# Students' Difficulties in Biology and Geology Project Work, in Portuguese Secondary Education

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## Abstract

*Project Work, a student-centred methodology, involves several phases from the definition of the research question to the evaluation of the project. This is not an easy methodology to use with secondary school students as they are more familiar with teacher-centred approaches, which tend to lead to a more passive learning style. The main goal of this study was to identify the students' difficulties during the different phases of project work. It was conducted with a 10th year Biology and Geology class consisting of 18 students, 5 boys and 13 girls, with ages between 15 and 16, in a school in the district of Coimbra, in Central Portugal. The subject area being studied was the interactions amongst geological substratum, soils and soil organisms. The students carried out field and laboratory work and the results were presented in three meetings for young scientists. At the end of the project, the students filled in a questionnaire that evaluated nine project work phases using a five-point response scale ranging from "very easy" to "very difficult". The phase identified as the most difficult was "Organization of Information" followed by "Search for Information", while the easiest was "Group Organization" and "Collaborative Work". The results revealed that students had difficulties with searching and organizing information. This is possibly due to students not being careful with the quality of both the information and the sources, but may also be because of their lack of practise in writing and producing texts.*

## 1. Introduction

Project work is a student-centred methodology, where students are actively involved in their own learning process. In project work, students have to define a research question that will be analysed and discussed using different approaches in order to obtain an answer. Project work is an intentional and original activity with a specific goal that promotes the development of skills, such as autonomy, initiative, creativity, critical thought and collaboration as it involves group work. However, it can generate complexity and uncertainty among participants. Project work is characterized by the creation of an end-product, for instance a presentation, an abstract, a poster or a three-dimensional model. Project work also has a social approach, as a result of teamwork [6].

Project work is an important learning process in the curricula of primary and secondary Portuguese education. From 2001 until 2010 the curriculum included, among other subjects, a non-subject called "Área de Projecto-Project Area" [3; 4]. In Project Area, students carried out collaborative projects, using the project work methodology [2; 10]. Project work can also be applied in different subjects [11] and in an extracurricular context [8; 9]. Nevertheless, this is not an easy methodology to use and requires more time to be implemented than others, special for young learners [6]. Furthermore, secondary school students are more familiar with teacher-centred approaches, which tend to lead to a more passive learning style. This study aims to identify the students' difficulties during the different phases of the project work.

## 2. Methodology

This study was carried out in a 135-minute once a week 10th year Biology and Geology class, with 18 students, 5 boys and 13 girls, aged between 15 and 16, during the 2010-2011 school year. The students were organized into four groups, according to their interests and friendships. In order to identify the students' difficulties, we selected nine phases for assessment, based on their own project work: 1) group organization; 2) research question definition; 3) search for information; 4) organization of information; 5) strategy selection; 6) project implementation; 7) data analysis; 8) end- product presentation; 9) collaborative work. At the end of the project, the students filled in a questionnaire in which they assessed each phase using a five-point response scale ranging from "very easy" to "very difficult". The results are also compared with the observations of the teacher during the development of the project work.

## 3. Results and discussion

Based on the results of the questionnaire, we calculated the mean and the standard deviation. The highest mean reveals the most difficult phase, while the lowest mean revels the easiest phase. The standard deviation shows the dispersion of a set of data from its mean. The students' evaluation of the project work phases, the mean (M) and the standard deviation (SD), calculated for each phase, are presented in Table 1.

Table 1. Students' evaluation of the project work phases and the mean±standard deviation (SD) values.

| Assessment* Project phase | 1 | 2 | 3 | 4 | 5 | Mean ± SD |
|---|---|---|---|---|---|---|
| Group organization | 5** | 7 | 2 | 3 | 1 | 2.3 ± 1.2 |
| Research question definition | | 7 | 7 | 4 | | 2.8±0.8 |
| Search for information | | 8 | 4 | 6 | | 2.9±0.9 |
| Organization of information | | 3 | 11 | 4 | | 3.1±0.6 |
| Strategy definition | | 8 | 8 | 1 | 1 | 2.7±0.8 |
| Project implementation | | 11 | 3 | 3 | 1 | 2.7±0.9 |
| Data analysis | | 7 | 8 | 3 | | 2.8±0.7 |
| End-produced Presentation | 1 | 9 | 5 | 3 | | 2.6±0.8 |
| Collaborative work | 6 | 7 | 1 | 4 | | 2.2±1.1 |

* Scale: 1 - very easy to 5 - very difficult

**- Number of answers

The phase with the highest mean (M = 3.1) was *Organization of Information* that and it also presented the lowest standard deviation (SD = 0.6), which revealed an agreement among students. Another difficult phase was *Search of Information* (M = 2.9; SD = 0.8). As was observed by the Project work teacher, this is because students have difficulties in finding relevant information on the Internet. The organization of the information can be difficult for young students and frequently can lead to Internet plagiarism phenomena. There are several aspects that could contribute to these phenomena such as: the highly accessible nature of internet information, websites without the author's name or a lack of knowledge and clarity on the issue of citing internet sources [1]. For Scanlon & Neumann [12] "What is not yet as clear is how these technologies [Internet] are shaping a new generation of students'

conception of what does and does not constitute fair use of the countless texts so readily available at their desktops." (p. 383). Nevertheless, it is essential to "teach them how to cite internet sources properly and (…) explain the importance of protecting intellectual property rights." (p. 34) [1]. In a study, with Portuguese elementary school teachers, about the conceptualization of the Project Area and the purposes of its implementation, the teachers pointed out as strengths, the development of initiative, creativity, communication, teamwork and critical thinking. However, about the difficulties of the implementation of Project Area, teachers report, among other things, the inability of students to search for information [13]. Another difficulty, as was observed by the Project work teacher, is related with oral and written communication in Science. When making the projects' end products, students still need to develop skills to communicate the results in the form of an abstract and/or a poster.

