An International Collaboration to Promote Inquiry-based Learning in Undergraduate Engineering Classrooms

[1]D'Arcy C. Randall, [1]Christy Moore, [2,3]Isabel S. Carvalho
The University of Texas at Austin, USA, darcyr@mail.utexas.edu; christym@mail.utexas.edu [1];
ISEL, Lisbon, Portugal, icarvalho@moonlight.pt [2]
IDMEC/FEUP, Porto, Portugal[3]

Abstract

Theorists such as Bransford et al. argue that twenty-first century educators need to teach students to do more than simply remember and repeat information. Engineering educators Prince and Felder critique traditional methods of teaching in which instructors focus on mathematics and theory, but fail to convey practical applications of that knowledge. They advocate moving students to a higher level of learning - past the stage of memorizing and reciting data - to more sophisticated methods of analysis, synthesis, and application of knowledge. To enact such transformations, Prince and Felder recommend "inductive teaching methods," including "inquiry-based learning," in which students learn through engaging with challenges and a series of questions. The purpose of this paper is to describe specific techniques of "inquiry-based learning" employed by three instructors in Engineering schools, one in Europe and two in the USA. The paper provides examples of inquiry-based learning activities from each of the authors. The paper then discusses the cross-pollination of ideas and describes how the authors have shared inquiry-based teaching strategies and collaborated to develop new and relevant assignments and approaches to teaching.

1. Introduction

The three authors of this paper met at an Engineering Education conference in Budapest, Hungary. While perusing the posters, one author laughed out loud. Curious, another author asked what was so funny, and the first pointed out the multiple posters featuring Venn diagrams showing the intersection of three sets. It was as if our colleagues—hundreds of engineering educators from six continents—had attended the same school, in which we absorbed Venn diagrams as a common language. In one way, the laugh has turned out to be on us, for this paper results from a three-way international collaboration reminiscent of the infamous Venn diagram. Yet what the diagram does not convey is the dynamic quality of that collaboration, a dynamism that springs from our shared interest in "inquiry-based teaching and learning" [1].

Inquiry-based teaching encourages students to learn through engaging with challenges and a series of questions. As Bateman [1] puts it, "The job is to teach students how to think, not what to think" (p. 197). Contemporary "inquiry-based" methods frequently draw from theory by Bransford et al., who argue that educators need to teach students, among other things, to examine their previous knowledge before building on it. Students should be aware of their knowledge, and its limits [2]. In the field of engineering education, Prince and Felder include inquiry-based teaching under the broader umbrella of "inductive teaching methods," which they advocate to move students to a higher level of learning - past the stage of memorizing and

reciting data - to the level of analyzing problems, synthesizing information, and applying what they learn in other situations and contexts [3, 4].

Science and engineering students, however, face particular challenges in inquiry-based learning. Edelson et al. list two of these challenges as (i) the development of "background knowledge" and (ii) the ability to sustain "extended activities," such as complex research problems. They recommend that teachers establish a "meaningful context" to motivate students; teachers can also design "staging activities," a series of activities that enable students to gain the background and motivation that they need to address the complex problems [5].

The purpose of this paper is to describe specific techniques of inquiry-based learning employed by the three authors who teach in Engineering schools. One professor, Isabel Carvalho, is based in Europe; the other two, D'Arcy Randall and Christy Moore, are based in the USA. The second purpose is to show how these techniques can be replicated and transferred to different contexts. Randall and Moore have worked together for over a decade and regularly consult with each other about teaching methods, assignments, and learning objectives. When these two professors began teaching a study abroad course in Spain, Carvalho advised them on techniques for introducing topics of global significance that will engage students. Her experience using similar topics in her own courses and her perspective as a European professor made her an invaluable colleague.

The paper describes the cross-pollination of ideas on the use of inquiry-based learning. It first provides examples of learning activities all of the authors use to help students manage a major research project. Next, it shows how the three collaborated to cross-adapt specific assignments for different kinds of classes. Two of the assignments are also discussed in Carvalho and Moore [6]; however, here the authors focus on different dimensions of the assignments. This work provides evidence of critical thinking among teachers striving to promote critical thinking among learners.

2. Individual Assignments

This section describes distinct research assignments integrating "inquiry-based learning" techniques; namely, Randall's undergraduate research projects in Engineering Communications, Moore's teaching on locating and evaluating credible sources for an academic research project, and Carvalho's master program research projects on Energy Production and Efficiency.

