIC WRITING IN ELECTRICAL ENGINEERING COURSES TO IMPROVE WRITING SKILLS AND CRITICAL THINKING

Sallehuddin Ibrahim
salleh@fke.utm.my

Mohd Amri Md Yunus
amri@utm.my

Mohd Taufiq Md Khairi
taufiq_khairi@yahoo.com
(PhD Student)

Fakulti Kejuruteraan Elektrik
Universiti Teknologi Malaysia
81310 Skudai, Johor

Abstract: Academic writing can play a vital role in engineering courses. It can have enhanced the ability of the students to write and hence the ability communicates to others also improved. It also strengthens their critical thinking because when the students write, they have to make sure that their writing quality impress those who read their writings. However sometimes lecturers are not satisfied with the quality of academic writing among students. In addition, many employers are not satisfied with the quality of writing and critical thinking among graduates. It is important that these problems are addressed at the university. This paper presents an investigation academic writing by the students at the Faculty of Electrical Engineering, Universiti Teknologi Malaysia in producing high quality academic writing and recommend ways to solve the problem.

Keywords: academic writing, critical thinking, skill

Introduction

Academic writing is vital for undergraduates undergoing engineering courses. Besides enhancing their writing skills, academic writing will also improve their critical thinking. Writing in the field of engineering requires that the writer must have the engineering knowledge as well as the ability to articulate that knowledge in a crystal clear, precise and systematic manner. Academic writing assignments enabled the students to comprehend what they have learned, enhance their learning skills, assist them to learn in a systematic manner, and improve their analytical as well as critical thinking. Writing can help in attaining technical depth and educational breadth as well as assisting students to think cautiously and enhances the development of logical reasoning (Wheeler, 1997). When students are given
writing tasks related to what they have learned in the class, they have to describe the various theories and processes which are applied in engineering and this alleviate their level of understanding. Many engineering students also do not realize that when they became engineers it is important they have good writing skills in order to describe the work that they have carried out such as in the form of technical reports.

In engineering education, academic writing can be utilized as a tool to enhance students’ engineering and science literacy. Students who study engineering have to undertake research in some form of another. A researcher must always keep asking questions associated with the research, undertake extensive literature review, have a clear cut picture about the problem statement, design suitable experiments, and analyse critically the results which they obtained after carrying out experiments. In order to make sure that all activities will attain its objective the results should be conveyed in a written form which can be verified by those who are competent in that field. This is beneficial for the students as it will them more mature in research activities as well as in their engineering and scientific knowledge (Hesselbach, 2012).

There is a huge gap between writing skills which students learned and practiced at school and the writing skills they gained at the university. At school’s students the writings are much simpler and they write in order to transform knowledge into articles which they can comprehend. Writing at school is also mainly for the students benefit only. On the other hand, at the university level students have to upgrade their writing skills and be more critical. The level of academic writing at university is much more challenging than those at school. They have to produce academic writings which are highly coherent (Wischgoll, 2017). As such it is vital that undergraduate students are trained as early as possible to be mature in academic writing. This aspect is ignored in many universities with the argument that there is not much time to train students to be competent in academic writing since there are so many engineering and technical knowledge to be acquired.

**Literature Review**

Undergraduate engineering students must be trained to have a strong foundation in engineering and are critical in their thinking. One way of harnessing the potential of students is by training them to write research papers or an academic papers. By doing this, they will be able to advance themselves, be a good communicator of ideas and train them to have a critical thinking. However, writing academic papers is not an easy task and it may be the last and probably the toughest skills students learn. (Paulston, 1972)

