

THE WORLD SHALL NOT FORGET MARIANA'S ENVIRONMENTAL DISASTER

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ABSTRACT

The following paper draws on the aftermath of Mariana's mudslide disaster in order to design an integrating project between several subjects for a class of high school learners. The project makes use of Project Based Learning (PBL) and interdisciplinarity to promote collaborative and student-centered learning, to propose innovative approaches to teaching in light of the 21st century education needs, to uphold changes in the educational field through different methodologies, and to foster teaching as the scenario for critical citizenship. Multiple products are envisioned as outcomes for this proposal, designing websites, mobile apps, to name a few. That said, it is our belief that integrating projects are part the 21st century education methodologies and approaches. And though they may seem laborious they are here to stay and solve complex issues that modernity brings to the world. Several interfaces are brought together in the construction of potential solutions and a better world. Addressing matters such as Mariana's disaster through the lens of PBL and interdisciplinarity is part of a *sine qua non* condition for upbringing a critical and aware citizen.

Keywords: project based learning; interdisciplinarity; Mariana mudslide; integrating courses.

1. INTRODUCTION

The contextualization in connection with interdisciplinarity are key to the learning process [7]. The community's reality can and should be used by educators in order to create an attractive learning environment which is closer to the student's circumstance. Faced with this, it is important to know the community's economic and social reality where the school is located. Some themes can be used to get closer to the school's circumstances, and when you have a major event taking place in the community, it conveys as a great opportunity to learn and create a learning environment, namely, local folkloric parties, any major changes in the regional economy (settling of a production plant or its exit), natural phenomena and also environmental disasters, what we address here. Environmental disasters provide a profitable discussion in various areas of knowledge, from Biology and Chemistry to moral philosophy discussions.

In 2015, an environmental disaster took place in the city of Mariana (MG), Brazil [3]: the breaking of a waste mining dam

(Fundão Dam), owned by SAMARCO and which completely destroyed the community of Bento Rodrigues and polluted all the Rio Doce Basin, which flows in 230 municipalities through the states of Minas Gerais (MG) and Espírito Santo (ES). The disaster also caused impacts on a wide range of sea, near the mouth of Rio Doce [1,2]. Rio Doce had a great biodiversity, it also sustained the economy of several bordering municipalities and indigenous communities.

The impact was too vast in environmental, economic and social aspects, since 18 people died, 800 people lost their homes and for a few months the inhabitants of the basin area could not drink the water in the region [6,8]. Not to mention the fact that all of those who lived from fishing and agriculture lost their income source. Additionally, the mudslide caused great turbidity in the water, killing fish by asphyxia [4], and affecting 71 species of fish [5].

While addressing the aftermath of Mariana as a disaster, as educators we must also raise awareness to such problematic and its direct and indirect consequences, let alone that it is also possible to elicit future actions that may act as preventing measures which may help maintain the environment safer. That said, we address how Mariana's disaster will be dealt with in the school as a PBL issue.

According to Phillipi [9], the need for new methodologies and approaches will evoke changes and transformation in the scientific and technological fields, and we must add the educational field as well in the scope.

With that in mind, and through Project Based Learning (PBL), here pinpointed as an effective methodology that brings together collaborative work towards a final engaging product to be developed by the learners, the disaster is recovered through new lens and envisioned with profitable educational results for the future generations to be aware of.

Despite the fact that the PBL methodology was initially carried out in the 16th century, when the first educational movements related to engineering and architecture appeared, it has not presented itself as a main strategy in learning and teaching processes in our classrooms, and this may be due to the historical positioning of a teacher-centered classroom that many teachers are led to take. In light of this, and considering that the school presents itself with a relevant role in the learner's critical upbringing as a citizen, this project aims at rekindling the discussion on Mariana's disaster and allowing for a better understanding, within all of its dimensions (environmental, geographical, social, economic and political) in such a way that

the disaster will not be forgotten. Furthermore, this project draws on former research and an interdisciplinary approach in order to:

- identify and analyze potential causes that led to the tragedy, as well as the environmental and social consequences, considering interdisciplinarity and understanding the disaster's scale;
- understand social, political and economic aspects related to the tragedy;
- sensitize the community around the school and the general population in relation to the disaster through collective actions that include social networking and wide dissemination;
- reflect upon each citizen's role, companies, social movements and other organizations in terms of controlling, following up and collecting actions along with the responsible body, not only in terms of the tragedy but also in terms of other environmental disasters and public contracts.