2.1 Research Based on Questions (Randall)

Randall's major research projects in her Engineering Communications courses begin and end with questions. Engineering Communications, a required course for all Undergraduate Engineering students at The University of Texas at Austin, aims to develop students' skills in written, visual, and oral presentation. Randall's version of Engineering Communications features a research paper. Students may write individual reports of 3000-4000 words, or team up to write a slightly longer report of 4100-5100 words.

Students pose their first set of questions shortly after choosing a topic. As they progress through their research, they answer one set of questions, only to generate others. The process can be illustrated by a spiral, as illustrated in Figure 1. In fact, although the research paper and

presentation have conclusions, the project itself is not resolved: the students end with new questions that they will not be able to answer—although a student in a subsequent class may take up the questions and begin the process anew.

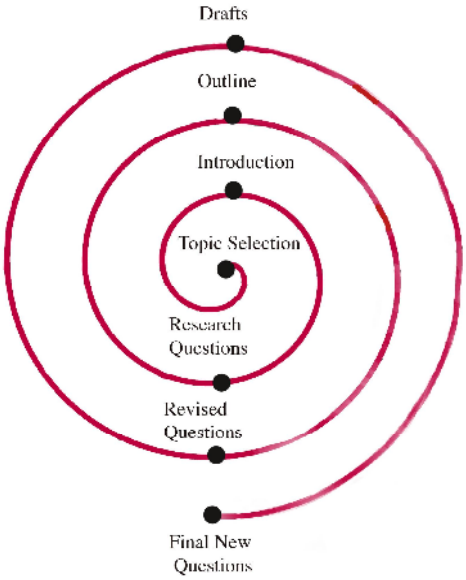

Figure 1: Spiral Process of Research

The research project typically consumes 10 weeks out of a 15-week semester. Most students have little experience writing such a lengthy paper. To address this challenge, Randall breaks down the writing and presentation process into seven phases: (1) selection of topic, (2) a short (400-word) topic Introduction, including three research questions; (3) an Introduction presentation; (4) an oral progress report with an outline and sometimes new questions; (5) a near-complete draft of the paper; (6) a 10-15 minute oral presentation, which includes new unresolved questions; and (7) the final, revised paper, which discusses those questions.
Table 1 outlines these phases.

Table 1: Research Assignment Phases

Phase	**Assignment**	**Comments**
1	Selection of topic (informal presentation)	Students pitch 2 ideas for Instructor feedback.
2	Introduction paper, with **3 research questions**	This short (400 word) paper also includes a hypothesis and annotated references.
3	Introduction Presentation	At the end of the Introduction Presentation, students raise their **3 questions**.
4	Oral Progress Report and Sentence Outline, with possibly **revised questions**	The progress report is essentially a conference between the Instructor or Teaching Assistant and the student.
5	Drafts and Peer Reviews (over 2-3 weeks)	The **questions** guide the research.
6	Formal Presentation, with **2-3 new questions posed by the student**	At the Presentation's Conclusion, each student also responds to **Q&A session.**
7	Final draft of Report, with **new questions.**	In the Final draft, students raise these **new questions** in the fuller context of their Conclusion.

After students select their topic, they enter Phases 2 and 3, in which they conduct enough initial research to write and present a short topic Introduction. Normally, this research amounts to between 4-6 credible sources obtained from the library database. Randall encourages students to respond actively to their reading and requires them to pose three genuine questions springing from the research. If students are not curious enough to raise questions, they should change their topic.

Randall intends that these questions guide the student toward their Progress Report in Phase 4. Undergraduates often do not realize how the scope of a research project can quickly overwhelm. For instance, Randall needed to warn the several students investigating BP's 2010 Deepwater Horizon Oil Spill that the topic was worth several books. When one student, however, became curious about the Corexit dispersants that BP used to control damage to the Gulf of Mexico and its shoreline, he found a well-focused topic that could be researched in depth during a semester [7].

By Phase 4, students should have enough information to begin outlining their paper. At this stage, Randall and her Teaching Assistants ask the students informally what further questions they have. If they have made progress with their research, and that research is well focused, students should be finding limits to what is known about their topic. We review the student's scope and limitations before they begin Phase 5, the arduous work of drafting the entire paper. The Teaching Assistants and Randall grade the drafts and return them to the students to revise.

