EduVis - A proposal of log visualization tool from interactions on VLE

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1. Introduction

Distance Learning (DL) is not a novelty. From the records of correspondence courses in Brazil in the 19th century [Saraiva 1996], to the rise of computers and evolution of the Internet, instructors and students have experienced novel ways of teaching and learning. In particular, improvements to multimedia technologies contributed to the creation of online courses in Virtual Learning Environments (VLEs). One of the reasons for the popularity of online courses is that students can decide their own study pace and participate in courses regardless of geographic distance limitations [Seaton et al. 2014]. VLEs are not exclusive to DL. There is evidence of their usage together with face-to-face learning (*aka* blended learning) [Damasceno et al. 2018].

The students' interactions with VLEs are often stored in logs. The analysis of these logs can predict the students' performance, evaluate their learning achievement in a course, and even identify behavior patterns [Romero and Ventura 2010, Dutt et al. 2017]. Instructors usually get information from observing what students say and do on a VLE. Some challenges regarding this analytical process are the following: the instructors often do not have time to analyze these logs in depth; they are not statistics experts; or they have not received training to extract key information from VLEs. For instance, Damasceno et al. (2018) conducted interviews with instructors and found evidence that most instructors do not have any analytic tool or information besides the student access logs. According to the instructors interviewed, they are very often overwhelmed by the time and effort needed to prepare their classes, to prepare and assess coursework, and to evaluate students.

Furthermore, Damasceno et al. (2018) uncovered requirements and proposed guidelines for what tools should help to analyze in VLEs. For instance, Damasceno et al. (2018) report papers present that (i) student engagement in the online environment can be measured by resources accessed on the environment, (ii) students can be clustered into different groups based on how much they access or interaction patterns, such as, what is the resources they interact first, how long they stay or what times they usually access the VLE . In addition, some instructors interviewed

reported that they intend to identify patterns related to (a) student access (*e.g.*, login, materials, forum) and (b) student performance. They also claim that a dashboard providing such student information could support them on to spending their time more efficiently, adopting new teaching methods and preparing better course materials.

The purpose of this paper is to present EduVis, a dashboard on-going development based on the guidelines and requirements raised by the literature and instructors [Damasceno et al. 2018]. EduVis was designed aims to provide and recommend visualizations according to instructor preferences. To achieve this goal, we first build charts related to the guidelines and requirements selected. Then, we develop features based on the literature to mitigate problems such as lack of user historical access, shortcuts to frequent user tasks, and recommendation of view to instructors with historical access.

This paper is structured as follows. Section 2 describes the design process performed in the development of the EduVis. In addition, it is presented recommendation features performed in the dashboard. Lastly, Section 3 presents some final considerations.

2. EduVis Design

EduVis is a dashboard that present views to support instructors identify students features such as engagement, interest, behavior and performance. The first step performed to design the EduVis was to understand and identify which requirements and guidelines, reported in Damasceno et al. (2018), can be developed using a dataset from VLEs. In general, these dataset store information about student access and interactions in the VLE and its resources (*e.g.*, forum, activities, videos, ebooks), grades, profile (*e.g.*, age, education level, gender). From a number of 58, we identified 43 requirements and guidelines related to dataset VLEs. In addition, we group them by common goal or similar data, resulting in 11 groups:

1. Both student engagement and interest can be measured by assessment did on the environment;

2. Both student engagement and interest can be measured by materials accessed on the environment;

3. Both student engagement and interest can be measured by total forum access, readings, and postings;

4. Both student engagement and interest can be measured by how long students are watching each video;

5. Students can be clustered into different groups based on their access, performance and interaction patterns on VLE;

6. Older students participate more in forums;

7. Completing activities and forum interactions can be used as a predictor of student course completion;

8. Access in the online environment resources increase in periods close exams or assessment deadline;

9. Statistics of interactions on video (e.g., access, re-watch, seek) can be used to identify if the student is watching the video, student navigation, connection problems and what videos (or segments) the students have liked and have difficulty;

10. "Likes" can be used to identify if the student has understood and liked the video;

11. Access and interations on VLE and its resources can be used to identify student navigate patterns.

Then, based on visualization guidelines[1], we designed a set of visualizations according to 43 requirements and guidelines selected. For instance, related to group 2, Figure 1 presents different ways to view the number of access in the materials grouped by students. Likewise, relating to group 5, Figure 2 shows charts to view data of both student performance and access in the VLE. It also presents clusters of students based on their access and performance patterns. All this process of requirements identification and grouping as well as all scripts to generate charts are available at GitHub[2].