There are many research and abundant of literatures on academic writing. Those research attempts to elucidate writing employing various strategies. Literatures on academic writing include Wheeler et al (1997), Giltrow et al (2005), Tomaska (2007), Phyllis and Lea (2008), Bamidele et al (2013), Tuomainen (2016), Norris (2016), Ismagulova (2016), Derntl (2014). The current needs to alleviate the level of writing among students have inspired this investigation on academic writing at Teknologi Malaysia (UTM). Students came from various background and as a result there are various and unique issues in academic writing which crop up. This research is a good opportunity to delve into those issues, understand the challenges as well as problems and address it.
In order to enhance writing skills research have shown that it is good to prepare the writers with suitable writing approaches and to assist the writing activity via feedback (Graham, 2006; Nelson and Schunn, 2009; Donker et al., 2014). Suitable writing approaches can assist writers to regulate and amend their endeavour to have a complete grasp on the writing task (Bereiter and Scardamalia, 1987). Feedback is one way of refining writing as it gives vital information on the suitability of the writing product (Graham and Perin, 2007). However sometimes negative feedback can also demotivate writers (Corno and Snow, 1986). To improve writing skills, Kellogg (2008) suggests the use of two methods i.e. acquiring the knowledge of writing through observations and acquiring knowledge of writing by practicing. Both methods supplement each other if they are implemented in the right manner. Braaksma et al. (2004) showed that improvement can be made via cognitive and metacognitive activities such as making assessment and contemplating on the writing tasks. Acquiring knowledge of writing by practicing is the result of observational learning. To reinforce writing skills, Kellogg (2008) suggests that an integration of observational learning and application through lots of exercises and this is implemented by with gradually fading support.

Critical thinking is considered to be one of the most vital barometers of student intellectual quality. Students should have the capacity to explain concepts in a logical and rational manner, be able to elucidate problems including complex problems, and utilize the knowledge that they have learned. Writing can enhance the development of critical thinking skills as it demands an individual to be explicit with his or her ideas and to assess as well as select the required tools for productive discussion. Writing also provide an opportunity to contemplate and think through reasoning and by doing that it could act as a cultivator of higher order thinking.

**Theoretical Framework**

It is important that before students are instructed to complete academic writing assignments, they should be motivated. They should be made to understand that academic writing is not just for the sake of fulfilling the course requirement but it is also in their best interest. When they are self-motivated, they will be passionate and they will undertake any academic writing tasks seriously and exert their upmost effort. This is important because it can be observed that when students are not motivated, they felt that writing is a burden. Hence the quality of writing they produced will be mediocre. For many engineering students, they prefer to focus on technical knowledge and skills and hence it is not surprising that they look at writing with disdain. Some felt that what matters in engineering is simply concepts, design, numbers, formulas, software, hardware etc. As such some felt that having a good academic writing skill is not useful at all. By exposing them to the importance of writing, it will propel them to carry out academic writing tasks seriously and diligently. Some students still have not leave their secondary school mindset including in writing. By entrusting them with academic writing assignments at the university level, they will learn to be mature.

In order for the students to have a holistic picture of academic writing, the students were briefed on what an academic writing is. They were informed that academic writing is unique and should not be confused with other writing tasks such as laboratory reports that they have to do. Engineering journals have an accepted structure which make it slightly easier to write.
comprising the title, abstract, keywords, introduction, literature review, and a general outline of the paper, a methods section detailing the methods used, separate or combined results, discussion and application sections, and a final summary and conclusions (Socolofsky, 2004).

It is important that the students understand that the title of an article is the part that is read first and the most (Derntl, 2014) and as such students must be careful in choosing the appropriate words for the title. There is not much time for readers to scrutinize the whole content of an academic writing and as such the first thing they look for when searching for relevant papers is to refer to the title of the paper. A good title should have the fewest words but sufficiently describe the contents of the paper (Day, 1983) Students should also be trained to summarize the content of the paper in the abstracts section. All relevant information must be placed in abstract which facilitates the potential readers to understand what the paper is all about. The introduction leads the reader from a general subject to a specific area of research. It should also provide information on the latest development in the field. In engineering or scientific papers, the paper body expounds the material and data used for the research, the methodologies utilized to solve the research questions and the results. The paper should be described such that anyone who carries out the research using the same apparatus and material, should be able to reproduce it (Day, 1983). The references section should list out relevant literatures and should include the latest literatures which reflect the writer’s seriousness in monitoring the latest development in the research.

Methodology

As part of the research, in the first semester of the 2017/18 session, fifty-three students from the Faculty of Electrical Engineering, Universiti Teknologi Malaysia, who are studying in the second year of their degree course were given the tasks of carrying out two experiments. The experiments are part of the course ‘Instrumentation and Electrical Measurement’. For some students this is the first time they have the experience of using some of the equipment. One of the experiments is entitled ‘Basic Measurement of Electronic Circuit’ and the other experiment is entitled ‘Resistance Measurements’. These experiments are related to the subjects which they study i.e. Instrumentation and Electrical Measurement. While carrying out the experiments, lecturers monitor the students and assist them whenever needed. Students also can freely discuss with the lecturers concerning the related theories which are applicable to the experiments as well as any problems faced while carrying out the experiments.