In the final Phases 6 and 7, students are ready to wrap up their project, but Randall insists that they keep the project open-ended and integrate new questions into their conclusion. The questions typically address areas of research that the student did not have time or resources to complete, or forward-looking questions about how the issue affected industry. For instance, the student mentioned above who investigated the Corexit dispersants discussed BP's dispersant injection not only on the oil slick, but also on the seafloor at the wellhead. This second, unprecedented practice resulted in long oil plumes below the surface. The student asked, "What did BP America think of this course of action?" and "What exactly happened to the oil that is not accounted for in the surface cleanup and documented subsea oil plumes?" [7].

This lengthy research assignment is what Edelson et al. would call a challenging "extended activity" [5]. The phases, however, offer "sequenced activities" that "introduce learners to investigation techniques, help to develop background knowledge, and establish a motivating context." ([5], pg. 8). Feedback in students' informal evaluations suggests that most students find the phased structure helpful in accomplishing what first seemed to be an intimidating task.

2.2 Locating and Evaluating Credible Sources (Moore)

Moore and Randall teach similar courses in different Engineering departments at the University of Texas and use similar assignments. Like Randall, Moore assigns a major research project in her course that constitutes the biggest portion of the grade in the course. One of the most difficult tasks students face in the research project is the research itself. As Edelson et al. point out, one of the goals of inquiry-based learning is to foster "the acquisition of specific investigation skills" [5]. Students who have never lived without Wi-Fi are prone to view Google as the best research tool available and Wikipedia as the best source. The research project gives them the opportunity to hone their investigation skills by learning how to collect sources that are

appropriate for an academic research paper, to scrutinize sources they use, to look for signs of bias, and to put sources in context for their readers.

In Moore's Engineering Communication class, the first assignment in the series of phased activities that lead up to the research project is an annotated bibliography listing at least five credible sources. To prepare students for the annotated bibliography, and for the continuing research they will be conducting, Moore uses an exercise adapted from the PRiME Learning Modules [8], a suite of on-line lessons created by Moore and Randall and other Engineering Communications instructors at the University of Texas. Those modules have been discussed in depth by Randall and Moore elsewhere [9, 10].

In the adapted exercise on evaluating sources, students are given a list of URLs on a controversial topic and asked to evaluate the credibility of each source, first by simply looking at the URL and then by examining the web sites. For both parts of the exercise, the goal is not to provide students with immutable answers, but to introduce them to the challenges that arise in evaluating sources and the questions that good researchers must ask about every source they encounter.

The first step in the exercise is conducted as an in-class discussion. Students look at the following list of URLs, pertinent to the 1984 Union Carbide explosion in Bhopal, India:

http://www.studentsforbhopal.org/
http://www.epa.gov/history/topics/foreign/01.htm
http://www.bhopal.com/
http://www.bmj.com/content/314/7077/338.full
http://www.springerlink.com/content/t51630v973741g46/
http://www.christiansciencemonitor.com/2004/0504/p07s01-wosc.html
http://en.wikipedia.org/wiki/Bhopal

In keeping with the Bransford team's advocacy of learner-centered teaching [2], this first portion of the exercise allows students to demonstrate their prior knowledge. For instance, they can show, in class discussion, that they understand the difference between a .com URL and .gov or an .edu. Although many of them have never articulated their knowledge before, most students have an understanding what the domain name ".org" means or what's wrong with Wikipedia as a source or what a name like "studentsforbhopal" suggests to audiences before they ever even open the web page at that address. The discussion requires little informative input from the instructor. It allows students to articulate their understanding and sometimes to correct one another and to build on one another's knowledge. But in general, the instruction involves little more than asking questions.

For the second part of the exercise, students are given the same URLs and instructed to examine each web page, evaluate it, and rank its credibility on a matrix. They are also asked to think about what "bias" and "conflict of interest" mean to them. The sources in the list of URLs include the Union Carbide web site, an article from an academic journal, an article from a magazine, and the web page of an advocacy group. The exercise forces students to grapple with the difference in the quality of sources available to them on the web, encourages them to think about the criteria they use to evaluate sources, and alerts them to the standards that apply to academic papers.

