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Issues and practical solutions in project group writing in the PBL education

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Abstract

In this paper, the problematics of the writing process in undergraduate and master's courses in the context of a problem based learning education are analysed. In this context, writing usually occurs in students' groups. The principle is that students learn together with peers under the supervision of faculty members. In this context, the report is a "tool" which the students used to advance in their learning process and communicate with group members, supervisors and censors.

Despite the main well-recognised advantages of the students' projects in the PBL education context, some recursive pitfalls are encountered by students during the report writing process. These issues can eventually hinder learnings and/or demotivate students. In this paper, it is proposed to tackle these problems by providing students, at the beginning of the project, a clear description of the report section contents and a list of common pitfalls encountered by inexperienced students in the writing process. Additionally it is recommend to provide students with a clear indication of the report assessment criteria. In this way, students are aware of the areas to put their energies on, since the early phases of the project.

To summarize, based on the experience described in this paper, it can be stated that successful learning requires that the supervisor acts both as an academic expert, which provides written and verbal guidance. While PBL education system gives more freedom of initiative to the students compared to other education systems, the student guidelines, which are recommended in this study, can be considered not so invasive and can result beneficial to the student learnings.

Keywords: Academic writing, Peer learning, Writing groups

Type of contribution: PBL best practice paper

1 Introduction

Improving the quality of the student report influences the quality of writer's thought and helps the readers to better grasp the report content (Gopen and Swan, 1990). Effort and focus should be put by both supervisors and students to make sure that the writing process fulfils these objectives while respecting all academic standards.

In the engineering field, the IMRaD format (Introduction, Method, Results, and Discussion) has emerged as the standard template for scientific writing. This format is useful for the readers that will easily find well-organized information. The IMRaD format is also beneficial to students as they can follow a document structure that can help organizing their learnings.

Project- and problem- based learning has become a popular teaching method in many higher education institutions across the world as it promotes a learning style where students can actively engage in a real work project (Graaff and Kolmos, 2003). Differently from subject oriented project work, the problem

based work is characterised by the development a coherent analysis focused on specific research problem (Olsen and Pedersen, 2005). The problem work requires to formulate specific questions, to solve the problem and draw well-documented conclusions. Generally the project problem is defined by the students in dialogue with the supervisors (Dahl, 2018). At Aalborg University, during the engineering education, students carry out several projects in cooperation with researchers, industry partners and technicians to develop experimental and/or numerical activities. While exposed to this research environment, it comes natural for them to read scientific papers and develop the craft of research.

In the PBL context, the report writing during group projects is executed during an extended period of time in which the students develop their knowledge. In this context, the risk is that new and old information can be provided without uniformity. Additionally the work is carried out by several students causing inconsistency between different writing styles, nomenclatures and different language abilities. These leads to recurrent mistakes in the students reports especially among inexperienced students. Another major issue identified during the writing process is the students inability to describe the problem, to support it with previous studies and finally to draw sound conclusions and critical analysis of the project results. It becomes crucial in this context, the development of skills for giving and receiving feedback and critiquing others' work during cooperation among peers and supervisors.

In the paper, it is examined how we can improve students report writing during group work in the context of a PBL engineering education. The analysis can be considered applied to students that do not have yet reached a significant level of maturity in teamwork and reporting. The paper starts describing a common format for report writing in the PBL engineering education after the list of the main pitfalls in each sections is reported. Finally, it is proposed and analyse an assessment strategy, which can increase the motivation of students and ultimately improve their learning process.

2 Method

Some common pitfalls and mistakes can be identified during the students report writing. To tackle this problem, it is proposed to identify the main recursive pitfalls in report writing. It is also considered the possibility to describe in more details the content of each section of the project report. The IMRaD format is considered as a reference for this study because it is already the *de facto* standard in the engineering field. The report writing process is to be considered in the context of PBL engineering education where students are requested to solve a real and meaningful problem over the period of the project in cooperation with academic supervisors and industry partners.