EduVis was developed using Python 3, Plotly[3] to design charts, and Dash framework[4] for building web applications. Designed to be minimalist, the interface presents a menu on the left side including 11 options related to the 11 set of requirements and guidelines grouped. In general, the central area presents the charts linked to the option selected. Figure 3a and Figure 3b illustrate respectively either EduVis home page and a chart related to group 1.

Our aim to EduVis is a dashboard providing and recommending visualizations according to instructor preferences. Therefore, we based on user stereotypes [Rich 1979] to mitigate the "cold-start" problem, a recommendation problem caused by the lack of domain data [Cohen et al. 2017]. Our approach is to identify instructor stereotype, through a questionnaire to identify his/her preferences and profile, once the user signs in the dashboard for the first time. Then, based on feedback acquired for him/her, a set of visualization are linked to the instructor's profile. In addition, the instructor can enable/disable whatever chart related to each option in the menu.

[1]The guidelines are available at: data-to-viz.com
[2]Available at: github.com/andrelbd1/visualization-la
[3]Available at: plot.ly/python
[4]Available at: dash.plot.ly/

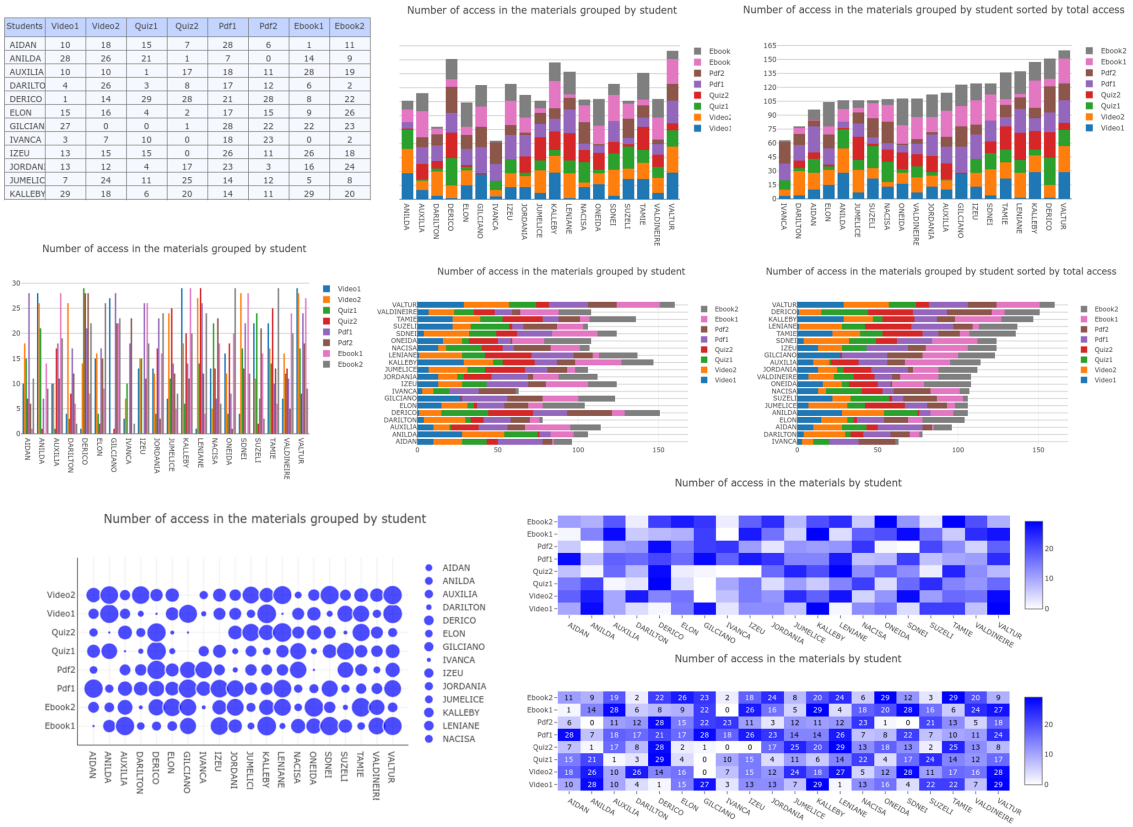


Figure 1: Visualization of the number of access in the materials grouped by students.

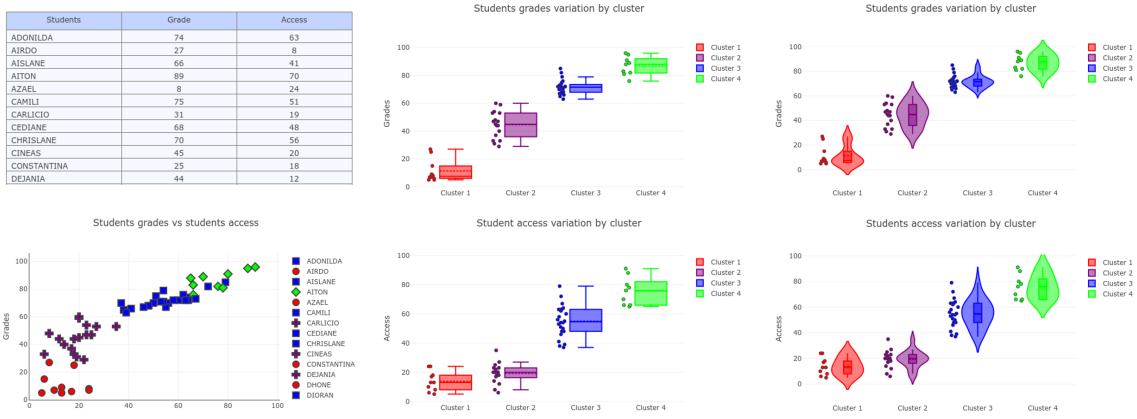
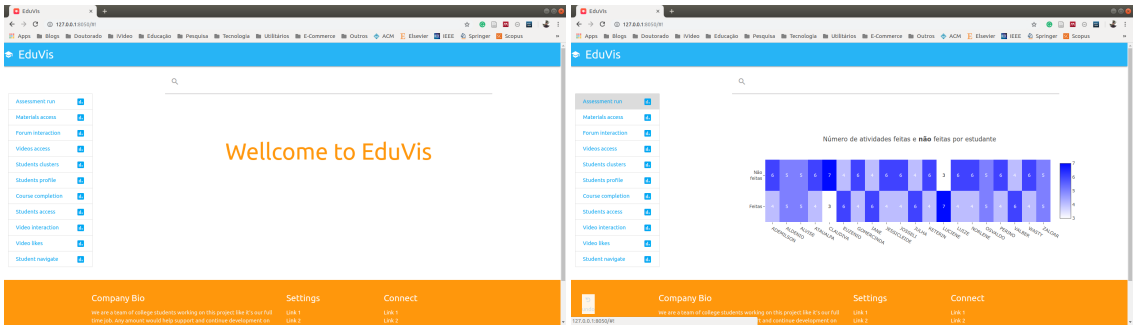


Figure 2: Visualization of both student performance and access in the VLE.

The dashboard also presents in the home page, shortcuts to views in order to increase the instructor's efficiency in the running of tasks. These shortcuts take into account the frequent user tasks from application logs [Dev and Liu 2017]. In other words, the dashboard builds a ranking of views based on the number of user access. Then, shortcuts are displayed in the home page as a static thumbnail image that



(a) Home page (b) A chart related to group 1.