In discussion of the assignment, the class explores the credibility of each source and the criteria that they and their classmates have applied to the sources. The discussion includes an exploration of the way bias presents itself in visual presentation of material, rhetorical representations of events, and even statistical data. Ultimately, students discover that the standards for .org or .com publications are self-imposed, as well as motivated by self-serving goals, and do not approach the standards demonstrated in a peer-reviewed academic journal. The conclusions that students ultimately articulate for themselves as they go through the exercise could be presented in the form of a lecture or a reading, but the inquiry-based process allows them to discover their own standards and internalize an analytical approach that will serve them as researchers.

2.3 Research Comparing Countries (Carvalho)

Carvalho teaches a technical course on Energy Production and Management in a Master's degree program in Mechanical Engineering. Carvalho's lectures are based on raising questions. Instead of feeding information to students, which eventually will turn into knowledge, she presents structured cases and requests that students draw conclusions and/or sort out what additional information is needed in order to solve or assess a specific problem or situation. Here, she emphasizes questions of relevance (separating the main from the accessory) and questions of implication (linking facts and hypothesis with results and outcomes).

Learning is perceived as taking place when teaching is supplemented with, or even embedded in, exercises that deliberately model real work situations. Therefore, Carvalho implements distinct learning activities and course assignments that deliberately focus on case studies and replicate real work situations [11, 12].

The main objectives of these lectures and the course assignments are to:

- Get students to learn/work within a real situation framework;
- Get students to formulate questions…not to answer questions;
- Get students to work as a team;
- Promote learning through self-generating questions, analysis, and reflection;
- Promote critical thinking (open ended problems) and look at different solutions, providing they are efficient and self-sustainable.

In one of the course assignments, students need to engage in research and information management and validation. They also establish comparisons and make decisions, share information like facts and figures, and discuss issues like supporting arguments with their peers. For this group assignment— performed online for several weeks—students are required to post original contributions on their own topic and comment on posts of other peer groups every week (see Figure 2). At the end of the semester, each group prepares a presentation to be delivered in class. An extended deadline is given for the written report delivery, allowing for students to improve their reports in response to peer comments and questions at the presentation stage.

