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A Case Study in Expo-Based Learning Applied to Information Visualization

M. Romero

KTH Royal Institute of Technology, Stockholm, Sweden

Abstract

We present preliminary results of the effect of Expo-Based Learning (EBL) applied to a course on information visualization. We define EBL as project-based learning (PBL) augmented with constructively-aligned large public demos [RTP14]. In this paper, we analyze the results of challenging and grading enrolled students to compete and present their projects publicly at an open student competition organized by a second university. We surveyed the students at the end of the course before the competition started and the end of the competition. We present the result of the impact of the student competition as it relates to the intended learning outcomes from the perspective of the students.

Categories and Subject Descriptors (according to ACM CCS): K.3.2 [K.3 COMPUTERS AND EDUCATION]: Computer and Information Science Education—Computer science education

1. Introduction

Previously, we introduced the concept of Expo-Based Learning as project-based learning constructively-aligned with large public presentations. Constructive alignment refers to assigning a grade for a task that is focused on achieving the intended learning outcomes (ILOs) [RTP14]. In the context of our original presentation of EBL, the students were tasked with presenting in front of two very large audiences at two public events. The course where the students presented was advanced graphics interaction and the events where they presented were a high school student conference with 5,000 attendees and a gaming conference with 30,000 attendance. The students presented for a total of 50 hours at the two events, 10 hours at the first and 40 hours at the second, the 40 hours spread over four days. The technical and communication challenges of these events demonstrated extremely valuable opportunities forwarding deep learning as evidenced by the surveys and individual interviews of the students. To expand on the methodology of EBL, we present the case study in this paper.

We introduce constructively-aligned project competition at an open student competition organized by the Linköping University's C-Visualization Center in Sweden. The event, called the C-Awards [http://www.cawards.se/], is a competition open to students from around Sweden. The competition awards 10,000 SEK (1,158 USD) to the winner of each of six categories. The students in this study sent six projects to compete in five categories.

The information visualization course offers 6.0 credits. During the course, the students complete three individual projects, each worth 20%, and one group project worth 30%. The students also received 10% for weekly readings. This paper focuses on the group project that competed at the C-Awards.

2. Description of the Student Groups, Project Execution, and Grading

The course had eighteen master's students in computer science or human-computer interaction. Four students were female. The students grouped into six teams of three or four people. The grouping criteria was to balance skills across groups and align interests within groups as much as possible.

The content of the project was free for the students to decide. The students had one week to propose and two weeks to implement the projects. They demonstrated the final projects in class, where they received a partial grade. After the presentations, the students had three weeks to improve their visualizations and write a two-page document and record a five-minute video for the competition. At the competition, they were tasked with presenting and demoing their interac-

Figure 1: *The students of information visualization during their final project demonstration in the Visualization Studio VIC* https://www.facebook.com/VisualizationStudio.

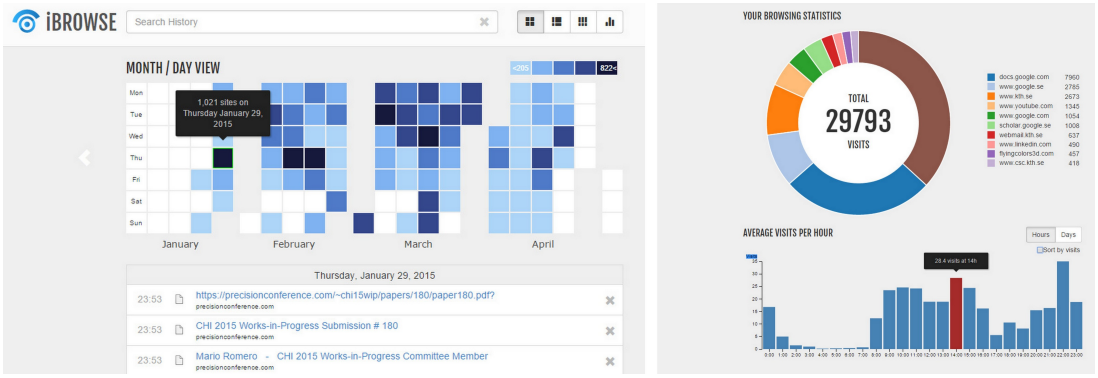

Figure 2: *iBrowse is iBrowse is a visualization of internet browsing history. See the video figure* https://vimeo.com/90013649. *Visit the webpage* http://goo.gl/J2kKG4.

tive visualizations in front of an audience of approximately 400 people.

The projects were graded as follows: 1. Proposal 10%; 2. Mid-term presentation 10%; 3. Final demo 20%; 4. Critiquing other projects 10%; 5. URL with the running code and a description of project 10%; 6. Two-page document and the video submission to the C-Awards 30%; and 7. Two-page report documenting their learning outcomes 10%.