2. METHODOLOGY

The project will begin with its questioning aiming at promoting a better understanding of the tragedy, its potential causes, consequences, unfolding actions in the aftermath, and so on.

The following question will lead the common thread: "what can we do in order to alert the population in a way that this tragedy shall not be forgotten or even so that a tragedy like this shall not be repeated?".

Initially, we will start with the "Questioning Week", when the students will take part of some specific activities to know the problem and to build the basis for discussion and development of the project, namely: watching documentaries about the disaster; taking part in round tables with subjects who are directly or indirectly connected to the disaster, such as researchers, water specialists, local inhabitants affected by the mudslide and a company employee; discussing how the tragedy has affected the community in terms of environmental, social, economic and political problems; and brainstorming potential courses of action to be invested in the near future as projects. The Questioning Week is also known as the "kick off", since it is during this moment that projects are going to be unfolded by the learners.

The following actions are also part of the project: the class will be divided into 08 groups and each group will be mediated by a facilitator/tutor/teacher. In the beginning, the tutor will aid learners in the process of elaboration and setting up a timetable which may be altered whenever necessary as the project unfolds.

Groups will gather weekly (i.e. Weekly Scrum Meeting). As for the facilitator/tutor/teacher, s/he will gather with the group every fortnight in order to share their mentees' feedback and then gather with the other facilitator/tutor/teacher, discuss problems and solutions and plan theoretical and practical approaches that may be needed over the next course of weeks.

The applied methodology will be based on Scrum due to its unfolding techniques in terms of practicality while dealing with group work and final project outcomes. Even though Scrum was designed for car factories, it is nowadays a better adapted methodology for managing and planning software, and it also allows for group (re)organization, managing and problem solving techniques, viable features in interdisciplinary projects that need constant review, rethinking and rearrangements in order to

comply with unexpected issues that may arise from the project's core.

It is paramount to emphasize that the project will be Scrum-based due to the fact that not all of its methodology will be used, but just some featuring roles that are relevant to raise students' awareness to managerial situations, for instance: to make them able to perform group tasks and to perform student-centered activities, to name a few.

The coordinator will represent the product owner, and therefore present the products options on the kickoff. The students will be part of the development team, and for that to be successful it is important that each group has learners with different skills in order to mingle their expertise towards their final product. There will also be the Scrum master character, a student who will keep the team going, making sure the tasks are kept on schedule and who may report to the facilitator/tutor/teacher if any major issue is to come up. It is important to mention that the Scrum master will not be the same during the production period and that this position will be switched after one or two weeks, so each and every project participant can be responsible for the project at one time and see and assist it through a different standpoint. The facilitator/tutor/teacher will be the person responsible for ensuring the task achievement in its narrow and broader scopes - from the theoretical point of view up to social or conceptual disagreements that the group may eventually face, s/he will be aiding the group in solving such demands.

Each group will choose a final product from the following list: website; folder; flipchart; organizing a cultural display in town; coming up with an open letter to the Brazilian society which must be translated into English so the world knows more about the disaster, the same group shall also organize an event to present the letter to society; design of a Facebook page to raise awareness about the problem and its potential solutions; organize either a play or a music festivity that has the tragedy as its theme; a memorial; a collaborative mobile app that will identify affected inhabitants that may want to contribute with information; or a diorama. Moreover, if any idea different from the above mentioned are brought to light, it might also be added to the list and carried out by one of the groups who have suggested. To sum up, developing products as the ones previously listed encourage learning and teaching practices while developing resources not only focused in the classroom but also in the community, let alone evoking integrating practices that can potentially be used as examples in other institutions.

The list will be made available at the School's website one week before the kickoff. According to the project participants' interests - teachers, learners and inhabitants - there will also be the possibility of designing and publishing academic papers based on the research, projects and experiences, which may either be written in Portuguese or in English.

All projects will be submitted to the Ethics Committee on Research on Human Beings through Plataforma Brasil at the end of the first month, right after the kickoff, which will happen during Week 1.