As a solution to the problem, it is also proposed to improve the project report assessment by providing the students, clear indications on how the project will be evaluated. After, the limits and implications of this approach are discussed.

3 Results

The general report structure of a PBL Report format is similar to the IMRaD format. Figure 1 shows a comparison between the two formats. For the IMRaD format structure and contents of each section, several guidelines are available (Manterola *et al.*, 2007; Gastel and Gastel, 2013). PBL format provided in (Olsen and Pedersen, 2005) Chp.14 is a used as a reference in this study.

It is important to point out that the IMRaD and PBL report formats have developed independently in different context. According to (Meadows, 1985), the IMRad report format has been defined over the time in an evolutionary process where authors have described the typical steps of a scientific investigation in a linear manner. The PBL report format, on the other hand, has not been "officially" defined, although some requirements are usually demanded. For instance, it is important for the students to formulate specific problem questions. On the other hand, a throughout literature review of the state of the art of the

technology as seen in scientific papers may be necessary. PBL report format provided in (Olsen and Pedersen, 2005) defined three main sections for the format.

From the figure, it comes evident that the IMRaD format has a higher number of sections. In particular, the analysis section of the PBL format is divided in three subsections i.e. methodology, results and discussion. The IMRaD format has a more clear division of the information reported in each section whereas the PBL format leave more freedom to students on the content organization in the analysis section.

PBL format	IMRaD
Introduction	Introduction
Analysis	Methodology
	Results
	Discussion
Conclusions	Conclusion

Figure 1: Comparison between the IMRaD format and the PBL report format described in (Olsen and Pedersen, 2005) Chp.14.

3.1 Description and common pitfalls of each reportsection

In this section, it is provided a brief description of each section of the report according to the IMRaD format. Additionally, based on the author teaching experience, the main pitfalls encountered by students groups in the writing of the project report are pointed out. The intent is to give to students clear guidelines at the beginning of the project.

Abstract	
Contents	**Common pitfalls**
• The abstract stands alone and includes the main sections of the report: Background, Methods, Results, and Conclusions. • In the abstract, only specific and quantitative results should be included.	• *Provide vague and not specific information on the project results.* • *The background section is disproportionally long compared to the other sections.*

Introduction "Why the project was done?"	
Contents	**Common pitfalls**
The introduction should be organized as follow: • Background of the study with relevant literature. • "Problem statement" and "main questions" to be addressed in the study.	• *Missing relevant and authoritative references from literature.* Forming a good understanding of the problem background can be bypassed, for instance if the project supervisor has already given specific indication on the problem to be addressed in the project and students

• Brief description of the structure of the report.	may find unnecessary to spend the time studying the relevant state-of-the-art papers. In some cases, students may believe that a background problem analysis can be a waste of time and it is better to spend the time producing more results. • *Missing work context.* This can happen when the students have not clear the connections with previous work or with state of the art. In this case, the writers leaves the readers with ambiguity and difficulties to understand the context of the project. • *The problem statement is not clear and specific*. It is likely that the problem cannot be formulated in details at the beginning of the project. Nevertheless, it is important that the students re-formulate the problem statement and research question thought the project. This exercise has the effect to keep the team in focus. • *The problem is not formulated in the early phase of the project.* In this case, time can be wasted on irrelevant tasks and activities that do not provide value to the projects.

Method "How was the study done?"	
Contents	**Common pitfalls**
• Assumptions of the study. • Accurate description of the model and/or experiments supported by relevant references and all the input necessary to solve the problem.	• *Missing important assumption, information and data that hinder the possibility to reproduce the work described in the report.* In this case, the reader, which is not aware of the details of the project, may find difficult to get the clear picture of the study.

Results "What it was found?**"**	
Contents	**Common pitfalls**
This section provides the description of the study findings that match the problem statement and research questions. In an engineering report, this section generally includes figures and tables that were produced during the study. Each result should be specifically commented with reference to	• *Missing description of crucial data and information.* In some cases, it is impossible for the reader to assess the validity of the results because crucial data are missing in this section. This mistake is quite common because it requires a lot of experience to identify which information should be included in the report and which can be considered not critical to

theories described in the methodology section.	form a deep understanding of the results. In a project that requires inputs from several students, it is more likely that this will happen as different students have different understanding of the subject and write different parts of the document.