The grading criteria consisted on the quality of the answers to the following questions: 1. Who is the user? 2. What are the tasks? 3. What is the data? 4. What are the data of transformations? 5. What are the visual mappings? 6. What are the visual structures? 7. What are the view transformations? 8. What are the views? 9. How does the demo support the tasks? 10. How can it be improved? The premise of EBL is that flaws in the answer to these questions become evident by presenting the projects to larger and more diverse audiences.

This is a project-based learning course and it is also a studio-based learning. The course took place at the Visualization Studio VIC at KTH Royal Institute of Technology, Stockholm, Sweden. Figure 1 shows the students of information visualization during their final project demonstration in the studio. VIC performs three functions: research, education, and outreach. The research centers on visualization-supported collaborative work and foundational interactive and graphics technologies. It is also a showcase and classroom environment where we teach and demo our existing projects. Finally it is an outreach environment where we invite industry partners and primary and secondary school students to interact with the technology, science, and students at KTH. VIC provides a number of cutting-edge technologies and the expertise to readily use the infrastructure. Some of the technologies VIC houses are an ultra-high definition 4K stereoscopic projection four-meter wall with traditional keyboard and mouse interfaces augmented with gesture-, voice-, touch-, and phone-based interaction infrastructures. VIC houses as well a number of Oculus Rifts, cinema-quality audio, high-definition video conferencing with eye contract, eye tracking, GPU-based computing clusters, diverse interaction and sensor systems, haptic devices, and 3-D printers.

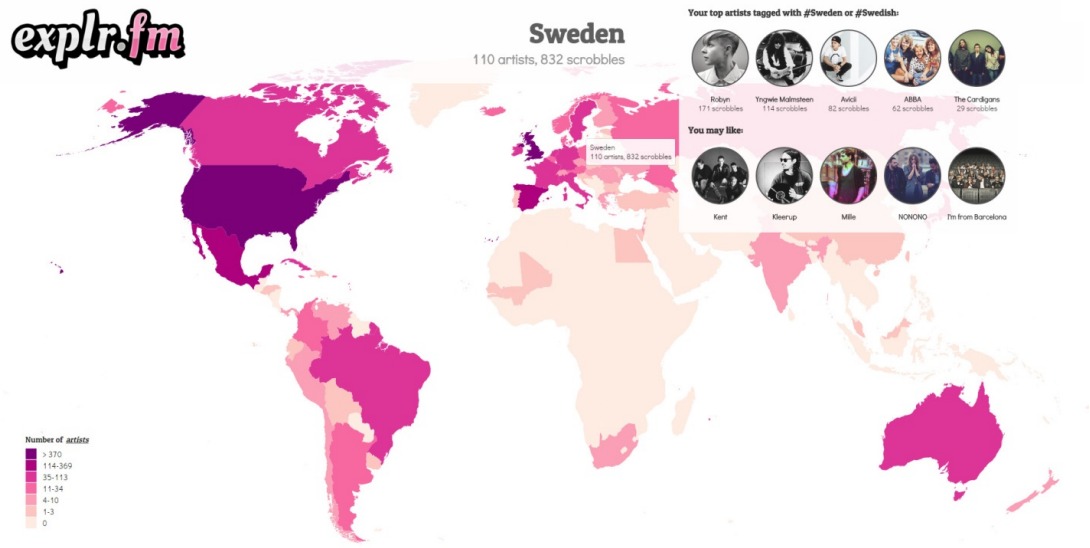

Figure 3: *explr.fm is a visualization of the national provenance of the artists on a user's LastFM playlist. See the video figure* https://vimeo.com/90011479*. Visit the webpage* http://explr.fm/*.*

VIC also has a full-time staff that supports the coordination and engineering of the projects.

3. Two Sample Projects

The course had six group projects. In the interest of space, we highlight two of the six projects here.

Figure 2 shows *iBrowse*, a visualization of internet browsing history [http://goo.gl/J2kKG4]. It was created by master's students Wouter Jansen, Ivo van Bon, and Henri Louis Schröter. It shows a calendar view were the color saturation of each cell represents a daily aggregate of the number of site visits. It also provides pie charts and histograms visualizing the most visited web sites and the days and hours were most of the browsing occurs.

Figure 3 shows *explr.fm*, a visualization of the national provenance of the artists on a user's LastFM playlist. It was created by master's students Anna Movin, Daniel Molin, Moa Bergsmark, Tommy Feldt. The application provides an overview through a choropleth map and a number of targeted details on demand, including a list of suggestions based on the existing playlist [http://explr.fm/]. The project explr.fm was the only winner of the six projects in the category people's choice awards.

4. Experimental Design

The goal of the experiment is to measure the impact on intended learning outcomes (ILOs) of the students in information visualization participating at the open student competition, the C- awards. The instrument to measure the impact is a pre- and post-survey of the perceived learning outcomes by the students. We surveyed the students at the point where they finished presenting the last demo as part of the regular class and then we surveyed the students after their participation at the awards.