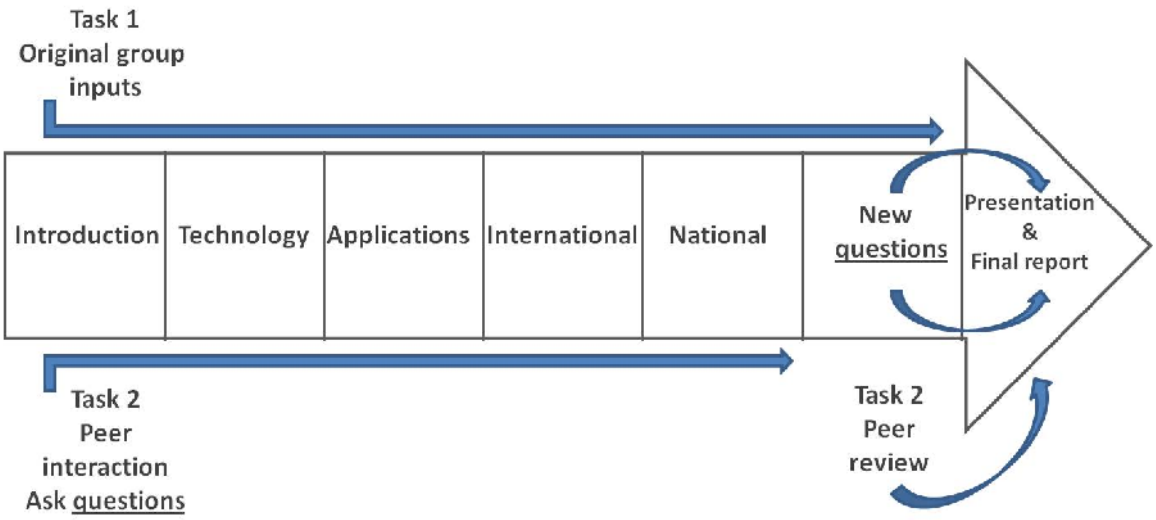

Figure 2: Stages of the technology assignment

The research assignment is based on a list of topics proposed in class. When Carvalho initiated this assignment a few years ago, its main focus was on technology. Hence, topics such as Fossil Fuels, Nuclear Energy, Cogeneration, Energy Market, Recycling, Buildings, Transports and Renewable Energy (Wind, Solar, Oceans, etc.) among others were chosen. Later on, Carvalho realized the need to raise students' awareness of the environmental, policy, and economic factors that affect energy production technologies, energy efficiency, and legislation. Thus, she introduced the "country" topic. The choice of countries was based on Carvalho's previous experience with research assignments that were more technology driven, and followed the stages as illustrated in Figure 2. This new approach required a slight change at the assignment design level, and Carvalho requested that the students integrate different countries' energy strategies and environmental policies as a compulsory part of the assignment (International Stage in Figure 2). Emergent markets as China and India were the initial choices. Although the students were surprised by the inclusion of such topics in the list of assignments (and reluctant to proceed), after some assistance from Carvalho, they found the topics motivating and full of surprising information to share with their peers. These initial assignments proved to be a success for students and… for learning. Therefore, Carvalho added other countries to the list of topics and introduced the "countries to compare" as shown in Table 2.

Table 2: Countries and topics for Energy Production and Efficiency assignment

Countries to Compare	**Topic**
•China and India	Energy Production and Consumption and related technologies
•Australia and Iceland	Fossil versus Renewable Energies
•Sweden and Spain	Technologies and Energy and Environmental Policies
•Japan and US	Primary Energy Resources and Environmental Policy
•Brazil and Canada	Energy Resources and Energy and Environmental Policies

Presently, both “technology” and “country” driven assignments may co-exist. As students often have difficulty starting and carrying out the “countries” research assignment without a strong technical frame, Carvalho allocates time in class and online [13, 14] to assist students for the first two weeks.

The research assignment is now based on a list of topics proposed in class such as the following: two countries (characterize, compare and contrast); regions (European Union); Coal, Oil and Natural Gas (countries’ survey and related technologies); the buildings sector (compare/contrast and case studies for different countries); the transport sector (environmental, policy and economic implications of partially moving from oil to other sources of energy), and so on.

Students start with “stage one topic” (Introduction, in Figure 2) by engaging in research in order to accomplish task 1. Task 2 requires students to read their peers’ original inputs (task 1), formulate questions, and search for the answers. Each stage (week) has a different topic, as shown in Figure 2, with the purpose of guiding the students through the entire research assignment. These structured stages of the research assignment integrated with the online feedback have proven to be effective in promoting in-class Q&A sessions and in preparing for peer review activities towards the end of the assignment.

The country-driven research assignment follows a similar structure. Carvalho requests that students establish links between Energy, Environment, Policy and Economy, and incorporate elements as technologies, applications, national and international scenarios, case studies, and future trends (new questions). The 2011 structure of this assignment, which now incorporates some of Moore’s and Randall’s techniques, is presented in Table 5 in section 3.3.

3. Influence and Collaboration

Getting acquainted with one another’s course assignments and asking questions on topics and methodologies is at the center of the present collaboration. As we compare and contrast our inquiry-based approaches, we generate further questions, demanding further answers. Thus, our own inquiries lead to deeper reflections on why and how we each continue with some approaches, or change others. This process has effectively promoted cross-pollination. This section traces how Randall’s and Moore’s respective Study Abroad courses developed from their collaboration with each other and Carvalho; it concludes showing how Carvalho integrated some of Randall’s and Moore’s approaches and materials into her own technical-based course.

3.1 Initial Research Assignments 2008-09 (Randall)

In 2008, Randall designed and taught a pilot Summer Study Abroad version of Engineering Communications at the Universidad de Cantabria in Santander, Spain. This course is part of a University of Texas Summer Faculty-Led Program for students studying the Spanish Language and Culture, Biology, Business, and Engineering. Like the home campus version, the Santander class includes a Research Project, plus readings and short assignments on other topics. However, summer classes run for 6 weeks rather than 15, so the format presents a challenge for classes that require Research Projects.
The Research Project for the Study Abroad version is, like that described above in Section 2.1 and Table 1, divided into short phases that lead to a paper and presentation. The challenges to

conducting an “extended activity,” however, were compounded in Spain. The first time Randall taught the Santander class in 2008, students struggled to conduct research within the tight schedule. In Santander, after-hours computer access and Internet hotspots were rare, so Randall decided that subsequent classes should complete as much research as possible on the home campus. In 2009, students chose topics, questions, and began their research before leaving the US. Although the students needed to find additional sources from Santander, they could use the course to concentrate on writing and presentation. At the end of the 2009 term, Randall and her students agreed that the modified schedule enabled the class to meet its goals without overwhelming the students.