School facilities and resources will be approached in the following section.

2.1. Work atmosphere & resources

Classrooms will be served with shuttle tables allowing for group and individual work; overhead projector; chemical and biological test laboratories for analyzing the following: water, soil, and flora and fauna microbiologically affected; projection screens; computers; web conference rooms; microphones; speakers; high

speed Wi-Fi; dry-erase board wall; magnetic whiteboard; flipchart; compact and mobile panels that allow for group divisions in the same room and pitching projects; suspended microphones; couches and small coffee tables.

2.2. Schedule

Table 1. Timetable in order to approach PBL

Week	Day	Activity
01	01	Reception / Documentary about Mariana's Disaster.
	02	"Round Table" about the theme.
	03	Application method: "world cafe problems"
	04	Meeting with local inhabitants affected by the tragedy
	05	Brainstorming session with 3rd year Informatics course students and Chemistry and Biology teachers from the affected areas
02	-	- Weekly meeting with each group and its Scrum Master - Meeting between teachers and Scrum Masters
03	-	- Weekly meeting with each group and its Scrum Master
04	-	- Weekly meeting with each group and its Scrum Master - Meeting between teachers and Scrum Masters
05	-	- Weekly meeting with each group and its Scrum Master - Meeting with Chemistry and Biology teachers from the affected areas (by videoconference)
06	-	- Weekly meeting with each group and its Scrum Master - Meeting between teachers and Scrum Masters
07	-	- Weekly meeting with each group and its Scrum Master
08	-	- Weekly meeting with each group and its Scrum Master - Meeting between teachers and Scrum Masters
09	-	- Weekly meeting with each group and its Scrum Master
10	-	- Weekly meeting with each group and its Scrum Master - Meeting between teachers and Scrum Masters
11	-	- Weekly meeting with each group and its Scrum Master - Meeting with Chemistry and Biology teachers from the affected areas (by videoconference)
12	-	- Weekly meeting with each group and its Scrum Master - Meeting between teachers and Scrum Masters
13	-	- Weekly meeting with each group and its Scrum Master

14	-	- Weekly meeting with each group and its Scrum Master - Meeting between teachers and Scrum Masters
15	-	- Finalizing activities
16	-	- Final products pitching - Online questionnaire for project assessment
17	-	- Portfolio + self-assessment

Activities will be closely monitored by teachers attending the project, who will also meet every fortnight to discuss unfolding developments and potential remedial actions for issues that may arise.

2.3. Assessment

Assessment is also part of this project since it allows for a better view and future actions, not only regarding the project *per se* but also learners' knowledge production. Nevertheless, assessment procedures will involve more than testing since they will be a combination of learners own view of the whole process and the community's view. The former will draw on the design of a portfolio, in which learners are going to insert descriptions, verbal or non-verbal, concerning their experience with the PBL project and their final product, already mentioned under the methodology section of this paper; while the latter will be based on the outcomes that arrives from a Google Form made available during an Expo, in which the final products are going to be brought to presentation. The portfolio may be physical or created on websites as blogs. In the absence of internet access, visitors will also be able to answer the very same survey available in paper for distribution. Therefore, learners will be assessed as follows: Portfolio and Product-client assessment at the Expo. The project will be appraised through this survey for all participants, from learners to teachers and invited guests, such as the local inhabitants. The assessment will be carried out during Mariana Expo and the best voted project will achieve a visit to Ouro Preto's museums, a nearby city in Minas Gerais State, as the prize. And as for the grading, the achieved grade (A, A+, A-, B, B+, B-, C and Fail) will be used in all the courses engaged in the project.

3. EXPECTED RESULTS

It is our belief that integrating projects are part of the 21st century education methodologies and approaches. And though they may seem laborious they are here to stay and solve complex issues that modernity brings to the world. Several interfaces are brought together in the construction of potential solutions and a better world. Addressing matters such as Mariana's disaster through the lens of PBL and interdisciplinarity is part of a *sine qua non* condition for upbringing a critical and aware citizen. Discussions fostered by this theme may develop an essential role so that the community seeks a wider participation from the involved companies and its representations in decision-making matters that may have direct impact over the city and its surroundings.

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