We deployed a voluntary online survey. We achieved 100% response rate from the students for both the pre-and the post-surveys. The surveys included Likert scale questions with open-ended fields for expanding on the answer and open-ended questions as well. In the results, we present statistical analysis of the Likert scale questions and we highlight the results of a focused qualitative analysis of the open-ended questions.

5. Results

We first determined the number of hours on task for all the participating students in the course. From the results of the survey, we establish that each student spend an average of 35 hours on the tasks related to the project from its conception to the final presentation in front of the class. Then each student spent, on average, an additional 25 hours between the final course presentation and participating at the C-awards, including the 6 hours at the awards. Participation at the C-awards granted 20% of the grade, yet the students devoted 40% of their time to this part of the project. When asked why this is the case, the most common response was that the competition, the public recognition of winning, the monetary reward, and the risk of humiliating themselves with poor projects motivated them to push themselves harder.

Figure 4 shows the mean and standard error bars from

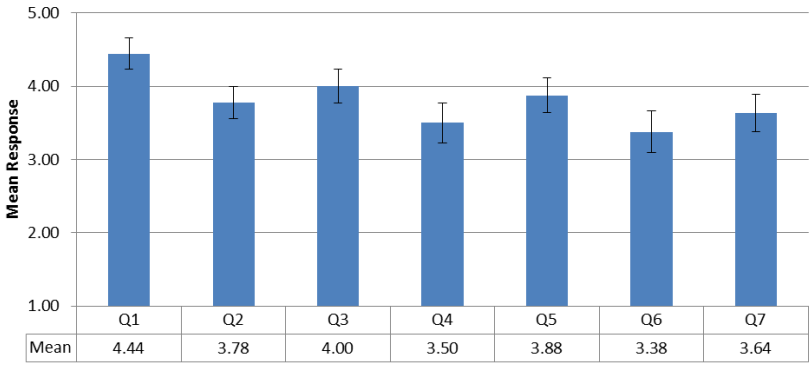

Figure 4: *Mean response to the Likert scale questions and standard error bars. The scale goes from 1, completely disagree to 5, completely agree. The statements are "the following activity contributed to my learning": Q1. Creating project 4; Q2. Presenting the final demo in front of classmates; Q3. The content of the projects from other schools; Q4. Interacting with audience; Q5. Working on the project between the final demo and the C-Awards; Q6. Preparing the two-page document and the five-minute video; and Q7. Presenting project 4 at the C-Awards. Q1 and Q2 were pre-survey; Through ANOVA Mulitple Measures we determine a statistically significant difference at 95% confidence only between Q1 and Q6.*

the five-point Likert scale questions deployed to the eighteen students. Q1 and Q2 were part of the pre-survey deployed immediatly after the final in-class presentation. The other questions were part of the post-survey, deployed immediatly after the C-Awards. The scale goes from 1, completely disagree to 5, completely agree. The statements are "the following activity contributed to my learning of information visualization": Q1. Designing and creating project 4; Q2. Presenting the final demo of project 4 in front of your classmates; Q3. The content of the projects competing from other schools; Q4. Interacting with presenters from other schools; Q5. Working on the project between the final in-class demo and the C-Awards; Q6. Preparing the two-page document and the five-minute video for the C-Awards; and Q7. Presenting project 4 at the C-Awards. Through ANOVA Mulitple Measures we determine a statistically significant difference at 95% confidence only between Q1 and Q6. Therefore, we can conclude that the creation of the video and two-page document for the C-Awards was not an effective mechanism to forward the ILOs in the course. We can also conclude that the participation at the C-Awards promoted the ILOs as much as the traditional activities of creating and presenting the projects in front of classmates. We expected higher results from participation at the public competition.

Next, we analyze the response to the open-ended questions. To the question "Including the C-Awards, the three best things about this course are:", 8/18 students replied that the C-Awards were among the top three elements of the course. When asked what they would change about the course, no one proposed removing the C-Awards. When asked what they learned from presenting at the C-Awards, most students highlighted their newly acquired communication skills.

6. Conclusion and Future Work

We defined Expo-Based Learning (EBL) as constructively aligning large public presentations with the methodology of project based learning. From the statistical analysis of the Likert scale question and the qualitative analysis of the open-ended questions, we conclude that participating at the open student competition, the C-Awards, presented several opportunities to promote the intended learning outcomes of the course. We interviewed the students asking for their perpective of the public element of EBL. Our next step is to conduct a qualitative analysis of the interview and reflect back on the results presented here. Through the open-ended questions we have learned so far that the greatest effect of EBL is motivating the students to improve their professionalism by delivering quality results on non-negotiable deadlines with the added pressure of presenting in front of large audiences.

7. Acknowledgements

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References

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