Before they began the experiments they have been taught with the concepts and fundamentals related to their experimental work as well as given guidelines on academic journal writing. As such they should not have any significant problem in conducting the experiment as well as linking the knowledge and the applications of their knowledge. Samples of high quality journal articles were also discussed with the students as references. The students have been taught the basics related to the experiments. With the knowledge given to them, they should be able to write the content of the paper. However, since they are new to writing academic journals, they should be familiarized with academic journals and how to organize their ideas in formal written form. They were asked to write two papers describing the experiments they carried out. They have been given guidelines on how to write scientific papers based on the Institute of Electrical and Electronic Engineers (IEEE) format which is one of the most popular format in electrical engineering. The students submitted the papers before the
beginning of the examination week. This is the only course in the second year where students were given the tasks of submitting assignments explaining the experiments they carried out in the form of scientific journal. This is also the first experience for the students in preparing an academic writing in the form of an engineering journal.

In this research, analysis is made on the assignments that the students submitted. Each section i.e. title, abstract, keywords, introduction, materials and methods, result, discussion, conclusions, acknowledgement and references will be scrutinized. The content will also be looked into to observe how the students synthesize the knowledge they have and the experimental results they obtained and described them in a coherent way. The structure and format of the papers will also be observed. The language proficiency of the student when they write the articles is also important. Any possibility of plagiarism will be analysed. The outcome of this observation will be useful as it will be taken into account when teaching other students in the future on writing academic journals.

**Result and Discussion**

The writings prepared by the students were given marks and analysis was carried out on their writings. All students submit their assignments and as a whole the students attempted to write the best journals. Since this is the first time students are required to prepare assignments in the form of academic cum engineering journal is not surprising to find that there are confusion and flaws that should be addressed if the articles are to be considered worthy to be published in the scientific journals. Students are informed about their weaknesses and they responded positively with an open mind stating that they will try to improve.

Analysis of the articles that the students write provided insight into the critical thinking skills of the students changed in response to writing. By writing students can enhance their analysis, evaluation and inference skills. When observing the academic journals that the students write, in the abstract section, the students clearly write the purpose of doing their project. However, some of them do not described the problem statement in which they should identify the problem being solved or the hypothesis being investigated. Most of them briefly described the procedures being used in the experiment. However, most of them do not state the results as well as the conclusions in their abstracts. Concerning the acknowledgement section, one student acknowledges another lecturer who taught the same subject but for the other section. This could possibly be attributed to the fact that the student discusses with students from other sections and copy parts of the articles from other students.

The proficiency of the English language for most articles written by the students are generally moderate except for a student whose language proficiency is very poor. The article can hardly be understood. The terms used were also alien to the terms normally used in Engineering. When the student was asked whether he used the Google translation software in order to write his article. The student admitted that he uses the software saying that the reason he did so was because his computer broke down and he had only three days left before the deadline.

As for the formatting of the article, most of the students used the template based on the IEEE given to them. Two of the students write the articles having one column instead on in one column. They put a front cover page stating that the articles are laboratory reports instead of
journal. Although students have been informed many times about the journal content as well as format and were given the journal template, both students do not comply with the instruction. It seems both are confused because although they described their articles as laboratory reports but the structure of the articles was written based on the journal structure containing sections such as abstract, introduction, measurement setup, acknowledgment, conclusion and references.

Conclusion

The integration of academic writing in engineering programmes can enhance engineering education, improve writing skills and sharpen students’ critical thinking. Results from the observations can be utilized to determine the students’ strength and weaknesses as well as seek ways on how to improve them. Findings from this research will be used to further enhance the students writing and thinking abilities in the future. Students also gained valuable experience and knowledge from the writing tasks given to them.

Acknowledgements

The authors would like to acknowledge the financial assistance and facilities provided by Universiti Teknologi Malaysia under the research grant Dana Pembangunan Pengajaran Vot 4J255 which enabled this research to be conducted.

References