The phases which involved teamwork were the least difficult for the students: Collaborative work (M = 2.2; SD = 1.1) and Group organization (M = 2.3; SD = 1.2). In both phases, the majority of the students found it very easy or easy, but some found it difficult (table 1). In order to calculate if there exists a significant difference between the highest and the lowest mean, a two-sample t-test for unequal variance and equal sample size was conducted. The highest mean ($\mu = 3.056$; $\sigma^2 = 0.408$) was compared with lowest mean ($\mu = 2.167$; $\sigma^2 = 0.408$) and there is a significant difference between them ($p = 0.008$; $t = 2.866$; $t_0 = 2.052$).

Working in teams requires an effective collaboration between all members and sometimes this harmony is not possible, as was observed by the Project work teacher. For this reason, the organization of the groups can lead to conflict and difficulties, even when the students have organized their own groups. This discrepancy among students in relation to teamwork was also detected in a study with Portuguese higher education students. "Relationship problems between group members and their natural conflicts were recorded for most students, but differently. Some saw this as a disadvantage and others as a valuable learning." (p. 1796) [7]. Another study, with Portuguese primary school teachers and their students, revealed that group work is one of the most widely used learning strategies by both teachers and students, however, "(...) it is necessary for teachers to have more in-service education on how to develop it best." (p. 449) [5] was emphasised. Although group work still remains a difficulty for some Portuguese students, at different educational levels, this collaborative learning strategy should be encouraged as it stimulates critical thinking and contributes to prepare them for modern citizenship and work.

## 4. Conclusions

This study revealed that the main difficulties in project work are not related with its nature, but with the skills common to other learning processes. One of these difficulties is related with researching information (searching and organizing information). This is probably due to the fact that students are not careful with the quality of both the information and the sources and, also, due to their lack of practice writing and producing scientific texts. The literature also mentions the nature of Internet information as a possible cause for the difficulties with internet research, which include high accessibility and the lack of author's name explicit in websites. The phase identified as the least difficult was *Collaborative Work*. Most of the participants classify this phase as "easy" or "very easy". The results are in accordance with other studies conducted with Portuguese students and show that collaborative teamwork skills still needs to be developed in Portuguese Education in order to successfully perform group work.

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## References

[1] Baruchson-Arbib, S. & Yaari, E. (2006). Printed Versus Internet Plagiarism: A Study of Students' Perception. International Journal of Information Ethics, 1 (06), 29-35.

[2] Correia, G. & Gomes, C. (2009). Estudos ambientais na Área de Projecto do 12º ano de escolaridade: uma aplicação prática. XIII Encontro Nacional de Educação em Ciências, Castelo Branco, 836-848.

[3] Decree-Law 6/2001. Republic Daily, no. 15, series I-A, 2001, January 18.

[4] Decree-Law 7/2001. Republic Daily no. 15, series I-A, 2001, January 18.

[5] Freitas, M. & Solé, M. (2004). Experiencing citizenship primary classrooms. In A. Ross (Eds.). The experience of citizenship (443-450). London: CiCe.

[6] Kolmos, A., Kuru, S., Hansen, H., Eskil, T., Podesta, L., Fink, F., Graaff, E., Wolff, J. & Soylu, A. (2007). Problem Based Learning. TREE – Teaching and Research in Engineering in Europe Special Interest Group B5, "Problem based and project oriented learning".

[7] Lima, R., Carvalho, D., Flores, M. & Hattum, N. (2005). Ensino/aprendizagem por projecto: balanço de uma experiência na universidade do Minho. In B. D. Silva & L. S. Almeida, (Eds.). Actas do VIII Congresso Galaico-Português de Psicopedagogia (1787-1798). Braga: Centro de Investigação em Educação do Instituto de Educação e Psicologia da Universidade do Minho.

[8] Pires, E., Gomes, C. & Pereira, A. (2009). Actividades extra-curriculares – um projecto ganho. XIII Encontro Nacional de Educação em Ciências, Castelo Branco, 584-594.

[9] Rocha, A., Maia, M., Gomes, C. & Pereira, A. (2009). Actividades práticas em contexto extracurricular com alunos do 9º ano de escolaridade. XIII Encontro Nacional de Educação em Ciências, Castelo Branco, 595-603.

[10] Rola, A. & Gomes, C. (2010). O trabalho de projecto em Geologia. Um estudo de avaliação com alunos do 7º ano de escolaridade. e-Terra, 15 (30), 1-4. XIII Congresso Nacional de Geologia, Braga. Retrieved from http://metododirecto.pt/CNG2010/index.php/vol/article/viewFile/58/169

[11] Rola, A, Gomes, C. & Abrantes, I. (2011). Apresentação do trabalho de projecto "Interacções entre a geosfera e a biosfera. Um estudo com solos da vila da Lousã. Revista Nova Ágora, IIª Série, 2, p. 11.

[12] Scanlon, P. & Neumann, D. (2002). Internet plagiarism among college students. Journal of College Student Development, 43 (3), 374-385.

[13] Sampaio, P. (2008). Repensar a Área de Projecto. Revista Noesis Online. Retrieved from http://www.dgidc.minedu.pt/revista_noesis/Documents/artigos_teoricos/RepensaraareadeProject.pdf