3.2 Revised Research Assignment (Moore)

Following in Randall’s footsteps, in the summer of 2010, Moore taught the Study Abroad Engineering Communication course in Santander, Spain. Working closely with Randall to develop a course plan, she adopted many of the assignments, readings, and exercises that Randall piloted in the summer of 2009, including a semester-long research project that was accomplished in incremental steps.

In addition, Moore contacted Carvalho to ask for guidance in developing a research project assignment that would involve students in an examination of global issues. Hoping to motivate students as Edelson suggests by giving them “meaningful problems” to investigate [5], Moore asked Carvalho to explain her approach to research projects that compare countries and asked for advice on having students compare the infrastructure supporting transportation, waste-disposal, energy, water, and food-supply systems in different countries. The goal was to give American students, many of whom were travelling abroad for the first time, the opportunity to engage fully with the study abroad experience by giving them research projects on meaningful global issues. Moore and Carvalho have discussed those goals—of creating relevant global assignments for undergraduates—in more detail elsewhere [6]. Moore intended to define the general parameters of the assignment and then let students choose the systems they wanted to research and the countries they would compare. Carvalho suggested, however, that students’ choices be limited, especially with regard to the countries compared. After conferring on the assignment’s particulars, Moore decided to follow Carvalho’s suggestions to make the projects collaborative, to focus on energy-related topics, and to choose the countries that students would compare.

Moore met with students twice in the spring semester, and began defining the research assignment then. In the first meeting, students, alone at first and then in group discussion, were asked to brainstorm about topics pertinent to energy. The fruit of that discussion was a black board covered with possible topics. Students were given the opportunity to discuss the relevance of different topics and combine and refine the original ideas. By the end of that class, students had identified the topics that they thought were most interesting and relevant and had chosen the topics they most wanted to work on. Ultimately, the class of fifteen chose five topics [6]. Three students signed up for each topic. After that first class meeting, Moore consulted with Carvalho and discussed which countries student groups should compare. With Carvalho’s input, Moore then chose the countries. Ultimately, each group compared the U.S. and Spain to a third country. The final topics are shown in Table 3 below.

Table 3: Topics for Engineering Communication Research [6]

Topic	**Countries to Compare**
•Traditional Sources of Energy	U.S., Spain, Brazil
•Alternative Energy in US, S	U.S., Spain, Sweden
•Consumption of Energy in US	U.S., Spain, United Arab Emirates
•Impact of Energy on the Environment	U.S., Spain, China
•Business and Politics of Energy in US	U.S., Spain, Nigeria

To help the students manage a large collaborative project, Moore gave them weekly assignments that allowed them to complete the project in incremental steps and encouraged collaboration. For an outline and assignment sequence, see Table 4, which was adapted from the syllabus and also appears in [6].

Table 4: Sequence of Assignments on Energy Research Project.

DATE	**Assignment Due**
May 10 (preliminary class #1)	Preliminary research **questions**
May 21 (preliminary class #2)	Bibliography (list 10 sources from each individual that are relevant to your topic)
Week 1	Revised research **questions**
Week 2	Progress Report Presentation Expanded Annotated bibliography (15 sources with summaries)
Week 3	Annotated outline
Week 4	Drafts and peer critiques
Week 5	Drafts and peer critiques
Week 6	Presentations

As the list of assignments in the table shows, students began the project by composing a list of research questions. They turned in those questions before they left for Spain, and were required to have revised their research questions, based on initial research, by the first day of class. Although the assignment defined many aspects of the project for them, each team looked at a different topic. The research was open-ended, and the students themselves defined the threads of inquiry they thought were most important and relevant. The application of strategies recommended by Edelson et al., of giving defining meaningful problems and staging

activities along the way [5], helped students to succeed in the project. Although it was an extended collaborative assignment in a setting that had many recreational distractions, students in each group did become extremely engaged with their topics and with the collaborative process.