Figure 3: EduVis layout

the user could click on to access quickly the corresponding view. Another feature to improve instructor's efficiency is a search field where the instructor can make a question and the dashboard answer it through a related chart.

We also highlight the recommendation feature based on group recommendation methods [Xiao et al. 2017]. In contrast to the "cold-start" problem, this approach takes into account the historical access of the instructor and relate to its user stereotype group in order to recommend other charts to provide new insights in regard the data.

3. Final Considerations

EduVis is a dashboard proposed to support instructors in gathering insights through visualizations using access, profile and grade data from VLEs. This paper present an overview of the design process and features proposed to mitigate different problems of recommendation. The current status of the EduVis present all features in alpha version and it is required more development efforts. In addition, the gathering process of instructors stereotypes data is in the early stages.

Even though instructors are domain experts, they do not necessarily know the mechanisms of using information visualizations [Cox et al. 2001]. Therefore, we plan to conduct a study with instructors to evaluate the effectiveness of each visualization. We also intend to evaluate the visualization regarding questions elaborated based on Damasceno et al. (2018) requirements and to raise which chart(s) better answer each question and what other question(s) those charts also could answer. This way, we map their charts preferences regarding how to present the information necessary for their work. In addition, we will apply a Participatory Design technique called card sorting [Simonsen and Robertson 2012] to gather feedback about how categorize those visualizations in a way that makes sense to them.

References

[Cohen et al. 2017] Cohen, D., Aharon, M., Koren, Y., Somekh, O., and Nissim, R. (2017). Expediting Exploration by Attribute-to-Feature Mapping for Cold-Start Recommendations. In *Proceedings of the Eleventh ACM Conference on Recommender Systems - RecSys '17*, pages 184–192. ACM Press.

[Cox et al. 2001] Cox, K., Grinter, R. E., Hibino, S. L., Jagadeesan, L. J., and Mantilla, D. (2001). A multi-modal natural language interface to an information visualization environment. *International Journal of Speech Technology*, 4(3):297–314.

[Damasceno et al. 2018] Damasceno, A. L. B., Ribeiro, D. S., Colcher, S., and Barbosa, S. D. J. (2018). Entrevistas e mapeamento sistemático sobre análise de *logs* de interação de alunos em ambientes virtuais de aprendizagem.

[Dev and Liu 2017] Dev, H. and Liu, Z. (2017). Identifying Frequent User Tasks from Application Logs. In *Proceedings of the 22nd International Conference on Intelligent User Interfaces - IUI '17*, pages 263–273. ACM Press.

[Dutt et al. 2017] Dutt, A., Ismail, M. A., and Herawan, T. (2017). A Systematic Review on Educational Data Mining. *IEEE Access*, 5:15991–16005.

[Rich 1979] Rich, E. (1979). User modeling via stereotypes. *Cognitive Science*, 3(4):329–354.

[Romero and Ventura 2010] Romero, C. and Ventura, S. (2010). Educational Data Mining: A Review of the State of the Art. *IEEE Transactions on Systems, Man, and Cybernetics, Part C (Applications and Reviews)*, 40(6):601–618.

[Saraiva 1996] Saraiva, T. (1996). Educação a distância no brasil: lições da história. *Em Aberto*, 16(70):17–27.

[Seaton et al. 2014] Seaton, D. T., Bergner, Y., Chuang, I., Mitros, P., and Pritchard, D. E. (2014). Who does what in a massive open online course? *Commun. ACM*, 57(4):58–65.

[Simonsen and Robertson 2012] Simonsen, J. and Robertson, T. (2012). *Routledge International Handbook of Participatory Design.* Routledge.

[Xiao et al. 2017] Xiao, L., Min, Z., Yongfeng, Z., Zhaoquan, G., Yiqun, L., and Shaoping, M. (2017). Fairness-Aware Group Recommendation with Pareto-Efficiency. In *Proceedings of the Eleventh ACM Conference on Recommender Systems - RecSys '17*, pages 107–115. ACM Press.