Discussion "What is the study relevance?"	
Contents	**Common pitfalls**
This section should offer a broader elaboration of the single results shown in the previous section with connections between each of them as well as with other results from literature. Analytical insights, implications and the limits of the study should be commented in this section.	• *The section is completely omitted.* In some cases, it can be perceived that the project ends with the results. The writer may find sufficient to state something such as: "the results agree with the work available in open literature".

Conclusion "What are the major findings?"	
Contents	**Common pitfalls**
• Summary of the purpose of the study. • Conclusions of the study that match the research questions provided in the introduction section. The conclusions should briefly include all the study results. • Future directions.	• *Missing conclusion.* In same rare cases, students may think that conclusion are included in the results question. • *Conclusion are not well aligned with the research problem.* Readers want to see conclusions that are well connected to problem questions.

Reference List	
Contents	**Common pitfalls**
• List of articles, books and website used as a source material for the study.	• *Some key information, facts and figures are not referenced.* This can be problematic because it leaves the reader with a sense of ambiguity. • *The used reference are not authoritative.* Generally peer reviewed articles in well-recognized journals can be considered authoritative. Similar criteria should be applied to books and website.

3.2 Assessment

As suggested by (Race, 2014), it is widely accepted that the assessment is major driver for students learning and therefore if the assessment process is not done properly, it can demotivate the students or even hinder the effectiveness of the learning process. Students unfortunately often perceive the report marking criteria

as not clear. This can be particularly true if the criteria is not directly communicated to the students. Other times, it happens that students come from different academic background and they are not used to the new learning model. In this context, it is important to make the assessment transparent to students so that they are made aware of the basis on which the assessment of their work ismade.

To solve this problem, a grading checklist similar to the one proposed by Felder and Brent, 2010 can be provided to the students. In this way, the students can get an idea of the criteria by which their report will be assessed since an early stage. Technical content, organization and presentation are the three major levels that the students should improve and keep under control during the writing process. A List of levels for the evaluation is provided below. A weight can be attributed to each level; in this case, the technical content is the one which is considered the most important.

- *Technical content (60%)*
    - Clear introduction and background
    - Good knowledge of the subject
    - Clear model description
    - Scientific soundness of results
    - Conclusions are aligned with problem statement and research questions
- *Organization (10%)*
    - The document included all the sections in the IMRaD format
    - There are good transitions and connections between sections
- *Presentation (30%)*
    - Grammar and syntax, easy to read and clear language
    - Document formatting, quality of the figures and tables
    - Visual consistency across the document

4 Discussion

In the paper, it is suggested that providing explicit written guidelines can help students producing more scientifically sound results. During the dialogue with peers and supervisors many of the points suggested in this paper are discussed, some points may be considered common sense and in other cases, there is not enough time during the meeting to provide accurate description about the report contents and assessment.

An advantage of the suggested approach is that it will avoid situations in which there is ambiguity or lack of clarity, however some limits in this approach can be expected. First, novice students will need to work at different levels, this can be very demanding and cause high cognitive load with the risk that the students will experience other problems. Additionally, the rigorous working framework provided by the report guidelines may hinder the creative approach required by the problem solving.

5 Conclusion

Students go through same pitfalls and mistakes when facing project report writing. This could happen especially to inexperienced students in undergraduate and master's courses when they are still learning competencies such as teamwork and report writing.

Two main strategies are suggested to avoid these issues. The first strategy consists in providing the students with clear indications of the report sections with contents and common pitfalls. The second is to inform students with the assessment criteria of the project report since the early phases of theproject.

While the PBL system leaves more freedom for initiative to students, the directions suggested in this article can become beneficial to them, increase their output and overall their learning experience.

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