3.3 Adopted Techniques (Carvalho)

Since the authors first met in Budapest, they have participated in short joint collaborations that have led to reflection [6] and cross-pollination of teaching strategies. After working with Moore to develop an assignment for her study abroad course, Carvalho adopted some of Moore's strategies for her 2011 research assignment. Carvalho's students were already exposed to a tight step-by-step approach to research, objectives, report structure, and references usage by means of in-class exemplification, discussion, and structure guidelines. Nevertheless, challenges still remained for students to face. Some of these challenges included locating high quality and reliable references, focusing and integrating, defining clear and realistic objectives by listing the research questions for each topic/group, and using adequate references, such as citations and quotations.

As with Moore's students, Carvalho's students also find it difficult to get engaged in information research. Credibility of sources is also addressed in Carvalho's class, but her students are provided with a selection of credible sources at the initial kick-off of the research assignment. Then, students are instructed to carry out topic driven research and compare and contrast information. Here a major challenge arises, as students are so much accustomed to using "Google search" that their initial search for specific information using a more sophisticated tool, such as IEA (International Energy Agency) or at the EC (European Commission) portal, is scattered. Therefore, information research skills need to be properly addressed in class by providing examples and by sharing the results of a successful search. By incorporating at Phase 1 (deliverable 1) the requirement to present a structured list of relevant and credible references simultaneously with the research questions for each topic (see Table 4), Carvalho could provide students with earlier feedback about the use of references as well as the adequacy (and sometimes exaggerated number) of the research questions to be addressed.

As in Moore's assignment, each student is required to summarize at least five credible articles or reports that will contribute to their topic. This task, which requires students to get involved with synthesizing activities, has proven to be a difficult one for students to carry out. However, after in-class discussion and motivation, most students performed quite well. They were able to list relevant research questions that resulted in a clear and focused subject approach. Table 5 presents the updated structure on this course assignment, which shows evidence of positive cross-pollination.

Table 5: Updated structure of the assignment

Schedule	**Tasks**	**Comments**
Phase 1	Sources research (Reference List) Research **questions** and objectives, due date online (Group Forum)	Each student is required to summarize at least 5 credible articles / reports that will contribute to their topic
Phase 2	Progress Report 1 and structured reference list, due date online	Each group proposes a Table of Contents (Report outline) and identifies the sources that will contribute to their research
Phase 3	Progress Report 2 with group interaction (**questions**), due date online	Each group is to compare their sources with the other groups (minimum of 3) and identify common and contrasting data and related analysis presented in the report
Phase 4	Draft Report (online) and peer reviews (in class) - **Q&A session**	This week each group brings everything they have and exchange with another group for peer review
Phase 5	Final Report Draft and prepare presentations	Incorporate peer review comments and identify **new questions**
Phase 6	Presentations	Groups present their research to the class
Phase 7	Final Report, due date online	Upload Final Report and presentation

4. Conclusion

The three authors' initial meeting at the Budapest Engineering Education conference generated a productive collaboration that enlivened their own "inquiry-based" teaching and suggested ways in which the most successful practices may be replicated in other courses, subjects, and cultures. The three individual "inquiry-based" assignments described here use questions both to expand students' knowledge and to deepen their understanding. Yet the authors' investments in "inquiry-based" teaching also apply to their own pedagogical development. Their willingness to discuss a range of pedagogical topics, from specific practices to shared experiences and readings, led not only to an exchange of ideas, but also to deeper reflections on current practices. The cross-pollination of assignments and techniques resulted in well structured, stimulating, and relevant research projects that engage engineering students from Texas to Portugal, and from communication to technical classes.

Our own new questions concern students. One question remains about how inquiry-based learning can coexist or be integrated with a traditional education system. Some students—and professors—will always prefer traditional lecturing, which requests less effort from them on a weekly basis. What, for instance, might ease Carvalho's students' initial resistance to more active learning? Moore's team project worked well in the small Study Abroad class, but we are

uncertain how would it transfer to the larger classes on the home campus. Other questions spring from our different cultural backgrounds and academic concentrations. How can we use our experience and collaboration to raise students' awareness of cultural values and their implications for successful communication? Can we improve our students' communication skills by confronting them with different cultural communication styles? We look forward to engaging our students in more global collaborations, so that they, too, may laugh in recognition and discovery.

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